Coronavirus Effects on the U.S. Unemployment: Evidence from Google Trends

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Abstract

This paper investigates the relationship between Google search queries of "coronavirus" and "unemployment" using daily data from the United States. The investigation is achieved by employing a structural vector autoregression model, where queries of "interest rate" and "inflation" are also included. Historical decomposition analysis suggests that the spike in the search interest of "unemployment" is mostly explained by that of "coronavirus" in March 2020. The results also show that one unit of a positive shock in the search interest of "coronavirus" leads to 3 units of a significant cumulative increase in that of "unemployment" after one week which increases to 6 units after one month.

JEL Classification: J63, F66, I10

Key Words: COVID-19; Coronavirus; Unemployment; Interest Rate; Inflation

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1 Introduction

The weekly unemployment claims have increased by about 70,000 in the week ending March 14th, 2020 according to the U.S. Department of Labor, reaching its highest level since September 2nd, 2017. In the corresponding news release, the U.S. Department of Labor has announced the following statement:

> "During the week ending March 14, the increase in initial claims are clearly attributable to impacts from the COVID-19 virus. A number of states specifically cited COVID-19 related layoffs, while many states reported increased layoffs in service related industries broadly and in the accommodation and food services industries specifically, as well as in the transportation and warehousing industry, whether COVID-19 was identified directly or not."

where the Coronavirus Disease 2019 (COVID-19) is shown to be responsible.

By using daily data from Google search queries, this paper investigates the relationship between COVID-19 and the U.S. unemployment. The formal analysis is achieved by employing a structural vector autoregression (SVAR) model, where daily Google search queries of "coronavirus," "unemployment," "interest rate" and "inflation" are used. The sample covers the daily period between January 1st, 2020 and March 21st, 2020.

The results suggest that a unit shock on "coronavirus" leads to about 2.56 unit of a cumulative increase in "unemployment" after one week and 6.05 units of a cumulative increase after two months. The corresponding effects on "interest rate" are much smaller, about 1.34 units after one week and 0.84 units after two months, whereas those on "inflation" are negative of about -0.84 after one week, but they become insignificant after two months. Historical

decomposition estimates further suggest that "unemployment" is significantly explained by "coronavirus" the most among other variables starting from March 20th, 2020, whereas the contribution of other variables on "unemployment" is almost none.

The results are in line with earlier studies such as by Baldwin and di Mauro (2020) who suggest that COVID-19 is economically different due to the number of cases reported in several developed countries. Different from studies such as by Yilmazkuday (2020a) or Yilmazkuday (2020b) who investigates the effects of COVID-19 on the global economy or the S&P 500 Index, this paper investigates the effects of COVID-19 on the U.S. unemployment. This paper also deviates from these earlier studies by using daily data from Google search queries for the corresponding variables, which is similar to other studies independent of COVID-19 such as by Dergiades, Milas, and Panagiotidis (2015), Altavilla and Giannone (2017), Castelnuovo and Tran (2017), Wohlfarth (2018) or Bicchal and Raja Sethu Durai (2019), among many others.

The rest of the paper is organized as follows. The next section introduces the data set and methodology used. Section 3 depicts empirical results, while Section 4 concludes.

2 Data and Estimation Methodology

The formal investigation is achieved by using the SVAR model of $z_t = (\Delta c_t, \Delta p_t, \Delta u_t, \Delta i_t)'$, where Δc_t represents changes in the Google search query of "coronavirus," Δp_t represents changes in the Google search query of "inflation," Δu_t represents changes in the Google search query of "unemployment" and Δi_t represents changes in the Google search query of "interest rate." All data have been obtained from Google Trends.[1] The raw series are represented in

[1] The corresponding web page is https://trends.google.com.

Figure 1, where the peak popularity takes a value of 100 for each variable. As is evident, "coronavirus" has steadily increased over time, whereas the spikes in "interest rate" directly matches with the reductions in the Federal Funds Rate. The spike in "unemployment" starts on March 15th, 2020 as consistent with the weekly data of the U.S. Department of Labor, whereas "inflation" is mostly stable over time, subject to weekly seasonality (as is the case for "unemployment" and "interest rate" as well). Accordingly, these raw series are converted into weekly changes for estimation purposes (both to have stationarity and to control for weekly seasonality by construction).

