



*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

*No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.*

**Undercovering the Key Transportation Links in the U.S. Domestic Food Supply Chain  
Through Disruption Simulations**

**Sandy Dall’Erba, Department of Agricultural and Consumer Economics, University of Illinois Urbana-  
Champaign, dallerba@illinois.edu**

**Taejun Mo, Department of Agricultural and Consumer Economics ,University of Illinois Urbana-  
Champaign, taejunm2@illinois.edu**

***Selected Poster prepared for presentation at the 2024 Agricultural & Applied Economics Association  
Annual Meeting, New Orleans, LA: July 28-30, 2024***

*Copyright 2024 by [authors]. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.*

# Uncovering the Key Transportation Links in the U.S. Domestic Food Supply Chain Through Disruption Simulations



Department of Agricultural and Consumer Economics and Center for Climate, Regional, Environmental And Trade Economics, University of Illinois Urbana – Champaign



Taejun Mo, Sandy Dall’Erba

## RESEARCH BACKGROUND

- The last few years have been filled with examples of transportation route disruptions.
- COVID-19 pandemic and Suez Canal Blockage (Global)
- 2022 drought on the Mississippi River and 2024 Baltimore Bride Disruption (U.S. Domestic)
- Our focus is on U.S. domestic trade and more especially on the disruption of agricultural and food trade flows.

## METHOD and DATA

### Gravity Model

- Measuring trade flow based on each state’s supply, demand and trade costs.
- $$X_{ijkt} = \exp \{ \beta_{0kt} + \beta_{1k} \ln T_{ijkt} + \beta_{2k} C_{ij} + \beta_{3k} H_{ij} + \gamma_{ikt} + \delta_{jkt} \} + \epsilon_{ijkt}$$
- $X_{ijkt}$  : 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  $i=j$ ).
- $\gamma_{ikt}$  : export/commodity/year fixed effect.
- $\delta_{jkt}$  : import/commodity/year fixed effect.

### General Equilibrium Simulation

- Counterfactual scenario experiments to verify the impacts of trade disruptions on the trade and welfare of the U.S.
- Baseline Scenario: in the year of 2017
- Counterfactual Scenario: 10% increase 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.

