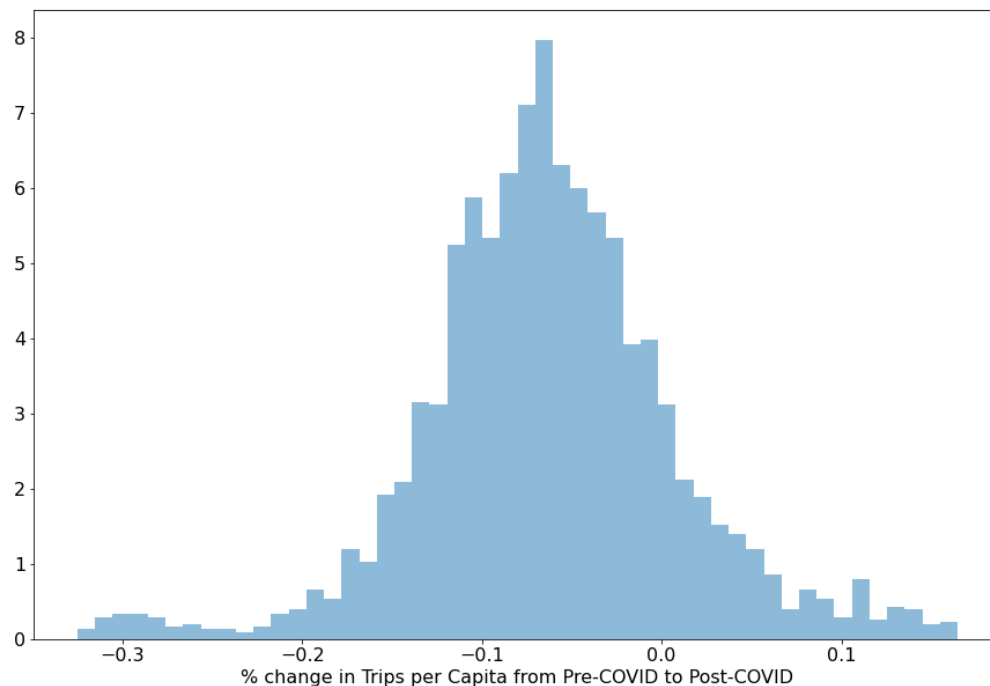


Background

Beginning in March 2020, we saw widespread lockdowns and fear of public interactions that had a large-scale impact on trip activity. The goal of this report is to measure that impact by county as a function of population density and the lengths of trips taken.

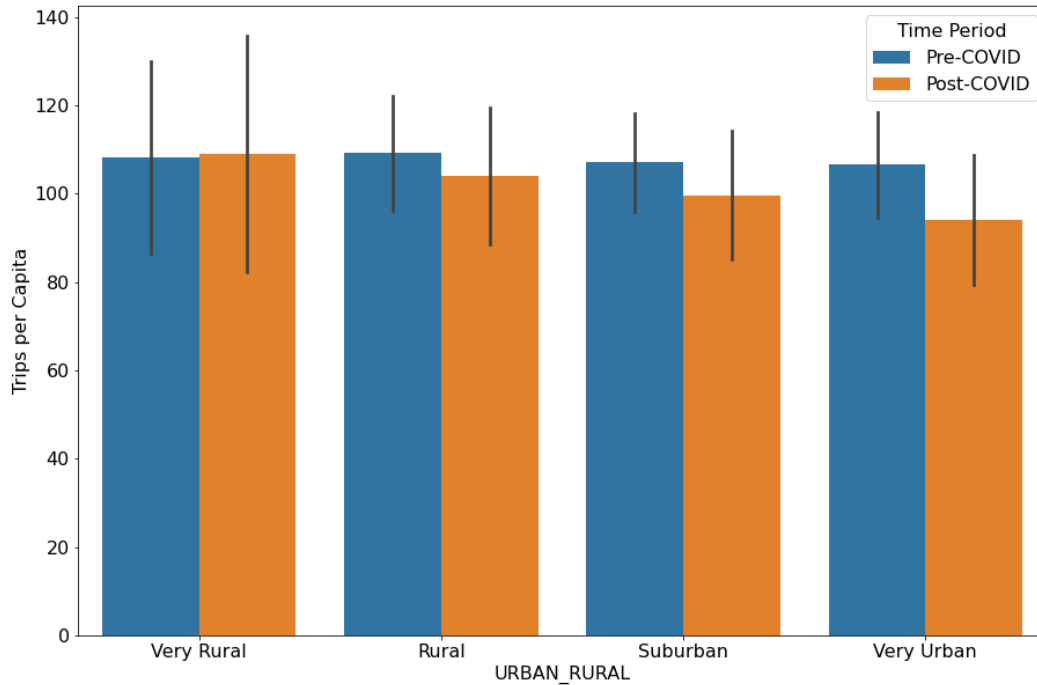
Looking at the percentage change in “Trips per Capita” by county from Jan – Mar 2020 (pre-COVID) to Apr – Jun 2020 (post-COVID), it is evident that the majority of US counties saw a decrease in trip activity during lockdowns. However, over 40% of counties experienced less than a 5% decrease to trip activity while 17% of counties even had increased trip activity.



