E-commerce Trends:
Logistics & Consumer Behavior

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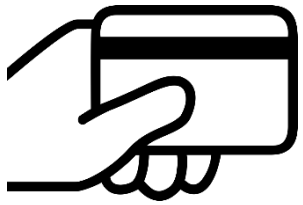
Presentation Contents

- Background on e-commerce
- Supply behaviors and modeling implications
- Covid-19 impacts

Retailing & Distribution



Economic Transactions

(Purchasing & Selling)

Movement of People, Goods, Services

Shopping

Any day…

40% of the population shop

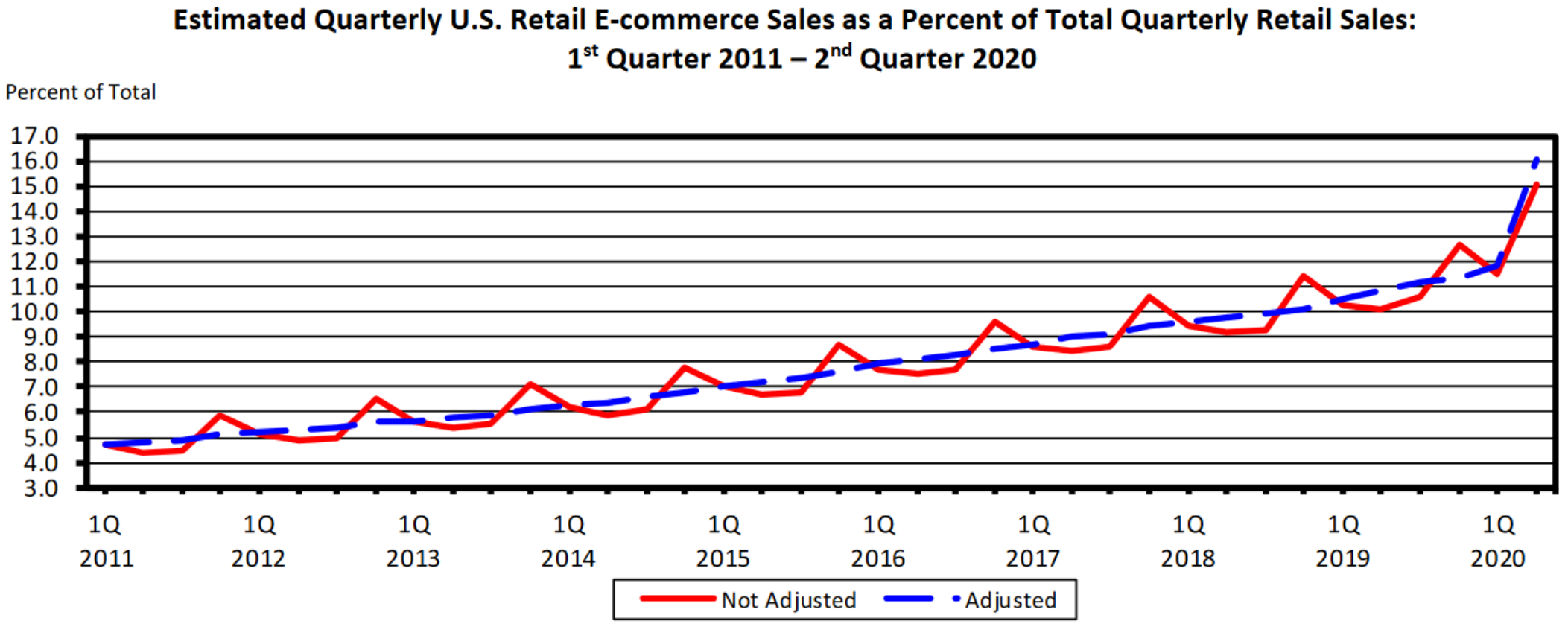
(2-3% shop online)

Today (before COVID)…

~55% of the population shop online

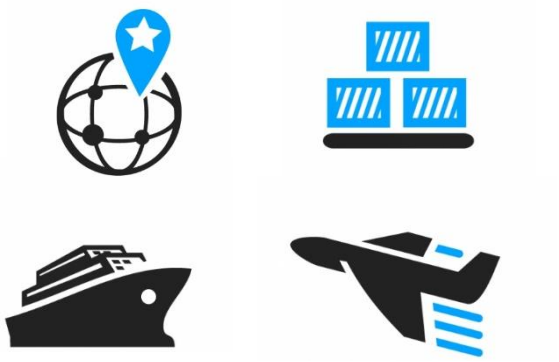
~80% of all shopping influenced by e-commerce

Retail & E-commerce Sales



https://www2.census.gov/retail/releases/historical/ecomm/20q2.pdf

Impacts of E-commerce



Freight & Logistics

- Location of freight facilities
- Location of demand
- Retail landscape
- Inventory practices and distribution services

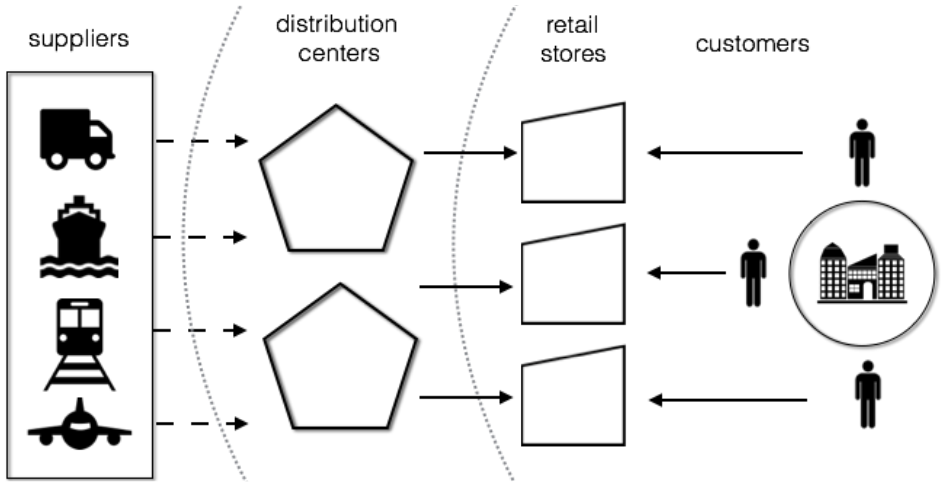
E-commerce

Omni-channel distribution and consumer behaviors

Shopping Behaviors

- Shopping process (search, purchase, transport)
- Tradeoff between individual's travel and deliveries

