COVID-19: Relationship between mobility and macroeconomic indicator

Sai Chand (chandu.dvd@gmail.com)
UNSW Sydney
Vaibhav Dange
Government of India
Vinayak Dixit
UNSW Sydney

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Abstract

Lockdowns have been widely used as a policy instrument to manage the COVID pandemic and ensure that the safety of communities and the healthcare system does not get overwhelmed by the number of cases. Though lockdowns are meant to assist with effectively managing the spread of the pandemic, they come at an enormous economic cost to individuals and households. Economically poorer households may be unable to adhere to such lockdowns as they might struggle to maintain their livelihood and venture out to find a livelihood. Using the Google Mobility Data of several countries and sub-regions, we find that increase in economic indicators such as per-capita GDP (in case of countries) and household income (in case of sub-regions within a country) is the single biggest indicator of the likely reduction in mobility to work and increase in time spent in-residence. The trend is remarkably stable, which can help determine elasticity values. It is anticipated that these macro-economic elasticities can be used to potentially design economic relief to make it possible for individuals to adhere to lockdown.

Introduction

Lockdowns have been implemented in several countries around the world as a form of non-pharmaceutical interventions (NPIs) to curb the spread of COVID-19. The main objective of the NPIs, such as quarantine, isolation, social distancing, lockdowns, etc., is to reduce mobility in order to reduce the risk of transmission of the disease. In the absence of confirmed medicine and vaccination, these NPIs play an important role in ensuring the safety of communities and that the healthcare systems are not overwhelmed. On the other side, NPIs disrupted economic activity, production, logistics, and mobility and could not be sustained in many countries for longer periods (Han et al., 2020; Singh et al., 2020). The compliance of the population with the NPIs and lockdowns has been heterogeneous and is reliant on economic, socio-demographic, and cultural factors.

There have been several studies evaluating and predicting the spread of COVID-19 at different geographic levels (Li et al., 2020; Rafiq et al., 2020; Wynants et al., 2020). There are also several studies on the association between mobility patterns and COVID-19 transmission (Badr et al., 2020; Gatalo et al., 2020; Xiong et al., 2020). However, there are limited studies exploring the impact of socio-economic characteristics on compliance with the lockdowns. A recent study (M Herren et al., 2020) found that countries with more authoritarian governments were more compliant with lockdown orders as measured by a reduction in mobility patterns. Using the Yandex mobility data in 308 municipalities in Russia, it was found that poorer municipalities observed a smaller decline in mobility during lockdown (Dokhov and Topnikov, 2020).

It is expected that the regions comprising of economically richer households could afford to stay at home and ride out the pandemic (at least for a few days, if not months), whereas the poorer households would struggle to maintain their livelihood and are expected to venture out to find a livelihood. In this paper, we investigate how economic wealth might affect their ability to not travel during the pandemic. To evaluate

this, we use the Google mobility data (Google, 2020) in conjunction with economic indicators of the region.

These insights will better help designing policies that could help better cater to the poor sections of the society who can afford to not travel during the pandemic.

Data

Google provides an open-sourced and free data set of mobility records for countries around the world (Google, 2020). The data shows how the time spent at locations changed compared to the baseline days. A baseline day represents a normal value for that day of the week. The baseline day is the median value from the 5-week period (3 January – 6 February 2020). The different categorised places included workplaces and residential area. Due to the high fidelity of data available at a state and county level in the U.S., we included this data in our analysis.

In this study, we analysed the mobility data from the 17th of February 2020 to 19th January 2021, i.e. a period of 340 days. However, not all geographical places have mobility data for the entire study period. In this study, we only considered the places where the mobility data is available for at least 90 days for both workplace and residential locations. This is done to ensure there is no sampling bias.

The average change for the entire data collection period could not be used as the exact period of lockdown differed from one country to another (and also within a country). The time spent at residential locations is expected to increase during the period of lockdowns. Therefore, we considered the average percentage change of the five most severely affected days.

Analysis

To evaluate the robustness of our analysis, we evaluated the impacts at three different geographical scales. These included 128 countries, 50 U.S. States, 1557 U.S. Counties and 169 Australian Councils. Strong and statistically significant correlations are observed between per capita GDP and percentage increase in time spent in residence (-0.49 to -0.56) and workplace (0.33 to 0.70) (Table 1). The elasticity values shown in Table 1 further demonstrate the high sensitivity of spending time at home and work with the per capita GDP. The increase in per capita GDP increased the likelihood of staying at home and reduced the likelihood of being at the workplace.

More granular analysis of the impacts at the county (in the U.S.) and council (in Australia) levels revealed similar strong statistically significant correlations with average income (Figure 2). Individuals were more likely to stay at home if they were in regions with higher household income (0.69), while individuals in regions with lower incomes were more likely to spend time in the workplace (-0.67). The high elasticity values further establish this strong trend between economic conditions and the likelihood to stay at home or be at work (Table 1).