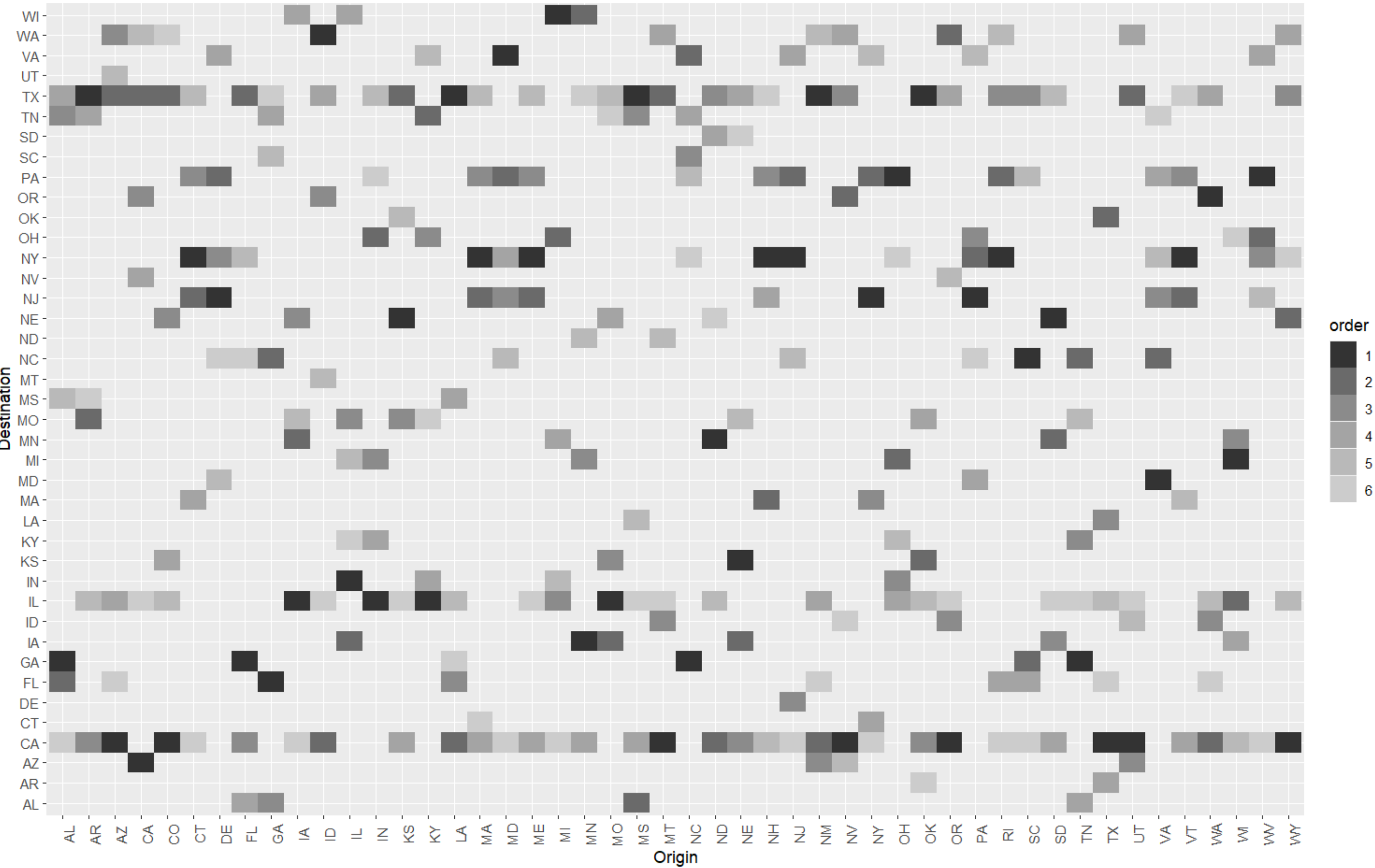
## RESULTS

### Gravity Model Estimation Results

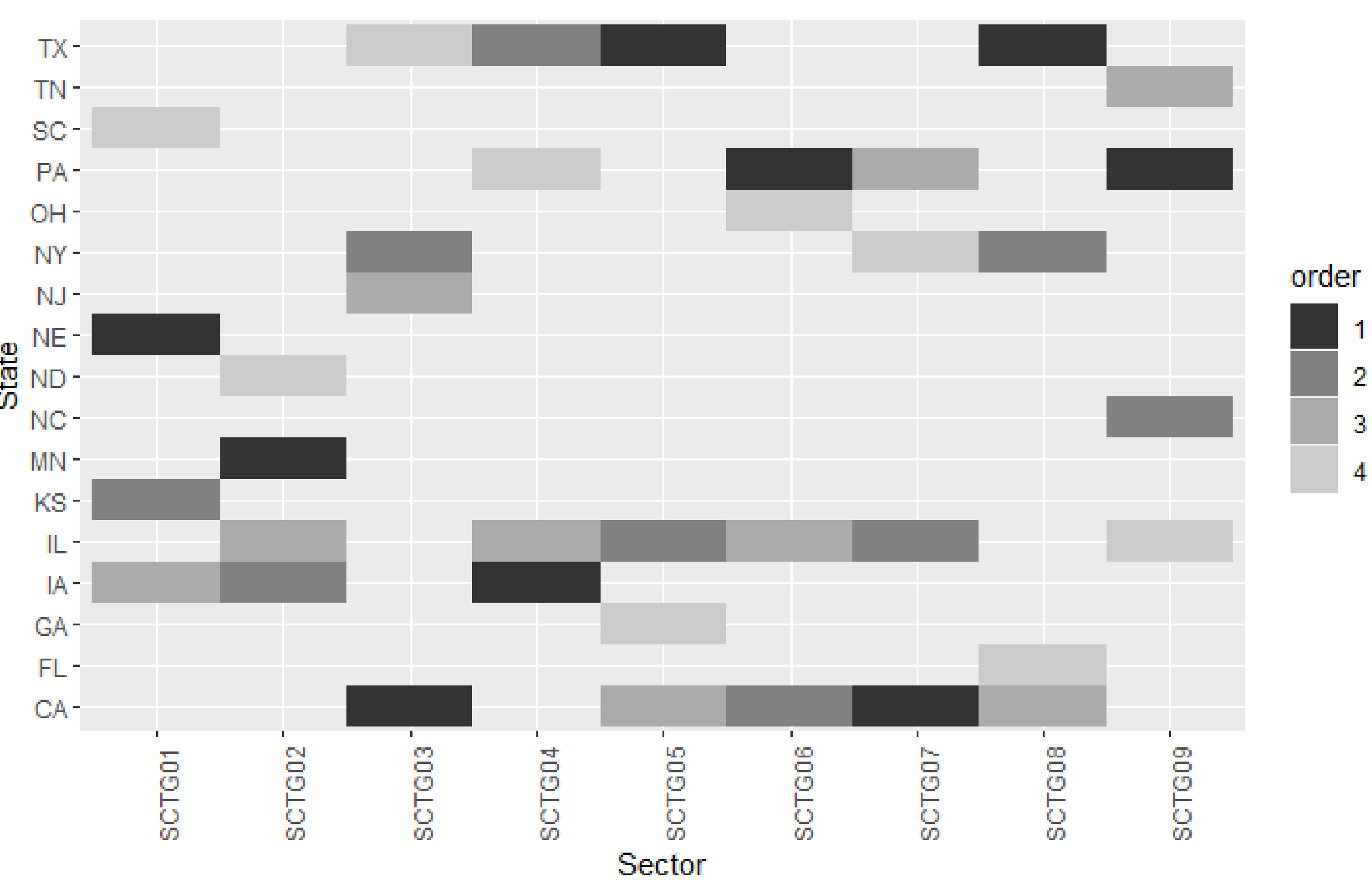
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	SCTG01	SCTG02	SCTG03	SCTG04	SCTG05	SCTG06	SCTG07	SCTG08	SCTG09	SUM
$T_{ijkt}$	-1.518*** (0.0958)	-1.180*** (0.0915)	-0.700*** (0.0426)	-1.034*** (0.0472)	-0.981*** (0.0306)	-0.961*** (0.0326)	-0.806*** (0.0290)	-0.717*** (0.0424)	-0.564*** (0.118)	-0.822*** (0.0271)
$C_{ij}$	2.269*** (0.146)	2.238*** (0.152)	1.379*** (0.0792)	1.086*** (0.0700)	0.509*** (0.0449)	0.695*** (0.0543)	0.875*** (0.0446)	0.906*** (0.0811)	1.354*** (0.215)	0.974*** (0.0389)
$H_{ij}$	2.606*** (0.286)	3.588*** (0.279)	2.887*** (0.139)	1.686*** (0.140)	0.798*** (0.0937)	0.906*** (0.0991)	1.736*** (0.0883)	3.362*** (0.132)	3.498*** (0.368)	2.017*** (0.0811)
Constant	12.33*** (0.684)	9.343*** (0.648)	8.926*** (0.313)	10.36*** (0.334)	11.99*** (0.218)	11.07*** (0.231)	10.99*** (0.208)	8.344*** (0.306)	7.732*** (0.854)	11.97*** (0.193)
Observations	12,005	12,005	12,005	12,005	12,005	12,005	12,005	12,005	12,005	12,005

