The Impact of Driverless Truck on National and State-level Trade

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RESEARCH BACKGROUND

- Trade flows between different geographical areas are fundamentally shaped by transportation costs.
- The ongoing advancements in driverless technology potentially led to a fleet of autonomous trucks in the U.S.
- Driverless truck technology is anticipated to significantly reduce transportation costs by mitigating labor expenses, thereby influencing the landscape of the U.S. interstate trade

METHOD and DATA

Gravity Model

- Measuring trade flow based on each state's supply, demand and trade costs.

$$X_{ijkt} = \exp\left\{\beta_{0kt} + \beta_{1k} \ln T_{ijkt} + \beta_{2k} C_{ij} + \beta_{3k} H_{ij} + \gamma_{ikt} + \delta_{jkt}\right\} + \epsilon_{ijkt}$$

X_{ijkt} : the bilateral trade flow in U.S. dollar from export state i to import state j of commodity k at period t

T_{ijkt} : a transportation cost between state i and j of commodity k at time t.

C_{ij} : a contiguity dummy variable that indicates whether two states share a border or not.

H_{ij} : a home-state dummy variable that indicates whether import state and export state are the same or not (i.e., $H_{ij} = 1$ only when i=j).

γ_{ikt} : export/commodity/year fixed effect.

δ_{jkt} : import/commodity/year fixed effect.

General Equilibrium Simulation

- Counterfactual scenario experiments to verify the impacts of driverless truck on the trade in the U.S.
- Baseline Scenario: in the year of 2017
- Counterfactual Scenario: 35% decrease in transportation cost

Data

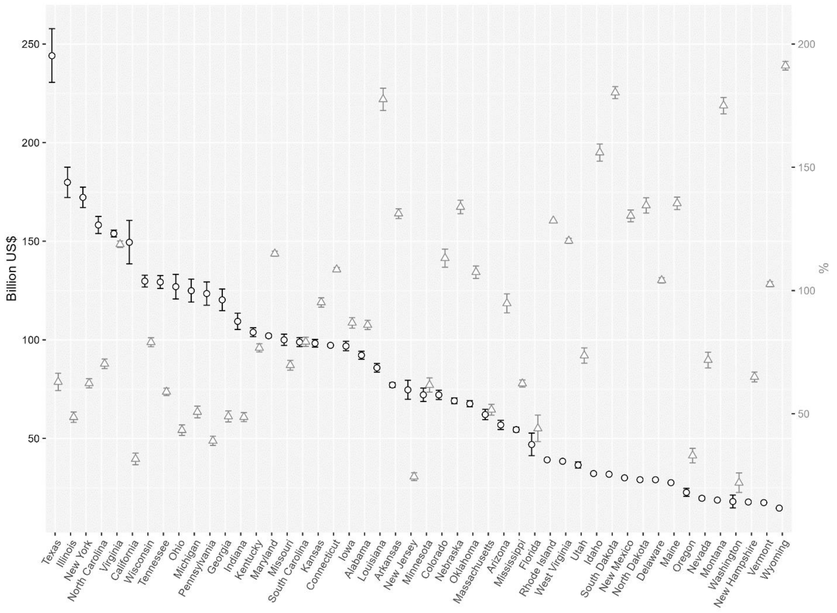
- Dataset of domestic trade flow data: Freight Analysis Framework Version 5 (FAF5).
- Trade flows are defined as the total value of commodities in 2017 constant dollars shipped from origin state i to destination state j at periods 1997, 2002, 2007, 2012, and 2017.
- 48 contiguous states in the U.S., where freights are conveyed by the truck.

RESULTS

Counterfactual Scenario

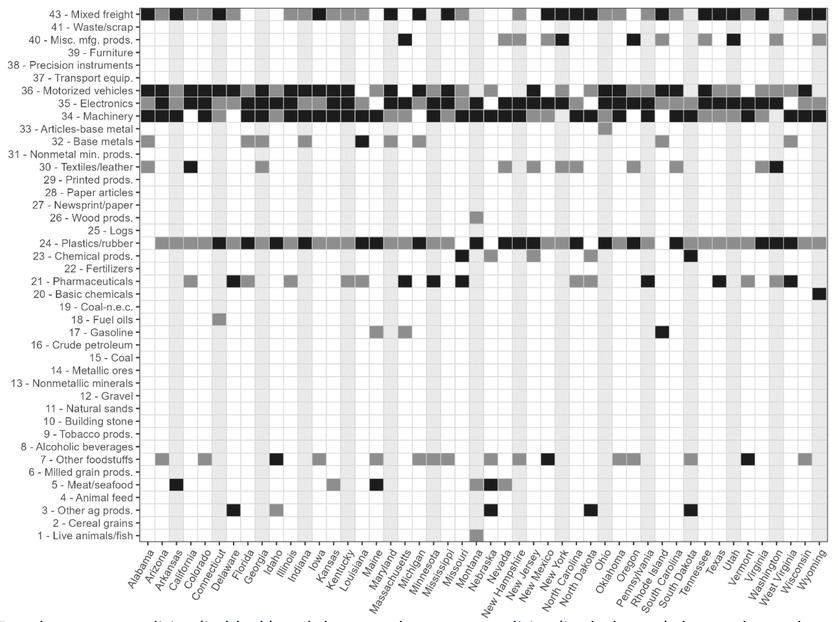
- Nationwide Impact of Driverless Truck Technology on Exports

Changes in exports from transportation cost reduction



Circles in the graph: billion US$ on the left, and triangles: % change on the right

Commodities with top changes in exports



Top three commodities (in black) and the next three commodities (in dark grey) that undergo the largest counterfactual increase in export values for each state.

Gravity Model Estimation Results

	(1) SCTG01	(2) SCTG02	(3) SCTG03	(4) SCTG04	(5) SCTG05	(6) Aggregate
T_{ijkt}	-1.511***	-1.179***	-0.692***	-1.026***	-0.960***	-0.719***
	(0.155)	(0.124)	(0.0752)	(0.0771)	(0.0557)	(0.0457)
Cij	2.270***	2.238***	1.385***	1.092***	0.526***	0.875***
	(0.222)	(0.189)	(0.142)	(0.103)	(0.0770)	(0.0613)
Hij	2.618***	3.590***	2.906***	1.704***	0.846***	1.907***
	(0.454)	(0.358)	(0.253)	(0.227)	(0.169)	(0.135)
Constant	12.29***	9.338***	8.875***	10.31***	11.85***	13.36***
	(1.099)	(0.861)	(0.559)	(0.544)	(0.396)	(0.323)
Observations	11,520	11,520	11,520	11,520	11,520	11,520

Robust standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05

- Only first five SCTGs including the aggregate of total 42 SCTGs are presented

CONCLUSIONS

Analysis Results

- Any decrease in the transportation cost would increase trade but that the elasticity varies across SCTGs.

By simulation,

- Adapting driverless technology would increase U.S. domestic exports by $3,873 billion (64.13%).
- In detail, Texas's export increases by $244 billion (62.92%), Illinois by $180 billion (48.62%), New York by $172 billion (62.38%).
- In commodity level, SCTG 36 (Motorized Vehicles), SCTG 35 (Electronics), SCTG 34 (Machinery) will benefit the most.

Future Research

- Uncovering the sources of heterogeneity in the estimated impact of driverless truck technology.
- Expanding the analysis in terms of transportations modes such as barge and train.