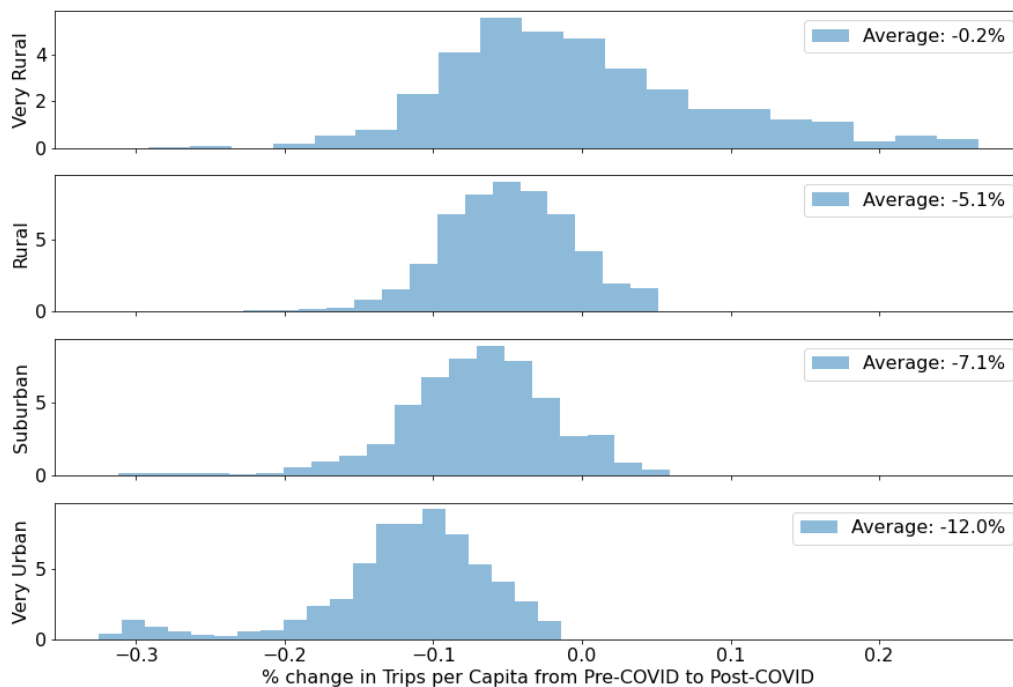
Hypothesis 1

Urban counties see the largest decrease in trip activity as a result of COVID lockdowns whereas suburban and rural counties saw little change or even increases to trip activity.

I defined counties as “Urban”, “Suburban”, “Rural”, and “Very Rural” by creating quartiles based on the percentage of a county’s population that resides in an urban setting (provided by the Census in 2010).



