Autonomous Vehicles and the Gig Economy: Competition and Coexistence

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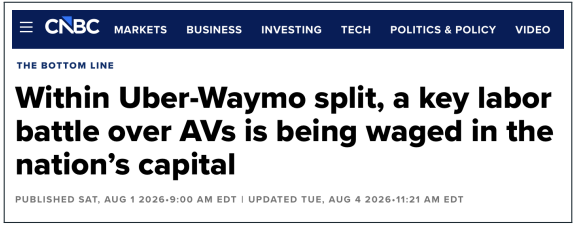
The policy debate over AVs and driver jobs



Minnesota Reformer

Minneapolis weighs ban on driverless robotaxis to protect rideshare drivers

BY **MAX NESTERAK** - SEPTEMBER 17, 2026 5:45 AM



CNBC MARKETS BUSINESS INVESTING TECH POLITICS & POLICY VIDEO

THE BOTTOM LINE

Within Uber-Waymo split, a key labor battle over AVs is being waged in the nation's capital

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Many current proposals delay or ban AVs.

The displacement question

Autonomous vehicles are arriving fast

- Waymo/Tesla robotaxi pilots in multiple U.S. cities; tens of millions of driverless miles logged, 10x increase in rides over 2 years
- Uber, Lyft dispatch AVs ; both expecting phase-in alongside human drivers

Each trip is a pure substitute for human labor

- $500{,}000$ full-time gig taxi/ride-hail jobs in the U.S.; millions more part-time
- At risk of **sudden, large-scale displacement**

Urgent Policy Questions

- Should cities ban or slow AVs to protect drivers? (Minneapolis is weighing a ban; New York's governor dropped a plan to allow robotaxis outside NYC)
- Can AV revenue be taxed to compensate drivers who lose work?

This paper

Central question

What policies can permit broad AV deployment **without harming the earnings of today's drivers**?

Our approach: First calibrated eq'm study of labor earnings under AV competition

- NYC TLC trip records (2012 yellow medallion panel; 2025 ride-hail)
- Dynamic labor-supply model of Buchholz, Shum, and Xu (2026)

Two programs studied:

- **Program 1 — Tax-and-subsidy:** tax AV revenue; rebate to drivers
- **Program 2 — Spatial restriction (our proposal):** restrict *where* AVs may operate

Preview of results

Program 1 generally fails

- Tax recovers only cost margin $(p - c_{AV})$; each displaced driver loses the full fare p
- Shorter waits add trips, but the tax works only if AV cost is below a third of the fare (baseline: 47%)

Program 2 works

- **Humans mildly benefit:** earnings increase $+0.7\%$ to $+2.5\%$
- Wide earnings-preserving band: AV can serve up to $33{-}34\%$ of trips without hurting drivers
- Mechanism: eliminating low-value destinations raises utilization rates (less search, less deadheading)

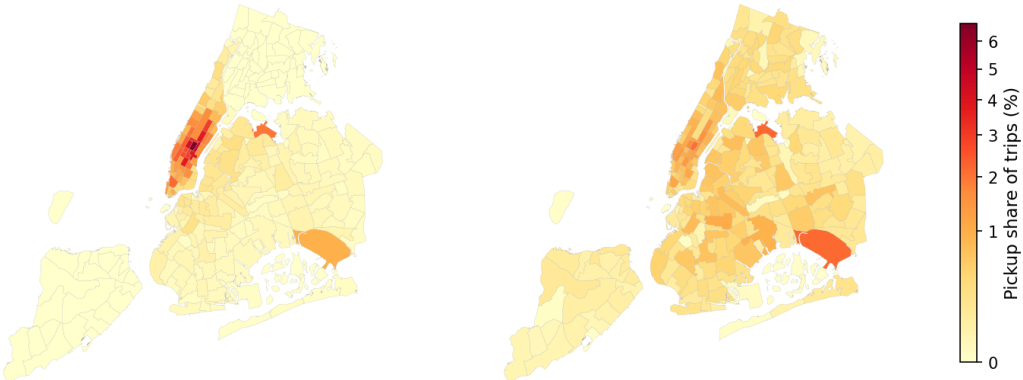
Setting and assumptions

- Platforms dispatches both AVs and human drivers (e.g. Uber/Lyft)
- Riders want a trip and *do not care* whether an AV or a person drives it
- The set of drivers is fixed. Each driver chooses how long to work each day
- An AV is a robot driver with a cost per hour and no preferences.
  (We have no AV data.)