Logistics

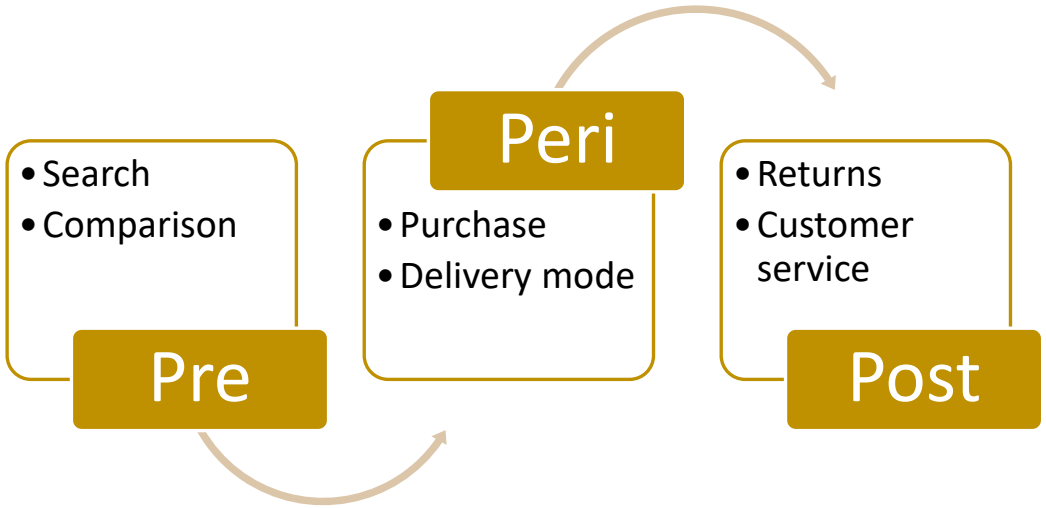


Shopping Behaviors

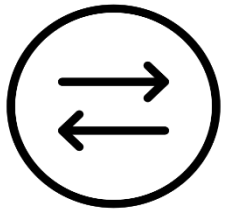
Jaller, M., & Pahwa, A. (2020). Evaluating the Environmental Impacts of Online Shopping: A Behavioral and Transportation Approach. *Transportation Research Part D: Transport and Environment*, *80*, 102223.

Shopping Process & Behaviors

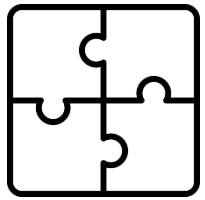
SHOPPING PROCESS



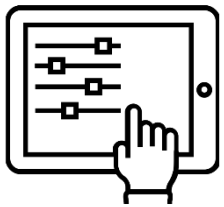
BEHAVIORS



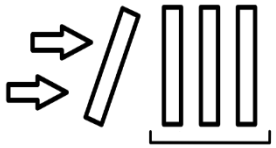
Substitution



Complementarity



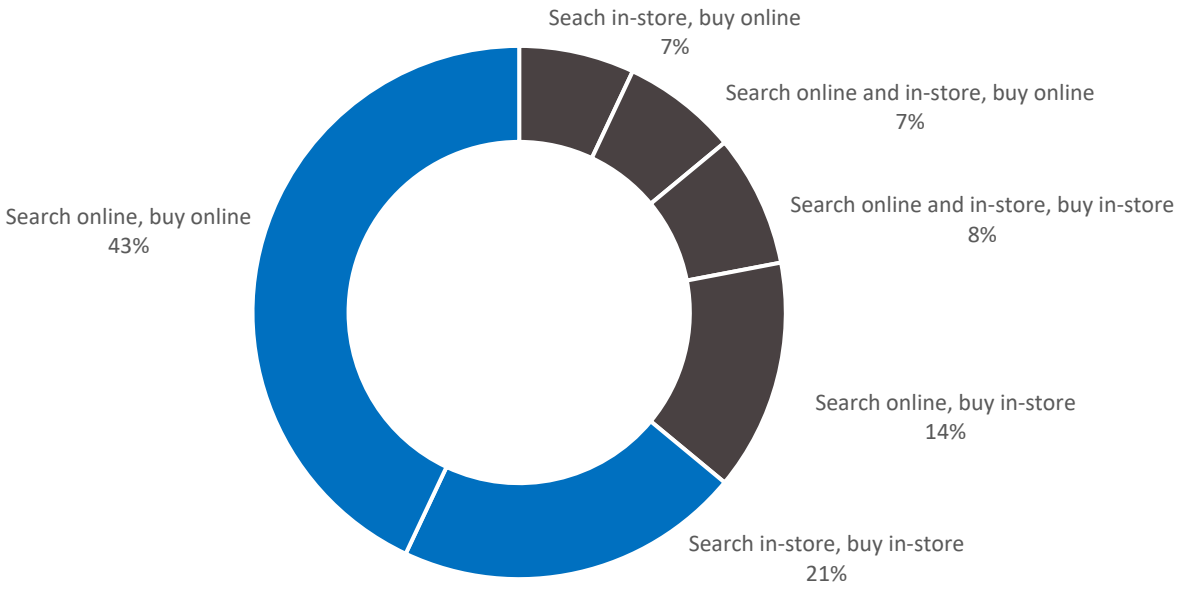
Modification



Induced

Travel & Shopping Behaviors

SHOPPING CHANNELS



Source: UPS Pulse of the Online Shopper™ White Paper, 2017

TRAVEL ACTIVITY OUTCOMES

Additional Factors

Delivery services

- Expedited/ rush delivery
- Alternative locations
- Click-n-collect
- Store pick-up

Basket sizes

- Items in a single purchase
- Larger for in-store purchase
- Grocery (different segment)

Returns

- ~10% in-store purchase
- ~20% online purchase
- Up to 50% for apparel
- Different return channels

We don’t have enough information to fully model these effects

Quantifying E-commerce Demand

Jaller, M., & Pahwa, A. (2020). Evaluating the Environmental Impacts of Online Shopping: A Behavioral and Transportation Approach. *Transportation Research Part D: Transport and Environment*, *80*, 102223.

