

Mobility during the Pandemic: the Swing Tilted to One Side

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Abstract. Researchers usually divide counties into the Democratic and the Republican in analyzing human mobility during the COVID-19 pandemic in the US. However, the Swing counties remain a blind spot. Our study reveals that the Swing counties highly resemble the Democratic, but considerably differ from the Republican with respect to the change in mobility volume. People living in the Swing and the Democratic counties consistently reduced traveling during the first wave. Towards the end of it, residents in the Republican counties started increasing traveling. In 2748 out of 3101 counties, the abrupt drop took place on the same day, March 16th, 3 days before the first stay-at-home order. Our findings highlight the role of political affiliation in shaping people's travel behavior and demonstrate the lag in public health policy.

Keywords. Human mobility, Political affiliation, the Swing

1. Introduction

Many countries adopted non-pharmaceutical interventions, such as travel restrictions and social distancing to curb the spread of the COVID-19. The effectiveness of these policies was subject to public involvement (Chan et al., 2021). The response to the travel restrictions varied among people (McKenzie et al., 2020). Political preference might influence individuals on how they perceived the risk of the virus and whether they chose to travel less (Hsiehchen et al., 2020). Grossman (2020) asserted that when a governor tweeted to call for reducing unnecessary traveling, residents in the Democratic counties were more likely to act. Barbalat (2022) further suggested that residents in the Republican counties traveled more as the restrictions tightened.



Published in "Proceedings of the 18th International Conference on Location Based Services (LBS 2023)", edited by Haosheng Huang, Nico Van de Weghe and Georg Gartner, LBS 2023, 20-22 November 2023 Ghent, Belgium.

This contribution underwent single-blind peer review based on the paper. <https://doi.org/10.34726/5746> | © Authors 2023. CC BY 4.0 License.

In the US, political polarization has exacerbated over the past 2 decades (Jung et al., 2017). The COVID-19 pandemic in the United States was as much a political problem as a public health problem (Clinton et al., 2021). Previous work mainly focused on the comparison between the Democratic and the Republican. While a survey by the Guardian¹ suggested that most Americans did not feel represented by the Democrats or the Republicans. We thus aim to analyze the human mobility pattern in the context of the Swing, the Democratic, and the Republican counties by investigating daily mobility volume during the first wave of the pandemic.

2. Methodology

2.1. Definition of Swing

The 2016 and 2020 US presidential election voting data at county level are retrieved from MIT Election Data Lab². A county is considered Swing³ if it did not consistently support the candidates from the same party. It is considered Democratic if the Democratic candidates won both the elections (Jung et al., 2017). Otherwise, it is Republican. We divide 3101 counties into 78 Swing, 467 Democratic, 2556 Republican. We notice that the ratio of the Swing to the Democratic and that of the Democratic to the Republican are both approximately 1/6. The small number of the Swing does not diminish its importance.

2.2. Characterization of Mobility Change

Our source data are the dynamic origin-destination matrices at county level synthesized by Kang (2020) from the SafeGraph⁴ mobile phone data. We process the data to derive the daily mobility volume indices of 3101 counties (7 out of 3108 contiguous counties are excluded due to missing data). The indices of each county are then normalized by dividing its average. The normalized indices fall between 0.45 and 1.95. A normalized index smaller than 1 suggests that people travel less than the average. Thereafter, we refer to the normalized indices simply as the mobility volume.

¹ <https://www.theguardian.com/us-news/2016/oct/25/american-political-parties-democrats-republicans-representation-survey>

² <https://electionlab.mit.edu/data>

³ <https://www.polyas.com/election-glossary/swing-states>

⁴ <https://www.safegraph.com/guides/mobility-data>

2.3. Identification of Structural Break

A structural break in time series is a significant change in the parameters of linear regression models (Güler et al., 2019). Having observed an abrupt change in the mobility volume, we apply radial basis function (Harchaoui & Cappé, 2007) to detect breakpoints. With the detected breakpoints, we perform piecewise time series analysis on the mobility volume. *Figure 1* illustrates the difference between a single regression and piecewise regressions. We gauge the change in the mobility level by comparing the average mobility volume before and after the breakpoint. We measure the rate of the change by the slope coefficient of a piecewise regression. Three indicators of each county are thus synthesized: *Mobility Volume Difference*, *Before-break Trend*, and *After-break Trend*. We perform the Analysis of Variance (ANOVA) and t-test to compare the Swing, the Democratic and the Republican counties with respect to each mobility indicator.