Two markets – Data from NYC Taxi and Limousine Commission

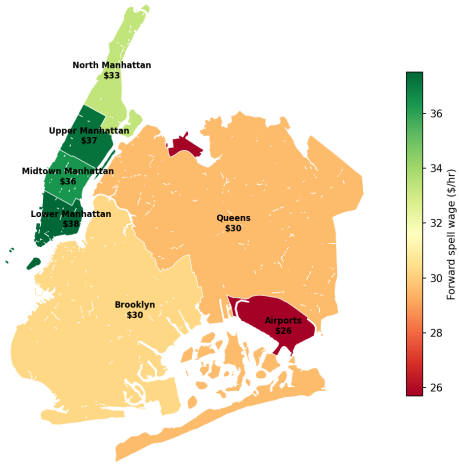
2012 street-hail taxis

2025 taxis and ride-hail



Share of pickups in Manhattan: 91% in 2012, 46% in 2025.

Where a trip ends determines what the driver earns next



Hourly earnings after a dropoff, by dropoff location (2012)

- Lower Manhattan: $38
- Airports: $26
- Let AVs take the trips that end in low-value places

Model: driver hours and earnings in equilibrium

We use the model to compute drivers' hours and earnings once AVs enter, with drivers free to adjust how long they work.

- After each dropoff a driver continues or quits, given income r, hours h, and location ℓ (Buchholz, Shum, and Xu 2026)

$$V(s) = \mathbb{E}\max\Big\{ \underbrace{U(r,h) + \varepsilon_q}_{\text{Quit, take payoff}}\,,\ \underbrace{\sum_{s'} \mathcal{F}(s' \mid s)\, V(s') + \varepsilon_c}_{\text{Continue, defer payoff}} \Big\}, \quad U(r,h) = r + \theta_1 h + \theta_2 h^2$$

- $\mathcal{F}$ is the distribution of a driver's next trip: fare, time including the wait, and dropoff location. It reflects demand, competition, and matching in equilibrium, and we estimate it from trip records ▸ 2025 construction
- AV entry changes $\mathcal{F}$. We re-solve the drivers' problem and record hours and earnings

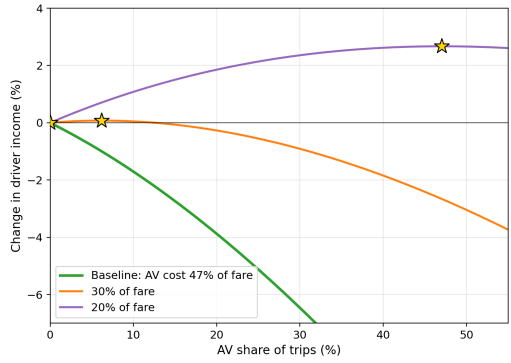
▸ Model fit ▸ 2012 fare increase

Program 1: tax AV revenue and pay drivers

- Each AV trip takes a fare p from a driver
- The tax can collect at most $p - c$, where c is the AV's cost
- Shorter waits add trips, so drivers can gain if

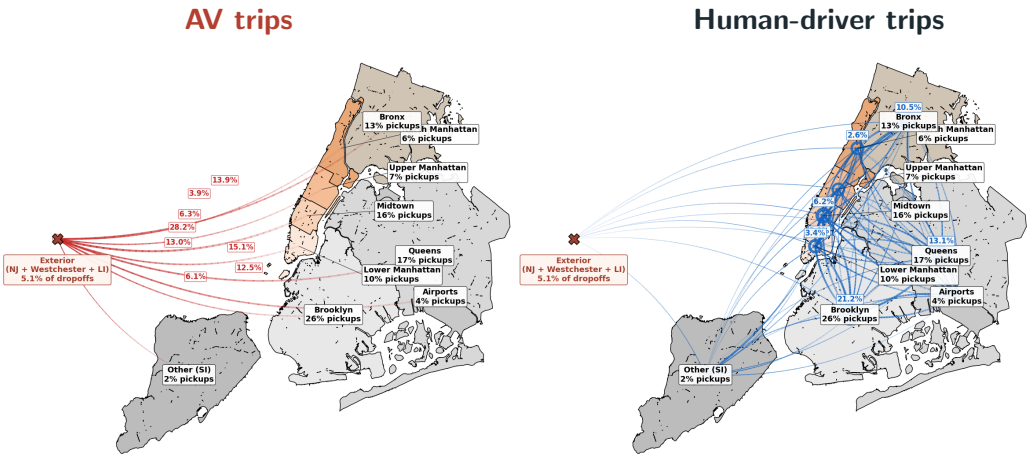
$$\eta\, \varepsilon_w \;\geq\; c/p$$

- New York: AV cost must be below a third of the fare, before congestion. Baseline: 47%