E-commerce Data

Public travel surveys	National Household Travel Survey (NHTS) American Community Survey (ACS)	American Time Use Survey (ATUS) Commodity Flow Survey (CFS)
Project-based travel surveys	Puget Sound Travel Study Southern Nevada Household Travel Survey California Household Travel Survey Southern California Regional Travel Study	Atlanta Regional Travel Survey Chicago Regional Household Travel Inventory Texas Regional Travel Surveys New Mexico Mid-Region Travel Survey
Traffic data	U.S. Department of Transportation	State Departments of Transportation
Market research	Statista U.S. Travel Association Harris Poll	Pew Research Center Global Business Travel Association Skift
Crowdsourced and remote sensed	Streetlight NREL FleetDNA Google COVID-19 Community Mobility Report ContentSquare	Apple & Google Maps Safecraft Cuebiq INRIX & HERE

National Household Travel Survey (NHTS)

- Likelihood of shopping online (in a month)
- Frequency of monthly shopping
- Travel distances and modes

American Time Use Survey (ATUS)

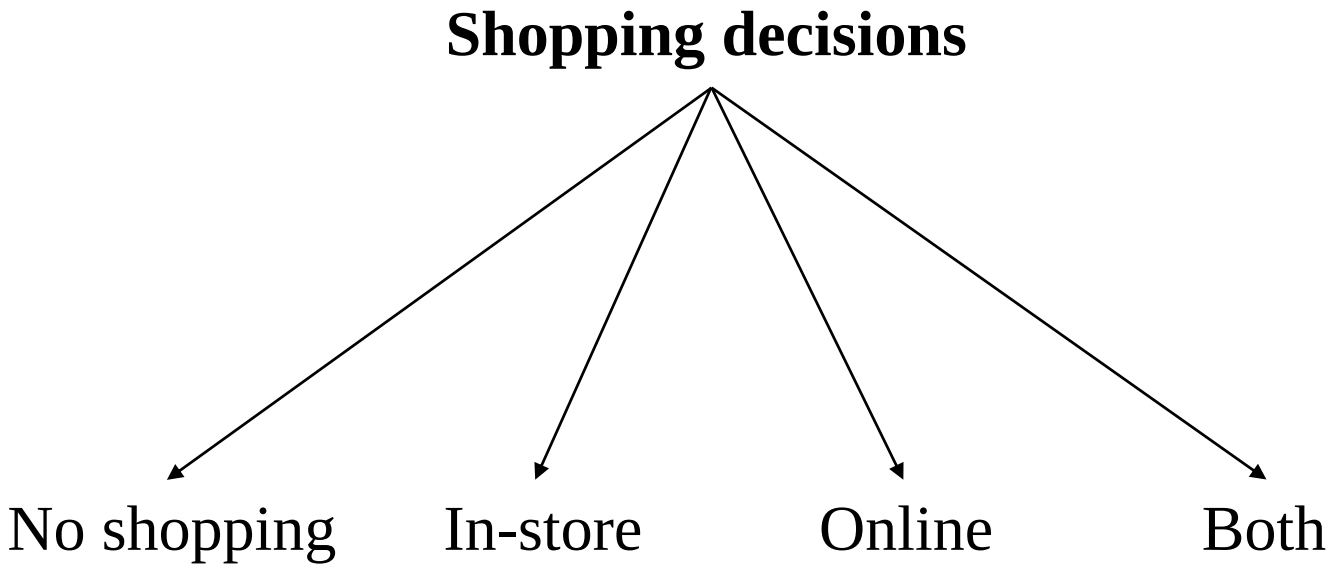
- Likelihood of shopping online (in a day)
- Likelihood of shopping in-store (in a day)
- Location type
- Co-activities and activity times
- Travel times and modes

1. Shopping Decisions

Estimated a multinomial logit model (MNL)

Assumptions:

- In-store: individual trip/tour
- Online: delivery tour
- Both: individual trip/tour, and delivery tour



Behavioral Model

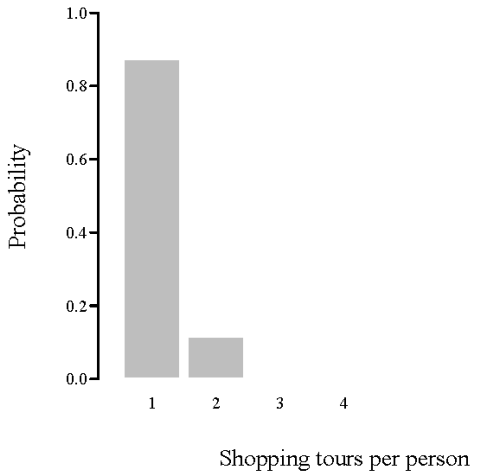
Alternatives	Frequency	Adjusted Mc Fadden R^2	
No shopping	0.593	Equally likely based	0.459
Exclusively in-store	0.385	Market share based	0.010
Exclusively online	0.012	**Chi-square test w.r.t. market share model**	
Both	0.010	Chi square value	325.5 (p-value = 0)