In formal terms, the SVAR model is given by:

$$A_o z_t = a + \sum_{k=1}^{2} A_k z_{t-k} + u_t$$

where u_t is the vector of serially and mutually uncorrelated structural innovations.[2] For estimation purposes, the model is expressed in reduced form as follows:

$$z_t = b + \sum_{k=1}^{2} B_k z_{t-k} + e_t$$

where $b = A_o^{-1}a$, $B_k = A_o^{-1}A_k$ for all k. It is postulated that the structural impact multiplier matrix A_o^{-1} has a recursive structure such that the reduced form errors e_t can be decomposed according to $e_t = A_o^{-1}u_t$, where the sizes of shocks are standardized to unity (i.e., the identification is by triangular factorization). The recursive structure imposed on A_o^{-1} requires an ordering of the variables used in the estimation for which we use the one already given by $z_t = (\Delta c_t, \Delta p_t, \Delta u_t, \Delta i_t)'$. Within this framework, "coronavirus" affects all

[2] The number of lags (of 2) has been determined by comparing log-10 marginal likelihood measures across alternative models. The model variables are confirmed to be stable and no root lies outside the unit circle.

economic variables, whereas it is not affected by them contemporaneously. Since "inflation" is mostly steady in Figure 1 (and prices are sticky in general), Δp_t is ordered first among economic variables, followed by "unemployment" that has accelerated starting from March 15th, 2020. Finally, "interest rate" is assumed to react to all variables, capturing the reaction of the Federal Funds Rate.

The estimation is achieved by a Bayesian approach with independent normal-Wishart priors. This corresponds to generating posterior draws for the structural model parameters by transforming each reduced-form posterior draw. In particular, for each draw of the covariance matrix from its posterior distribution, the corresponding posterior draw for A_o^{-1} is constructed by using by triangular factorization so that the sizes of shocks are standardized to unity. In the Bayesian framework, a total of 2,000 samples are drawn, where a burn-in sample of 1,000 draws is discarded. The remaining 1,000 draws are used to determine the historical decomposition and the structural impulse responses that are necessary for investigating the implications on the U.S. "unemployment." While the median of each distribution is considered as the Bayesian estimator, the 16th and 84th quantiles of distributions are used to construct the 68% credible intervals (which is the standard measure considered in the Bayesian literature).

3 Estimation Results

Cumulative impulse responses of all variables to a positive unit shock of "coronavirus" are summarized in Table 1, whereas they are given over time in Figure 2. As is evident, "unemployment" increases by 2.56 units after one week and 6.05 units after two months following a unit shock of "coronavirus." The effects of "coronavirus" on "interest rate" are much smaller,

about 1.34 units after one week and 0.84 units after two months. The corresponding effects on "inflation" are negative of about -0.84 after one week, but they become insignificant after two months. Overall, "unemployment" is the variable that reacts the most to "coronavirus" in the long run. Regarding the patterns over time given in Figure 2, it takes about three weeks for the effects of "coronavirus" to disappear on other variables.

Historical decomposition estimates for "unemployment" are given in Figure 3. As is evident, "unemployment" is significantly explained by "coronavirus" the most among other variables starting from March 20th, 2020, whereas the contribution of other variables is almost none.

4 Conclusion

This paper has investigated the effects of "coronavirus" on "unemployment" by using daily data from the U.S. obtained from Google search queries. The empirical results suggest that a unit shock on "coronavirus" leads to about 2.56 unit of a cumulative increase in "unemployment" after one week and 6.05 units of a cumulative increase after two months. The corresponding effects on "interest rate" are much smaller, about 1.34 units after one week and 0.84 units after two months, whereas those on "inflation" are negative of about -0.84 after one week, but they become insignificant after two months. Historical decomposition estimates further suggest that "unemployment" is significantly explained by "coronavirus" the most among other variables starting from March 20th, 2020, whereas the contribution of other variables on "unemployment" is almost none.

