Relation between Employment data and Mobility and Stringency indexes during the COVID-19 pandemic of 2020

Emmanuel Rodriguez Balleza

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1 Introduction and motivation

In January 2020, the first case of COVID-19 was detected in the United States, and just two months later, in March, the first Stay-at-home orders were issued by state governments, with California being the first state to issue it (see Moreland, Herlihy, and Tynan 2020)

The drastic reduction in the mobility of people, either due to uncertainty and fear, or due to the restrictions imposed, caused an important impact on the country's economy, being reflected by the increase in the Unemployment rate, which reached a unprecedented level since 1948, the year in which this data began to be calculated [see Figure 1]. At the beginning of the pandemic, the industries that provide services to people were the most affected (in particular the Leasure and Hospitality industry), however, over time, while the unemployment rates for the service industries continued at a high levels, other industries less related to services also began to be affected. (Falk et al. 2021)

In October 2020, Baek et al. (2020) studied the impact of Stay-at-home orders on unemployment insurance claims (UI) during the period between March 14 and April 14, 2020. Inspired by this article, a brief study is presented below, in where an attempt is made to adjust a statistical model that seeks to explain the monthly change in employment levels, by state and industry, based on data on people's mobility and stringency in the policies taken by local governments.

2 Data

This section describe the data we are using for this study.

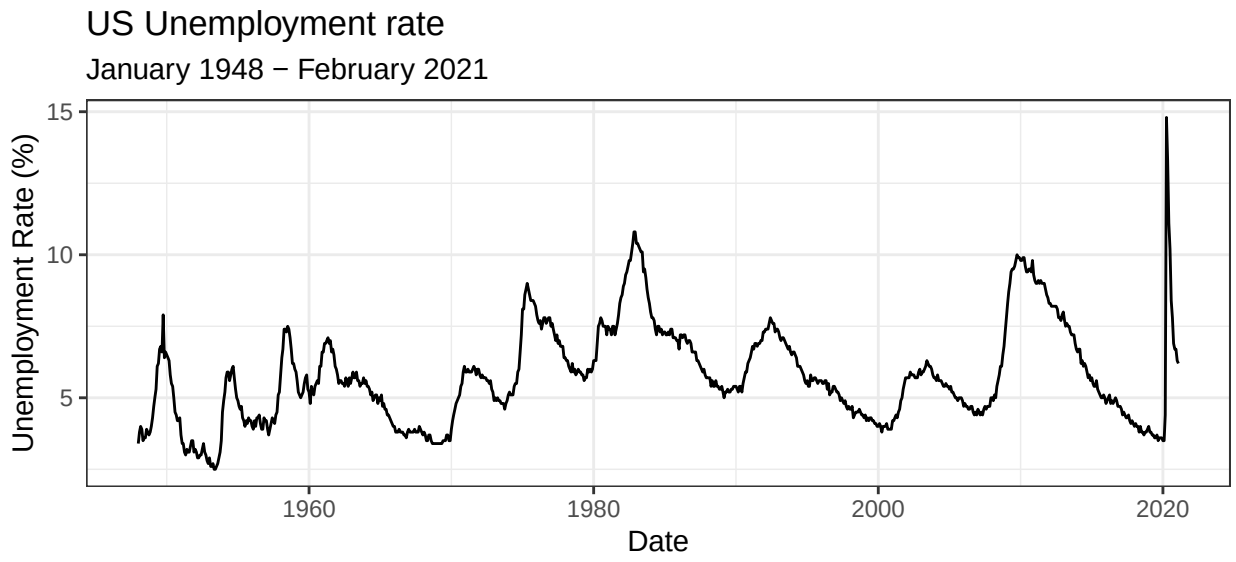

Figure 1: US Unemployment Rate. Source: US Bureau of Labor Statistics

2.1 Employment data

We obtained the Seasonal Adjusted (SA) Number of Employees (in thousands) by Industry and by State from the US Bureau of Labor Statistics (BLS). The information considers 50 States and the District of Columbia (51) and 13 industries [see Table 1]

This is a monthly data, and we used the historical information from December 2019 to January 2021.

Table 1: Industries considered by the BLS

Mining and Logging	Retail Trade	Professional and Business Services
Construction	Transportation and Utilities	Education and Health Services
Manufacturing	Information	Leisure and Hospitality
Wholesale Trade	Financial Activities	Other Services
		Government

2.2 Mobility data

Since February 2020, Google began publishing local mobility reports, which 'show movement trends over time ordered by geographical areas and classified in various categories of places, such as shops and leisure spaces, supermarkets and pharmacies, parks , transportation stations, workplaces and residential areas'.

For the sake of simplicity, we chose to work with the Residential Mobility index, considering it the most representative of the effect of Stay-at-home orders.