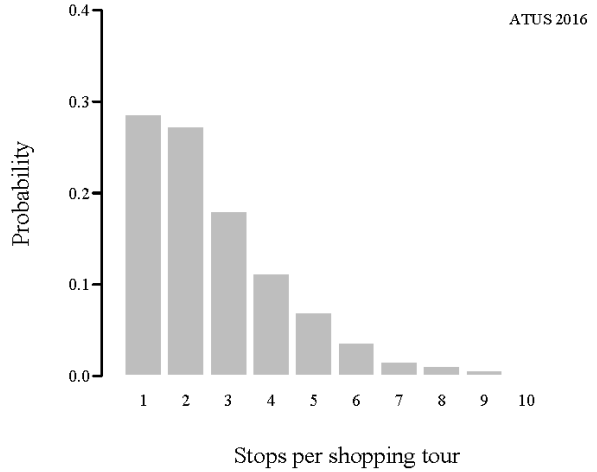
	Estimate, t-values and Significance (respectively)								
Variable	**In-store** (4038)			**Online** (121)			**Both** (107)		
(intercept)	-0.94	(-9.29)	***	-4.93	(-9.52)	***	-6.35	(-9.49)	***
Big City	0.07	(0.61)		-0.70	(-1.10)		-0.27	(-0.46)	
Female	0.04	(0.50)		1.09	(2.52)	*	1.40	(2.37)	*
Diff. in Mobility	-0.64	(-5.30)	***	-0.87†	(-1.33)		-2.20†	(-1.75)	.
Family Structure	-0.33	(-1.89)	.	-0.43	(-0.44)		2.54	(3.01)	**
Graduate	0.16	(2.66)	**	-0.39	(-1.33)		-0.31	(-0.96)	
Gen X	0.17	(3.06)	**	-0.06	(-0.21)		0.70	(2.23)	*
Baby Boomer	0.20	(3.25)	**	0.44	(1.57)		1.32	(4.04)	***
Silent	0.27	(3.58)	***	0.16	(0.43)		0.82‡	(1.92)	.
Low	-0.18	(-1.54)		0.65	(1.43)		0.92	(1.33)	
Lower Middle	0.01	(0.08)		0.23	(0.47)		1.05	(1.65)	.
Median	-0.07	(-0.78)		-0.35	(-0.68)		0.34	(0.51)	
Middle Middle	-0.03	(-0.31)		-1.13	(-1.37)		1.46	(2.58)	**
High	-0.20	(-1.80)	.	-0.37	(-0.66)		1.56	(2.69)	**
Northeast	0.24	(2.32)	*	0.46	(1.02)		-1.58	(-1.56)	
South	0.20	(2.62)	**	0.26	(0.74)		-0.24	(-0.62)	
West	0.10	(1.13)		-0.49	(-0.92)		0.46	(1.14)	
Fall	0.10	(2.06)	*	0.78	(3.93)	***	0.29	(1.31)	
MSA>1mill * Female	0.01	(0.10)		-0.84	(-1.94)	.	0.84	(1.88)	.
MSA>1mill * Fam. Str.	-0.11	(-0.64)		1.77	(2.09)	*	-1.46	(-1.76)	.
MSA>1mill * Graduate	0.20	(2.31)	*	0.84	(2.05)	*	0.57	(1.34)	
MSA>1mill * Northeast	-0.31	(-2.28)	*	-1.06‡	(-1.30)		1.66	(1.53)	
MSA>1mill * South	-0.23	(-2.14)	*	0.69	(1.20)		0.13	(0.24)	
MSA>1mill * West	0.02	(0.14)		1.57	(2.22)	*	-0.33	(-0.59)	
Female * Family Str.	0.69	(3.90)	***	-0.31	(-0.35)		-1.24	(-1.44)	
Female * Low	0.18	(1.24)		-1.67†	(-2.33)	*	-1.1‡	(-1.41)	
Female * Lower Middle	0.05	(0.38)		-0.58‡	(-0.91)		-2.07‡	(-2.50)	*
Female * Median	0.24	(2.03)	*	0.54	(0.89)		-0.44	(-0.59)	
Female * Middle Middle	0.18	(1.31)		1.04‡	(1.13)		-1.52‡	(-2.21)	*
Female * High	0.27	(1.81)	.	0.39	(0.54)		-2.04‡	(-2.73)	**

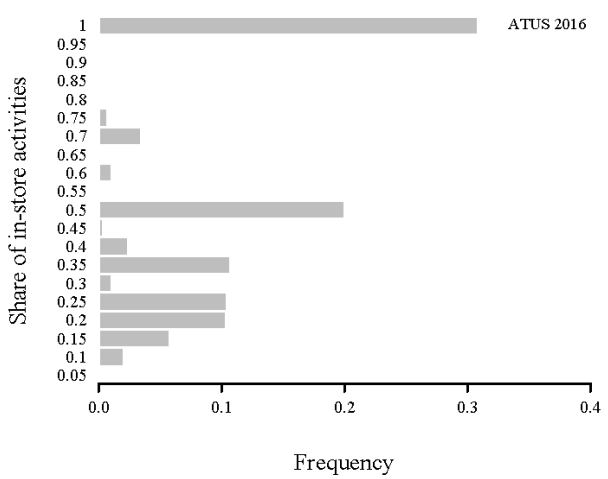
Significant levels: 0% '***' 0.1% '**' 1% '*' 5% '.' 10% ' ' 100%

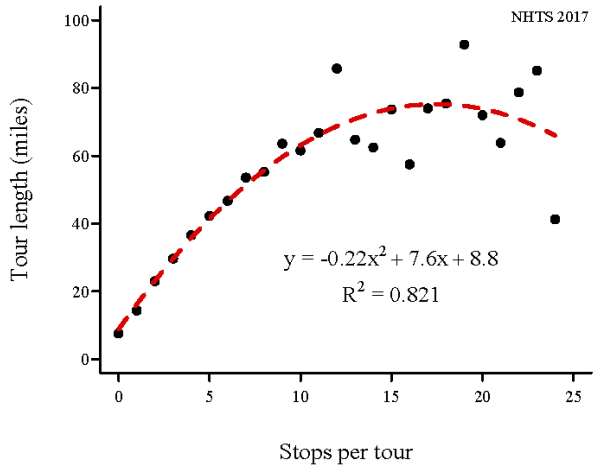
† Less than 5 observations ‡ Less than 10 observations