The figure above demonstrates a decline in trips per capita that seems to widen for more urban counties. Looking at the percent difference in trips per capita by county yields the histograms below:



Very rural counties demonstrate positive skew (+1.43) – a majority of these counties see a slight decrease in trip activity, but a handful seem to have significantly increased trip activity. In

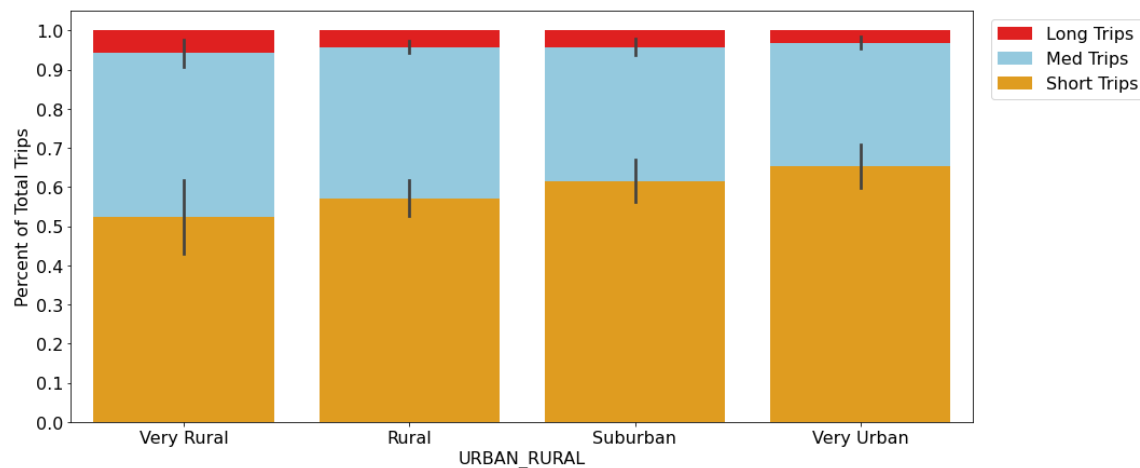
contrast, very urban counties have negative skew (-0.6) – some counties see extreme decreases in trip activity (second peak).

Using a permutation test to compare average percent differences between urban and other county types returns p-values <0.0001, indicating that the results backing up my hypothesis are significant.

Furthermore, regressing the % change by county as a linear function of pct_urban indicates a strong negative relationship (p-value <0.001 and P(F-statistic) <0.0001) between the two variables (see Appendix).

Hypothesis 2

The larger decrease in trip volume among urban counties is due to a greater decline in “short” (<5 mi) trips, which were more impacted by the lockdowns.



The figure above supports that more urban counties see a higher percentage of short distance trips. Investigating how trip volume for each trip length was impacted by lockdowns across county types yields the following:

	Difference in Trips per Capita from Pre-COVID to Post-COVID					
	Short Trips	% Diff	Medium Trips	% Diff	Long Trips	% Diff
Very Rural	1.75	3%	-0.65	-2%	-0.44	-10%
Rural	-1.35	-2%	-3.18	-7%	-0.65	-13%
Suburban	-3.84	-6%	-2.91	-7%	-0.60	-13%
Very Urban	-7.40	-11%	-4.71	-13%	-0.38	-11%

These summary statistics indicate that the larger decrease in trip activity seen by urban counties is predominantly driven by decreases in “short” trip volume. A possible explanation is that short trip lengths in urban environments are attributed to public transit – a definite COVID risk.

A few interesting things to note:

- “Long” trips (>50 mi) had consistent large percentage decreases across all county types, though they did not yield large differences per capita.
- There was a high amount of variance in the amount that “short” and “medium” (5-50 mi) trips decreased across county types. Very rural counties overall saw an increase in “short” trips. It’s possible that these trip lengths could still qualify as “staying at home” in a rural environment.
- “Medium” trips also saw a significant decrease on a percentage basis. This is possibly due to decreases in work-related transit, which often spans these trip lengths.