Table 1 Correlation and elasticity of change in time spent with respect to the economic indicator variable

Location	Dependent variable	Correlation Coefficient	Elasticity[1]
Residential (Countries)	GDP per capita (adjusted for PPP)	0.33**	0.81
Residential (US States)	GDP per capita	0.70**	4.73
Workplaces (Countries)	GDP per capita (adjusted for PPP)	-0.56**	0.70
Workplaces (US States)	GDP per capita	-0.49**	1.00
Residential (US Counties)	Median household income	0.69**	5.05
Residential (Australian Councils)	Median employee income	0.39**	10.21
Workplaces (US Counties)	Median household income	-0.67**	1.92
Workplaces (Australian Councils)	Median employee income	-0.42**	2.51

** indicates p value <0.01

[1] The elasticity is positive for workplaces as the percentage reduction are in the negative domain.

Conclusions

A robust analysis comparing per capita GDP and household income with the likelihood to stay at home and workplace unequivocally demonstrates that economic conditions have an impact on staying at home during a pandemic. This is intuitive given that poorer households do need to venture out to engage in work to provide for their livelihood.

Unilateral lockdown policies might not be sufficient to enforce individuals to stay at home in economically disadvantaged sections leading to a disproportionately higher spread of the virus in these sections. A lockdown policy that carefully considers this phenomenon to inform policies that can provide economic security is critical to ensure a reduction in mobility that would ultimately help mitigate the virus's spread. It is important to point out that these policies could vary from job retention schemes rolled out in several OECD countries (OECD, 2020) to freely provisioning essential rations to 800 million poor households in India (NDTV, 2020). Policies that help address the socio-cultural and economic requirements of a community are critical to help reduce mobility during a pandemic.

Declarations

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Availability of data and material

The raw mobility data used in the paper is publicly available at the following web link https://www.google.com/covid19/mobility/ . The processed data will be provided by the authors upon a reasonable request through email.