2. Personal Shopping Trips/Tours









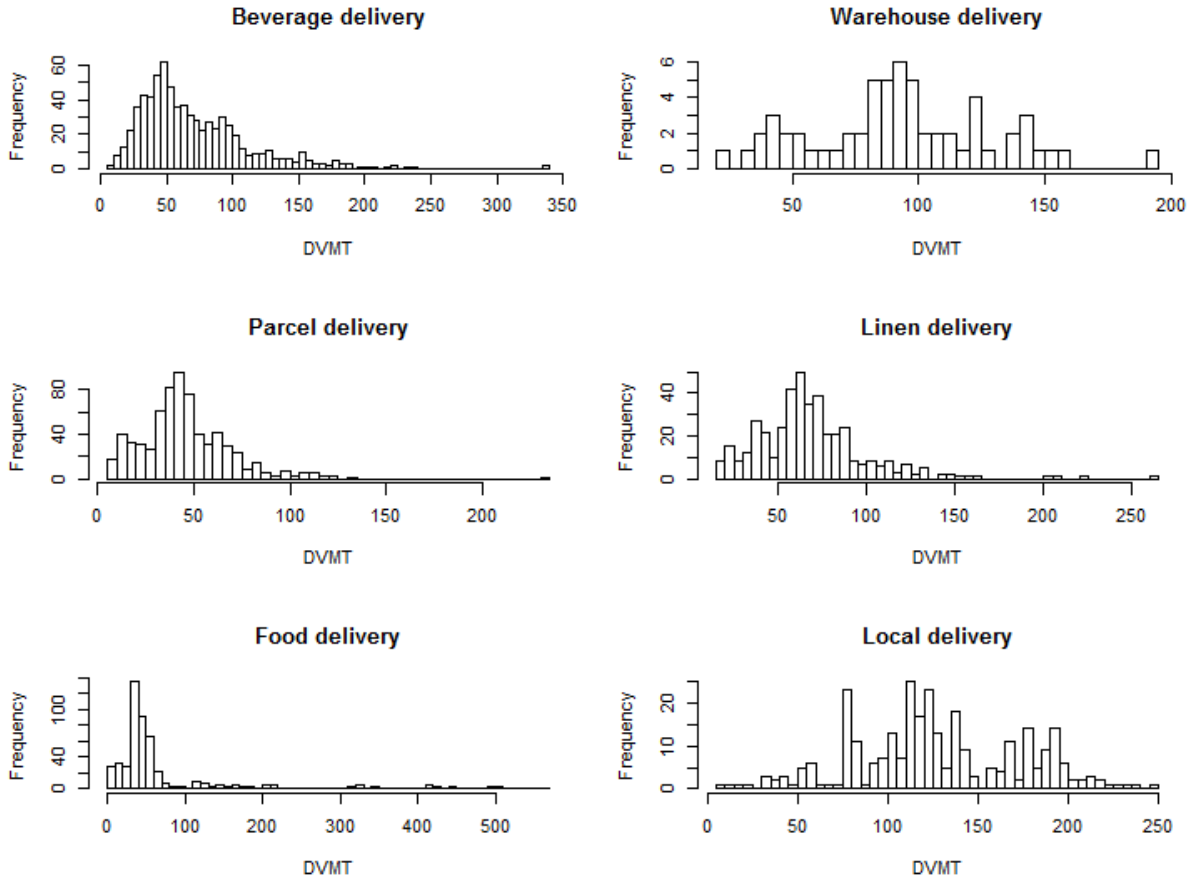
3. Last Mile Distribution

Using aggregated GPS data from FleetDNA

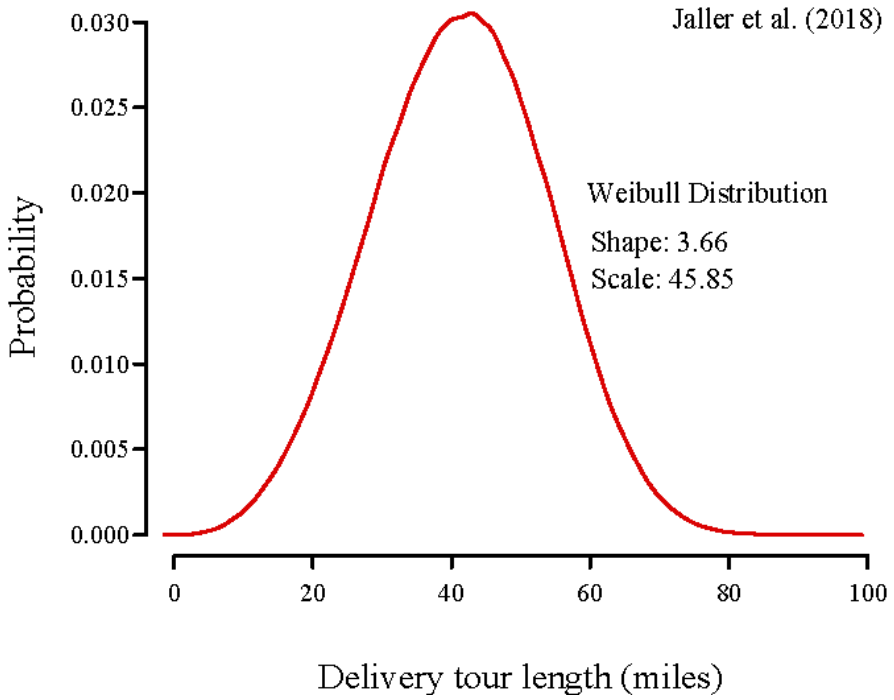
Different last mile delivery vocations have different patterns

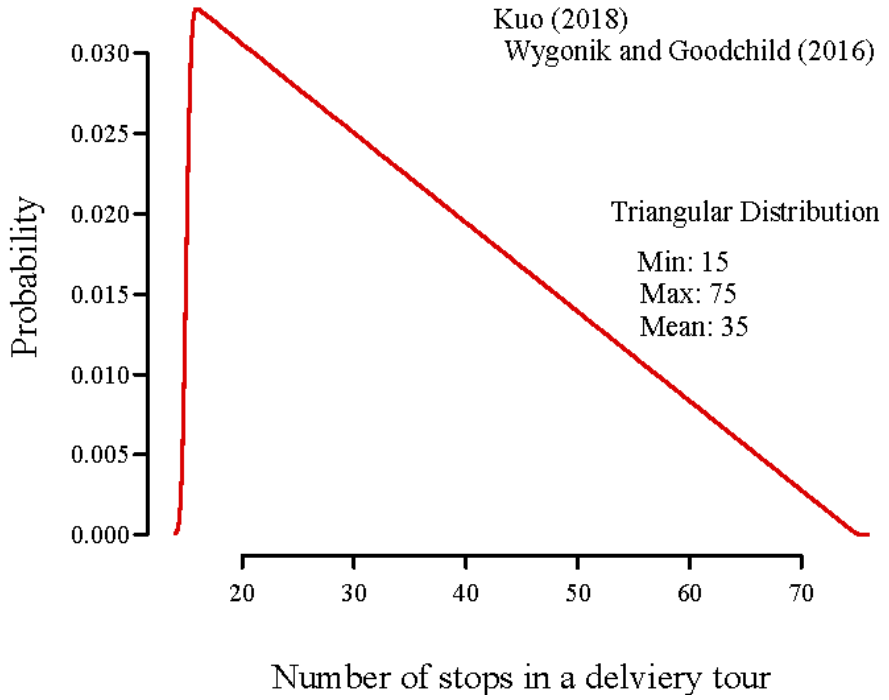
We assume most of the online orders will be delivered to the residence or preferred locations