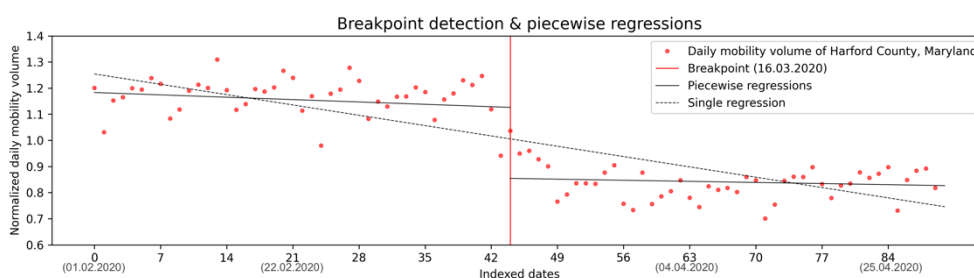


Figure 1. Harford County, Maryland is taken as an example to show the difference between a single regression and piecewise regressions.

3. Result

The mobility volume exhibits a weekly pattern, with the peak on Friday and the valley on Sunday. However, it deviates from the pattern and decreases monotonically in the week of March 16th (*Figure 2*). The breakpoint detection finds that 2936 out of the 3101 counties have one breakpoint. In 2748 counties, the breakpoints are on the same day, March 16th.

To minimize the impact of the weekly pattern, the mobility indicators are calculated with a tumbling window of 6 weeks (42 days). ANOVA and t-test suggest that the Swing counties are the same as the Democratic but different from the Republican regarding each of the three mobility indicators (*Table 1*). All the mobility indicators are negative except for the *After-break Trend* of the Republican counties. The magnitudes of all the indicators are greater in the Swing and the Democratic than the Republican.

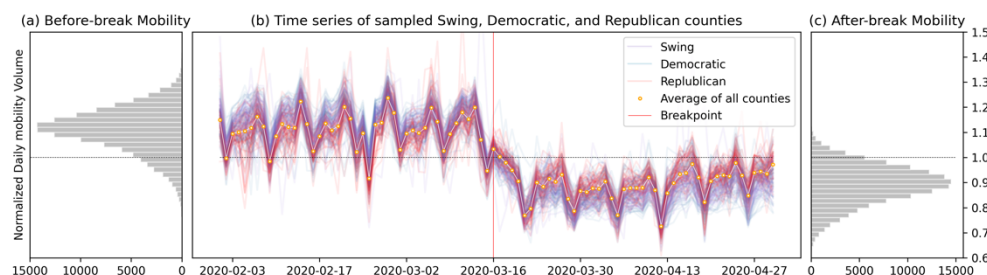


Figure 2. (a): Histogram of the daily mobility volume of all counties before the breakpoint. **(b):** Mobility volume time series of randomly sampled 50 Swing, 50 Democratic, and 50 Republican counties. **(c):** Histogram of the daily mobility volume of all counties after the breakpoint.

	Mean			T-test		
	Swi.	Dem.	Rep.	Swi. – Dem.	Swi. – Rep.	Dem. – Rep.
MVD	-0.2605	-0.2688	-0.2118	***	***	***
BBT	-0.0006	-0.0008	-0.0001	***	***	***
ABT	-0.0003	-0.0005	-0.0002	***	***	***

Table 1. Left: Descriptive statistics of mobility indicators: Mobility Volume Difference (MVD), Before-break Trend (BBT), and After-break Trend (ABT), in the Swing (Swi., N=76), the Democratic (Dem., N=420), and the Republican counties (Rep., N=2252) with a tumbling window of 6 weeks (42 days). **Right:** Pairwise t-test results (***) $p < 0.001$.

4. Discussion

We leverage mobility volume to characterize human mobility and presidential election voting data to define the political affiliation of each county. We utilize three indicators to quantify the level and the rate of the change in mobility volume. The *Mobility Volume Difference* suggests that the level of the change in mobility volume is greater in the Swing and the Democratic counties than in the Republican. Likewise, the *Before-break Trend* reveals that the rate of the change in mobility volume is greater in the Swing and the Democratic counties. The positive *After-break Trend* suggests that people living in the Republican counties had started traveling more while others kept avoiding traveling. However, our study did not consider the spatial dependence of mobility and political affiliation. This should be addressed in the future.

5. Conclusion

This study investigates the change in mobility volume in the Swing, the Democratic, and the Republican counties during the first wave of the

COVID-19 pandemic. The results suggest that the Swing and the Democratic counties are the same but different from the Republican concerning each of the 3 mobility indicators, *Mobility Volume Difference*, *Before-break Trend*, and *After-break Trend*. The Swing and the Democratic counties experienced the greatest change in mobility volume and a constant decreasing trend throughout the study period. Whereas the Republican counties had smaller change and observed an increasing trend after the breakpoints. The majority of the breakpoints are on the same day, March 16th, 3 days before the first stay-at-home order. We conclude that people took actions simultaneously and political affiliation had a greater impact on mobility volume than the travel restriction policies.

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