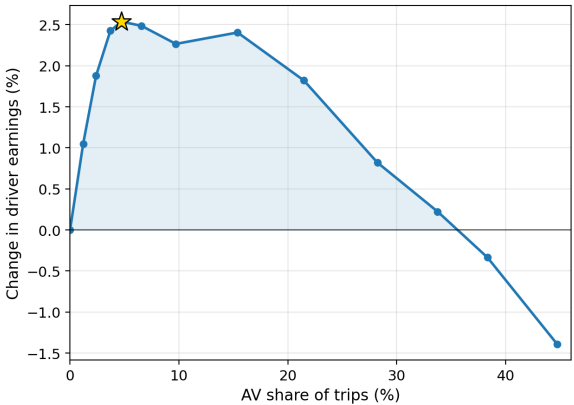
$\eta = 0.265$: this paper, 2012 shift changes. $\varepsilon_w = -1.225$: Frechette, Lizzeri, and Salz (2019).
Baseline $c/p = 0.47$: AV cost from Bösch et al. (2018).

Program 2: AVs take the trips that leave drivers worst placed



2025 ride-hail: AVs take trips that end outside the city. Drivers keep the rest.

Driver earnings as AVs take more trips (2025 ride-hail)



- Peak: earnings $+2.5\%$ with AVs on 4.7% of trips
- Earnings stay at or above baseline up to 34% of trips
- Pay per hour is about the same ($28). Drivers choose longer shifts
- Expected utility of a shift: $+3.9\%$

Which trips drivers keep depends on the market

	2012 street-hail	2025 ride-hail
Human drivers keep	Manhattan core	All of New York City
AV share of trips at earnings peak	21%	4.7%
Change in driver earnings	$+0.7\%$	$+2.5\%$
Earnings at or above baseline up to	33% of trips	34% of trips

- With street hail, trips out of the core are costly, so drivers keep the core. With app dispatch, drivers keep the whole city
- In thinner markets the gain is smaller. At half of 2025 density it is zero

Other proposals

Proposal	In our framework
Pay drivers to stop driving	A tax program, paid from AV revenue and so limited by $p - c$. It pays for past work and leaves drivers no choice over hours
One AV for each driver who retires	Slows deployment (partial ban)
A cap on AV permits	Limits the number of AVs, still hurts drivers

The last two limit the number of AVs and leave open which trips AVs take. AV entry spread across all trips lowers driver earnings.

Conclusion

- Along the transition, taxing AV revenue cannot replace the earnings drivers lose at current AV costs
- Restricting AVs to low-value trips keeps driver earnings at or above baseline, with AVs on up to a third of trips
- How far AVs can go depends on dispatch technology and market density
- Precedent: New York's Boro Taxi zones (2013)

Conclusion

Thank you!

Appendix: the 2012 fare increase, data vs model

Preferences are estimated on July–August 2012. Fares rose about 16% in September.

	Before		After	
	Data	Model	Data	Model
Shift length (hours)	8.1	8.0	8.1	8.2
Earnings per shift ($)	245	233	300	296
Earnings per hour ($)	30.3	29.1	36.9	36.0

None of these moments is used in estimation.

◂ Model

Appendix: tax program, formal results

Driver income W relative to baseline R, with AV trip share σ, total demand d, price ratio $\rho = p^{AV}/p^{H}$, tax rate $\tau \leq 1 - c/p$:

$$\frac{W}{R} \;=\; d\left[1 - \sigma(1 - \tau\rho)\right]$$

- **Fixed demand, equal fares.** $W < R$ for every feasible tax. The loss per displaced trip at the highest tax is c
- **AV priced above the human fare.** Riders leave the AV, so the tax base disappears
- **Demand responds to waits.** Drivers break even if and only if $-\eta\,\varepsilon_w \geq c/p$, with $\eta = 0.265$ and $\varepsilon_w = -1.225$
- **AV cost share.** $c/p = 0.47$ with the vehicle included, 0.34 for operating cost alone

Appendix: literature on taxing automation

- Costinot and Werning (2023): the optimal tax is small (1–4%) and falls over time
- Guerreiro, Rebelo, and Teles (2022): positive during the transition, zero once displaced cohort exits
- Thuemmel (2023): a subsidy while automation is expensive
- Korinek and Stiglitz (2019): taxing automation rents can be Pareto-improving

Literature asks which tax is socially optimal.
We ask which tax fully compensates one displaced group (a higher standard).