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

### Counterfactual Scenario #1: Interstate Segment Disruption



### Counterfactual Scenario #2: State’s Overall Trade Disruption



For Counterfactual Scenario #1

- Black squares from the origin to the destination report the top state linkage that generates the largest national loss of agrifood trade when disrupted

For Counterfactual Scenario #2

- Black squares from the sector to states report the top state that generates the largest national loss of agrifood trade when disrupted

## EXAMPLE

### New York – New Jersey (Counterfactual #1)

Ranking	State	Export Change	Welfare Change
1	NY-NJ	-767 (0.143)	-0.193
2	PA-NJ	-747 (0.139)	-0.186
3	CA-AZ	-678 (0.126)	-0.192
4	PA-NY	-558 (0.104)	-0.183
5	TX-CA	-551 (0.103)	-0.182
6	NY-MA	-527 (0.098)	-0.184
7	IN-IL	-519 (0.097)	-0.189
8	WI-MI	-512 (0.095)	-0.196
9	PA-OH	-501 (0.093)	-0.191
10	IA-IL	-465 (0.087)	-0.199

- 10% increase in transportation cost decreases the nationwide domestic trade of agrifood products by \$767 million.
- 0.15% of the nation’s trade value in agrifood commodities.
- 2.40% of New York’s agrifood production and 2.14% of New Jersey’s.

## CONCLUSIONS

- Increase in the transportation cost would reduce trade but the elasticity varies across SCTGs.
- ii) state-to-state segment disruptions (*aggregated level*)
- The segment between New York and New Jersey generates the largest nationwide trade loss when disrupted, and it is followed by the PA-NJ, NY-PA and CA-AZ links.
- ii) disruptions across all the links of a state (*sector level*)
- Nebraska is the top key state in the trade of SCTG 01, for the remaining sectors it is MI (02), CA (03), IA (04), TX (05), PA (06), CA (07), TX (08) and PA (09).