~8% of the people express a preference for click and pick

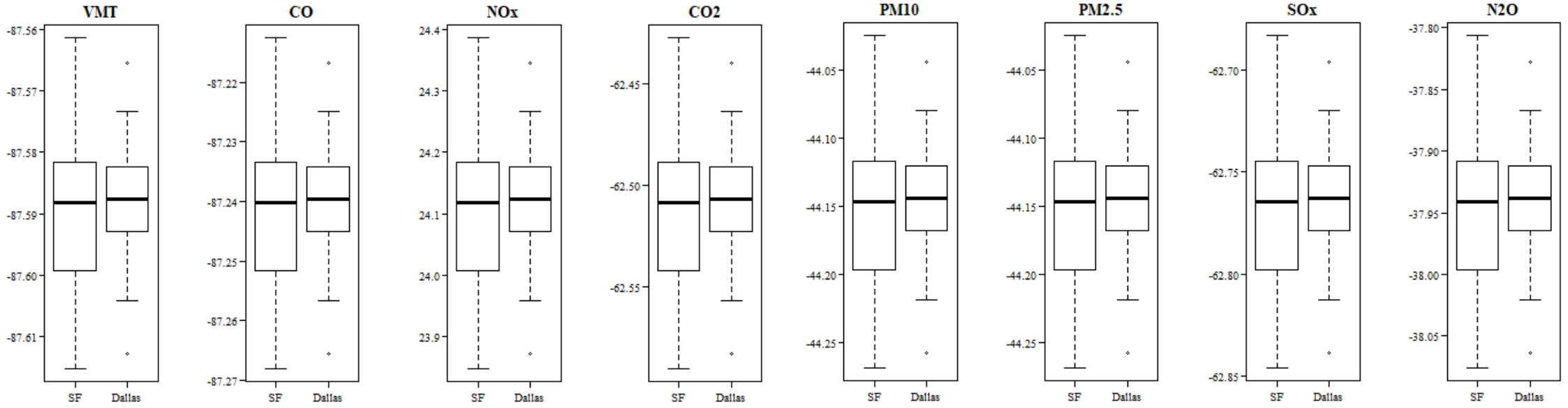


Modeling Delivery Tours



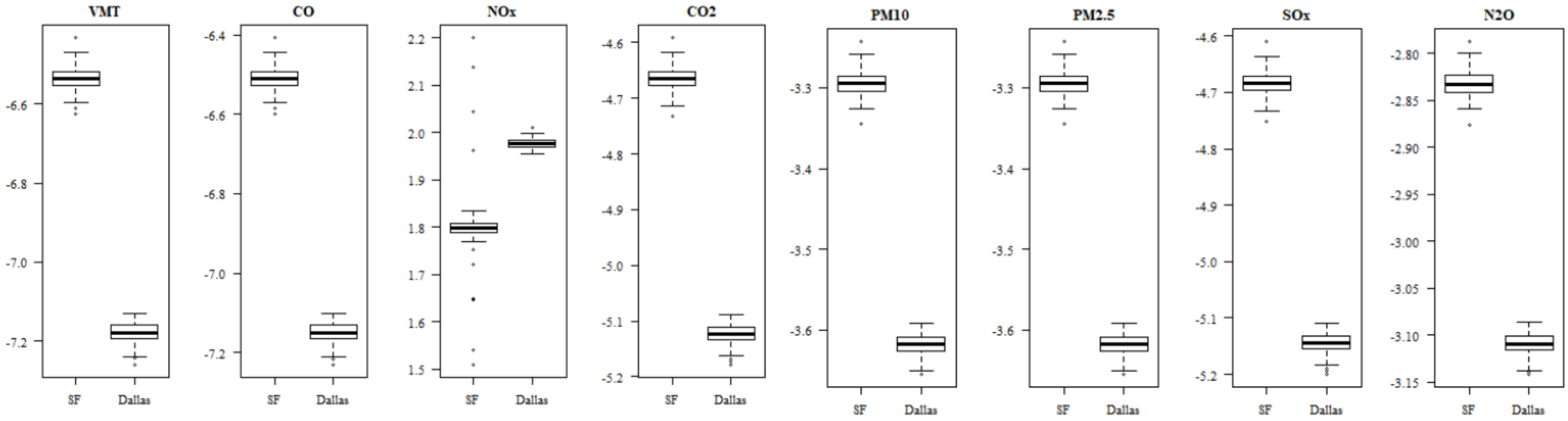


4. Online vs. in-Store



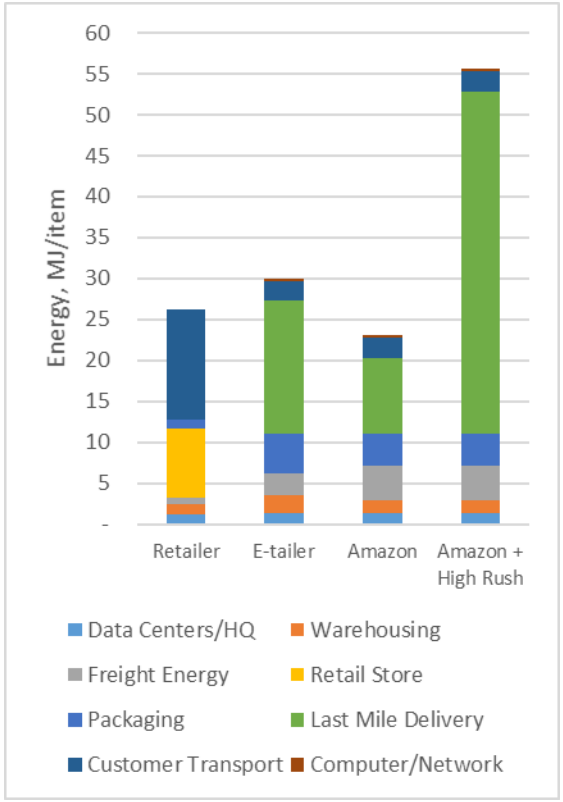
*Deliveries efficiency considers cargo consolidation