Appendix: how AV entry changes $\mathcal{F}$

Channel	Effect on $\mathcal{F}$	Value	Source
AV substitution	Removes AV-served trips	Capacity B (policy lever)	
Search time	Longer waits between fares as demand thins	$\eta = 0.265$	This paper, 2012 data
Demand response	Shorter rider waits bring new trips	$\varepsilon_w = -1.225$	Frechette et al. (2019)
Congestion	More vehicles slow trips	$\beta = 0.358$	Mangrum and Molnar (2020)
AV cost	Converts capacity to dollars	\$72,560 per AV per year	Bösch et al. (2018)

Appendix: model fit, 2012

	AM shift		PM shift		All	
	Data	Model	Data	Model	Data	Model
Shift length (hours)	8.48	8.60	7.26	6.64	8.09	8.00
Earnings per shift ($)	252	245	230	206	245	233
Earnings per hour ($)	29.7	28.5	31.7	31.0	30.3	29.1
Trips per shift	20.3	22.1	13.7	16.7	18.2	20.5

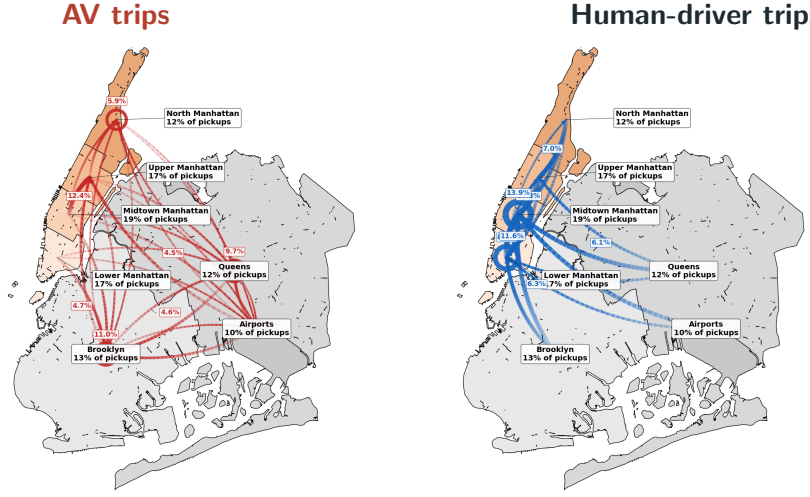
The estimator uses only the continue or quit decisions.

◂ Model

Appendix: fixed set of drivers

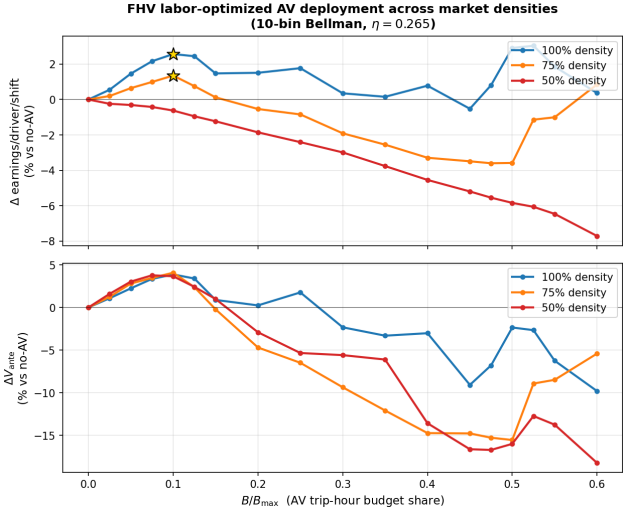
- Results are for the drivers working today
- With free entry, higher earnings would attract new drivers and the gain would shrink over time
- Incumbents are still no worse off than without AVs
- The reported gain is an upper bound per incumbent

Appendix: 2012 street-hail map



Shown at an AV share of 32% of trips.

Appendix: market density



Appendix: sensitivity of the 2025 result

	Peak change in earnings	No earnings loss up to
Baseline ($\eta = 0.265$)	$+2.5\%$	34% of trips
Lower η	$+3.1\%$	56% of trips
Higher η	$+2.2\%$	21% of trips
Three-quarters density	$+1.4\%$	
Half density	0	

Appendix: building the 2025 market

The 2025 ride-hail records have no driver identifiers, so shifts cannot be followed.

- Where trips go and what they pay: from the 2025 records
- How waits lengthen over a shift: from the 2012 panel
- Ten areas: seven from 2012, plus the Bronx, Staten Island, and outside the city
- A trip that ends outside the city has a 41-minute unpaid return

Appendix: implementation

Precedent: NYC Boro Taxi (2013)

Green cabs could not pick up in the Manhattan core or at airports. About 6,500 were active by 2015.

An AV permit

- Same tools: zones and permit classes
- AVs are licensed for trips that end outside the human-driver zone
- Unlike green cabs, the rule is on the destination, and AVs take the trips with the long empty return