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Figures

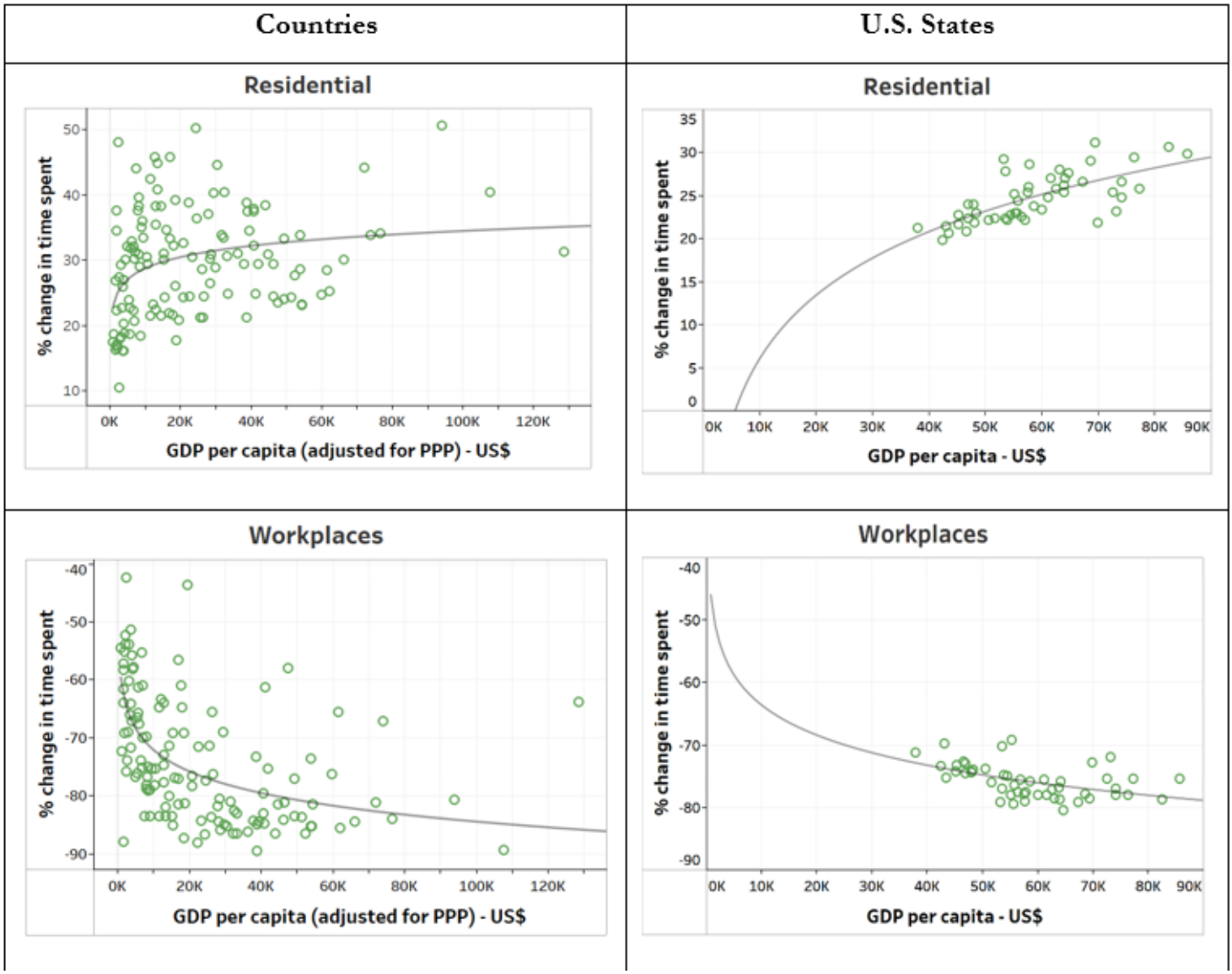

Figure 1

Percentage change in time spent vs GDP per capita in US$

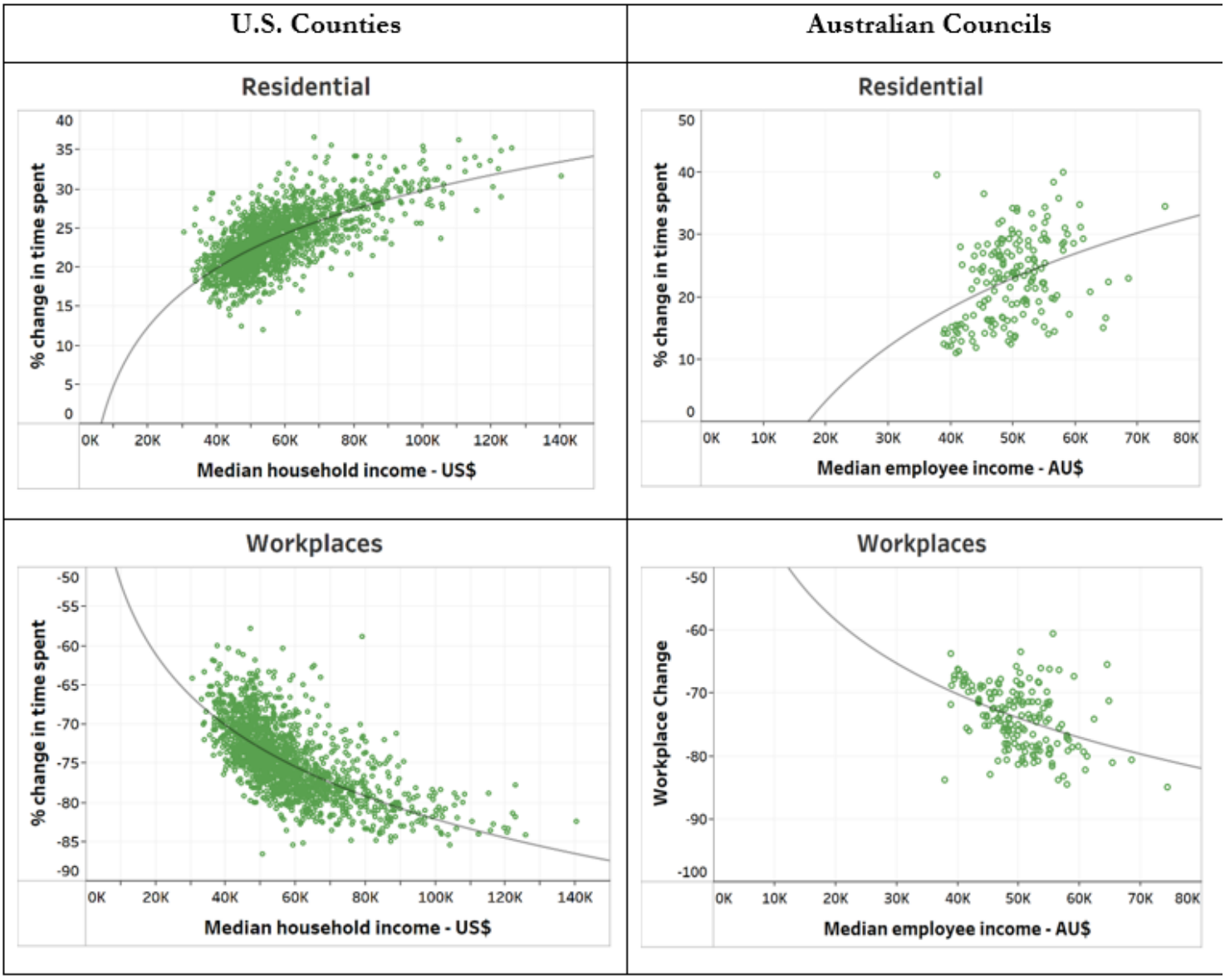

Figure 2

U.S. Counties and Australian Councils - Percentage change in time spent vs Median Income