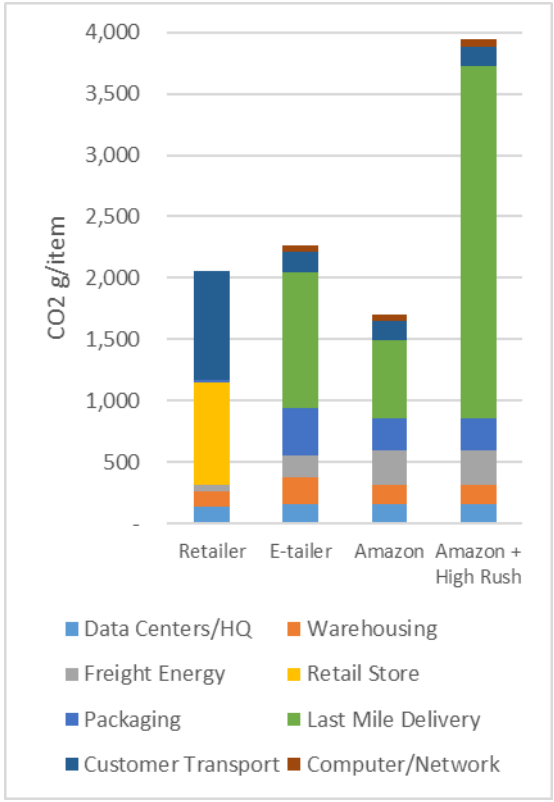
Omni-channel vs. in-Store



*Deliveries efficiency considers cargo consolidation

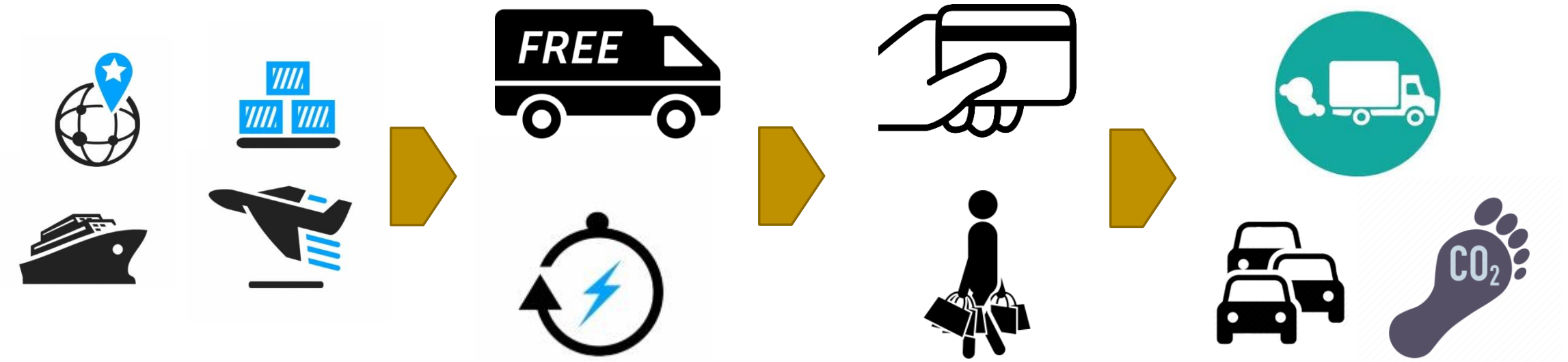
Impact of Rush Deliveries





M. Jaller, S. Matthews, G. Storch & N. Kukrika
https://www.generationim.com/research-centre/insights/ecommerce-vs-bricks-mortar/

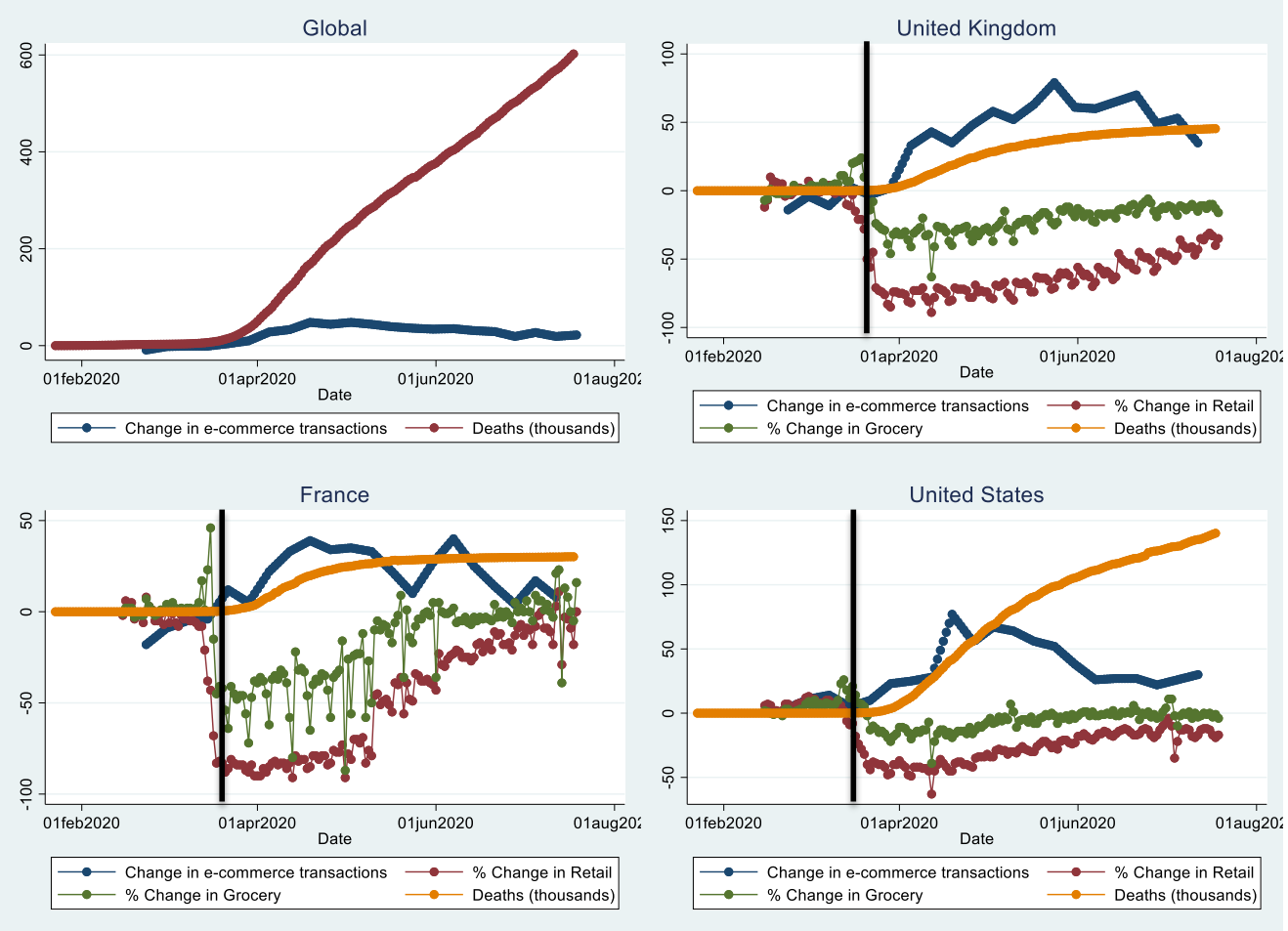
Summary



COVID-19 Impacts

Dennis, S., M. Jaller & T. Forscher (in-preparation). Short- and Long-term Impacts of COVID-19 on Grocery Shopping Behaviors