Factors to Consider

- Not all states and counties implemented lockdowns at the same time.
- Differences in lockdown strictness by state/metro may have sizeable impact on the trends displayed (i.e. CA).
- We know that (a) COVID protocol is correlated with political affiliation and (b) political affiliation is correlated with population density. This is a confounding variable.
- Mode of transportation (i.e. walking, automobile, public transit, flying) is not distinguished

Data & Definitions

Sources

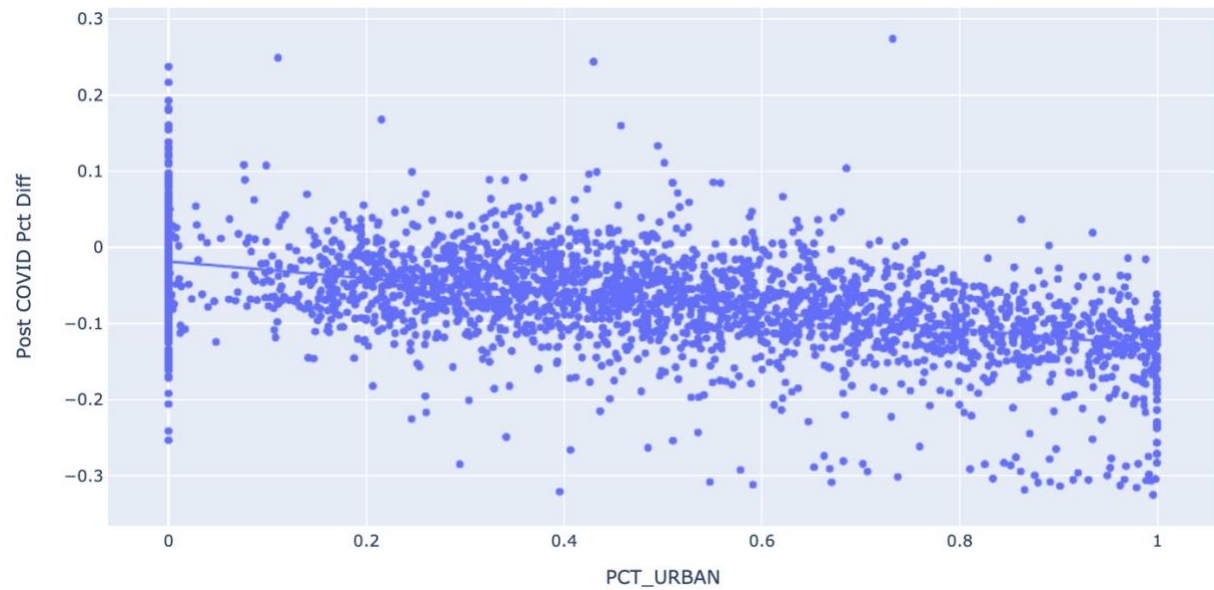
- [BTS Trips by Distance](#)
- [Census 2010 Percent Urban and Rural by County](#)
- [Census 2019 Population/Demographics Estimates](#)

Definitions

- Pre-COVID: January – March of 2020
- Post-COVID: April – June of 2020
- Short Trips: 1 to 5 miles
- Medium Trips: 5 to 50 miles
- Long Trips: 50+ miles

Appendix

Linear Regression: % change ~ f(pct_urban)



OLS Regression Results

Dep. Variable:	y	R-squared:	0.246
Model:	OLS	Adj. R-squared:	0.246
Method:	Least Squares	F-statistic:	921.2
Date:	Thu, 11 Mar 2021	Prob (F-statistic):	2.32e-175
Time:	12:14:30	Log-Likelihood:	4024.4
No. Observations:	2825	AIC:	-8045.
Df Residuals:	2823	BIC:	-8033.
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
const	-0.0185	0.002	-9.314	0.000	-0.022	-0.015
x1	-0.1109	0.004	-30.351	0.000	-0.118	-0.104

Histograms: % Change by County Type (vertical) and Trip Length (horizontal)