This is a Non Seasonal adjusted daily data, so, in order to make it comparable with the employment data, we used an additive time series model to eliminate the weekly seasonality factor from the series [see an example in Figure 2]

2.3 Stringency data

On March 2020, the Oxford COVID-19 Government Response Tracker (OxCGRT) began to collect publicly available information on a number of indicator of government response, such as school closures, travel bans,

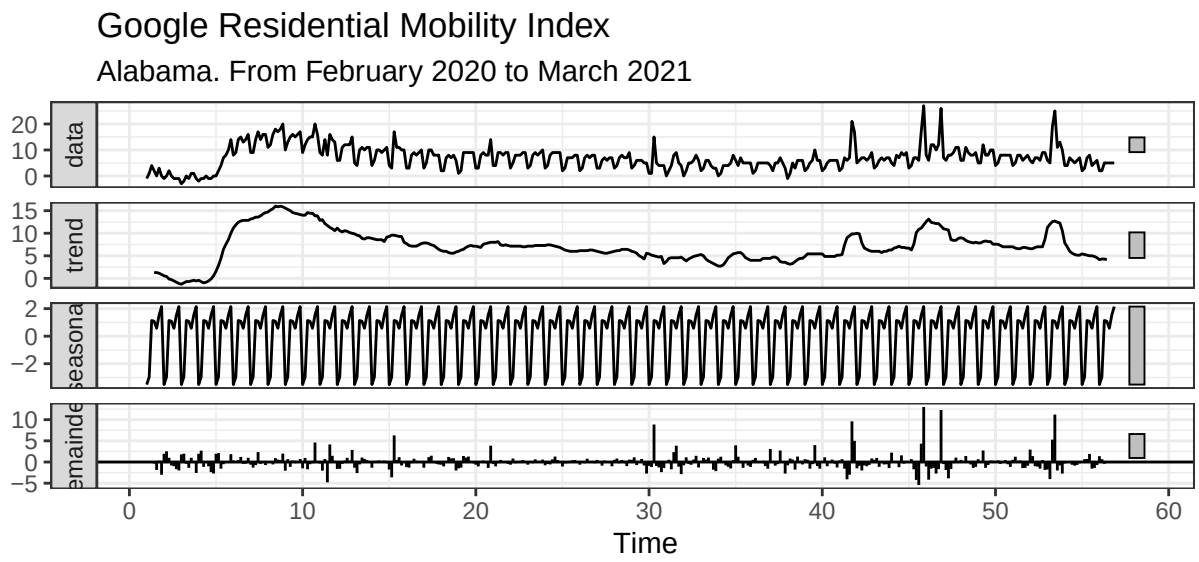

Figure 2: Decomposition of the Mobility Index time series using an additive model. Source of the data: Google Mobility reports

etc to build some indexes, including the called 'Stringency Index' which is measured from 0 to 100 on a daily basis (see Hale et al. 2020 for more information).

Similar to mobility data, this information is available at the national and state level.

2.4 Additional comments on the data

- Mobility and stringency indexes are available at the state level, and not at the sector level, so it is assumed that the value of these indexes is the same for all sectors.

2.5 Visualization of the data base

Table 2 presents a visualization of the final database that will be used

Table 2: Visualization of the data base

	date	state_name	employees	supersector_name	Mob_res_SA	stringency_index
1000	2020-03-31	Nebraska	37.2	Other Services	13.13	52.31
1001	2020-03-31	Nebraska	91.9	Leisure and Hospitality	13.13	52.31
1002	2020-03-31	Nebraska	155.8	Education and Health Services	13.13	52.31
1003	2020-03-31	Nebraska	174.6	Government	13.13	52.31
1004	2020-03-31	Nebraska	121.2	Professional and Business Services	13.13	52.31
1005	2020-03-31	Nebraska	17.1	Information	13.13	52.31

3 Proposed Model

To begin with, we want to propose the following model:

$$\Delta Employment_{state,sector,t} = \alpha + \beta_{sector}\Delta Mobility_{state,t} + \gamma_{sector}\Delta Stringency_{state,t} + \theta_{sector}(\Delta Mobility_{state,t} * \Delta Stringency_{state,t}) + \mu_{state} + \pi_t + \epsilon_{state,sector} \quad (1)$$

where,

- $\Delta Employment_{state,sector,t}$ is the monthly percentual change in the employment number per state and sector at time t.
- $\Delta Mobility_{state,t}$ is the monthly percentual change in the Residential Mobility index per state and at time t.
- $\Delta Stringency_{state,t}$ is the monthly change in the stringency index per state at time t.

4 Current Status

Currently, we are in the phase of deciding how to work on the model, looking for bibliography on the adjustment of regressions to time series using categorical variables, (in this case the state and sector variable)

References

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