COVID-19 & Shopping Behaviors



1. John's Hopkins Coronavirus Resource Center
2. Google COVID-19 Community Mobility Report

Time Series Analysis

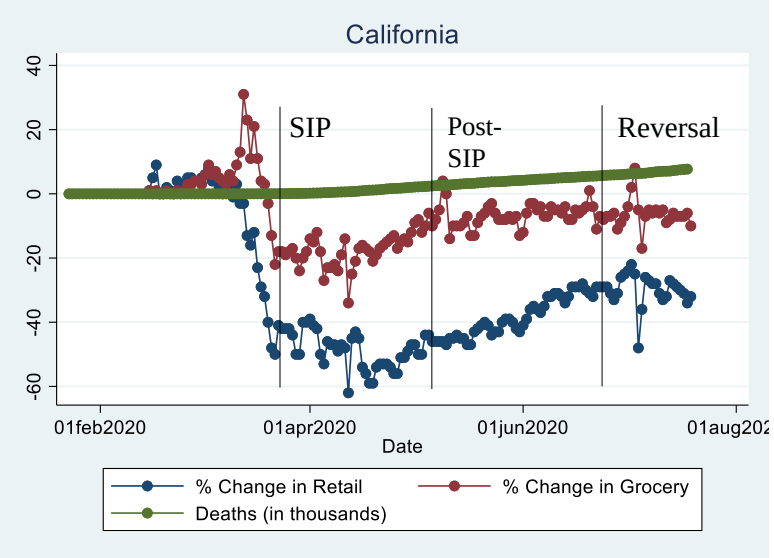
Vector Autoregressive and Vector Error-Correction Models (VAR/VECMs)

Understand the (macro) short- and long-term effects of COVID on Retail and Grocery Shopping

National, State, and regional levels

Data Description &/or Variables
fatality_rate – deaths/confirmed cases
groc – percent change in time spent at grocery and pharmacy locations ret – percent change in time spent at retail locations work – percent change in time spent at workplaces home – percent change in time spent at residence
trans_chng – online transaction index – 100
sip – date of SIP orders soe – SOE declaration reverse_date – dates when States reversed their reopening orders
newsarticles_us – count of total news articles with the keyword “COVID”
unemp –monthly total number of seasonally adjusted unemployment claims.
blm – indicator variable for whether or not major protests were reported holiday – including weekend-long gatherings or celebrations, and a day off of work (e.g., memorial day, independence day) shoppingholiday – indicator for specific holidays that typically involve the purchasing of some physical gift

California



Pre-SIP:

- Fatality rates negative effect in the short-term
- Unemployment long-term positive effect with grocery shopping

Post-SIP:

- Unemployment negative short-term effect, but positive long-term
- Fatalities had a negative long-term effect
- blm and holidays did not generate significant variables.

	Short-term								
	Pre-SIP			SIP			Post-SIP		
AIC	15.674			16.219			7.526		
HQIC	16.212			16.470			8.210		
SBIC	17.355			16.882			9.323		
	D.groc			**D.groc †**			**D.groc ‡**		
L1.ce1	1.80E-02	(8.17E-02)		-0.784	(0.156)	***	-0.701	(0.252)	***
L1.ce2							29.821	(912.985)	
L1.groc	-0.134	(0.240)		1.30E-01	(0.130)		0.192	(0.196)	
L2.	-0.153	(0.246)					2.14E-02	(0.148)	
L3.	0.247	(0.271)					0.153	(0.132)	
L1.fatalityrate	74.044	(309.6186)		104.214	(687.181)		72.169	(2094.917)	
L2.	85.083	(276.380)					354.540	(2125.910)	
L3.	92.509	(247.506)					-788.333	(1868.650)	
L1.unemp	2.55E-04	(7.15E-04)		-5.94E-05	(2.23E-05)	***	-5.69E-04	(4.65E-04)	
L2.	6.56E-05	(9.76E-04)					-1.90E-04	(5.37E-04)	
L3.	-5.87E-04	(9.32E-04)					2.46E-04	(4.25E-04)	
blm							-1.163	(1.102)	
holiday							-0.672	(2.316)	
shoppingholiday							-1.054	(2.860)	
constant	-6.934	(32.887)		-1078.593	(214.327)	***	1.21E-08	(0.658)	
	Long-term								
	Pre-SIP			SIP			Post-SIP		
	ce1. †			**ce1. †**			**ce1. ‡**		
groc	1			1			1		
fatalityrate	5657.219	(346.722)	***	173.777			(omitted)		
unemp	-1.49E-04	(5.46E-05)	***	-6.55E-06			-2.61E-05	(1.11E-05)	**
_trend	-0.220	(0.408)							
constant	516.145			-1354.608			87.217		
							ce2. †		
groc							1.36E-20		
fatalityrate							1		
unemp							-4.61E-08	(2.69E-09)	***
constant							9.98E-02		

COVID Patterns in Sacramento Region

Trend 1 – Fewer in-store shopping trips

60% reported fewer trips

Trend 2 – Larger in-store purchase (basket) sizes

43% reported increased purchases

51 respondents indicated making purchases for others

Trend 3 – More frequent e-commerce purchases, new e-commerce users

25% had never made an e-commerce grocery purchase prior to the pandemic

27% more frequent purchases

Trend 4 – Increase in e-commerce isn't necessarily a decrease in trip-making

45% picked at store, curbside, or alternate location

Source: T. Forscher: Survey conducted by University of California Berkeley

Questions!

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