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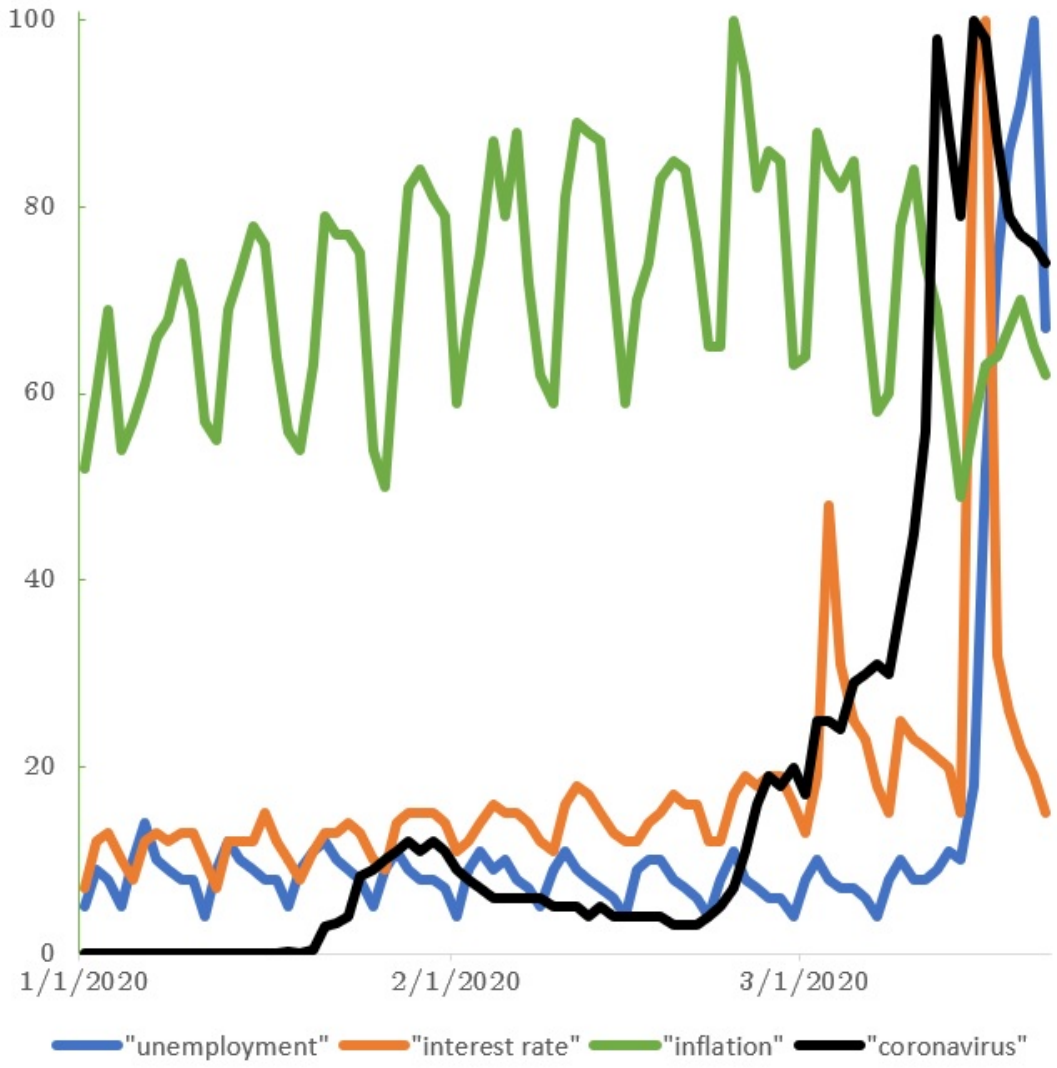
Table 1 - Cumulative Effects of "coronavirus"

	After 1 Week	After 1 Month	After 2 Months
Effects on "unemployment"	2.560	6.260	6.050
	[2.023, 3.111]	[4.509, 9.106]	[4.576, 8.451]
Effects on "interest Rate"	1.340	0.740	0.844
	[0.820, 1.918]	[−0.023, 1.614]	[0.063, 1.649]
Effects on "inflation"	−0.844	−0.164	−0.223
	[−1.245, −0.476]	[−0.786, 0.572]	[−0.805, 0.451]
Effects on "coronavirus"	4.682	2.514	2.830
	[4.034, 5.464]	[1.352, 4.094]	[1.780, 4.143]

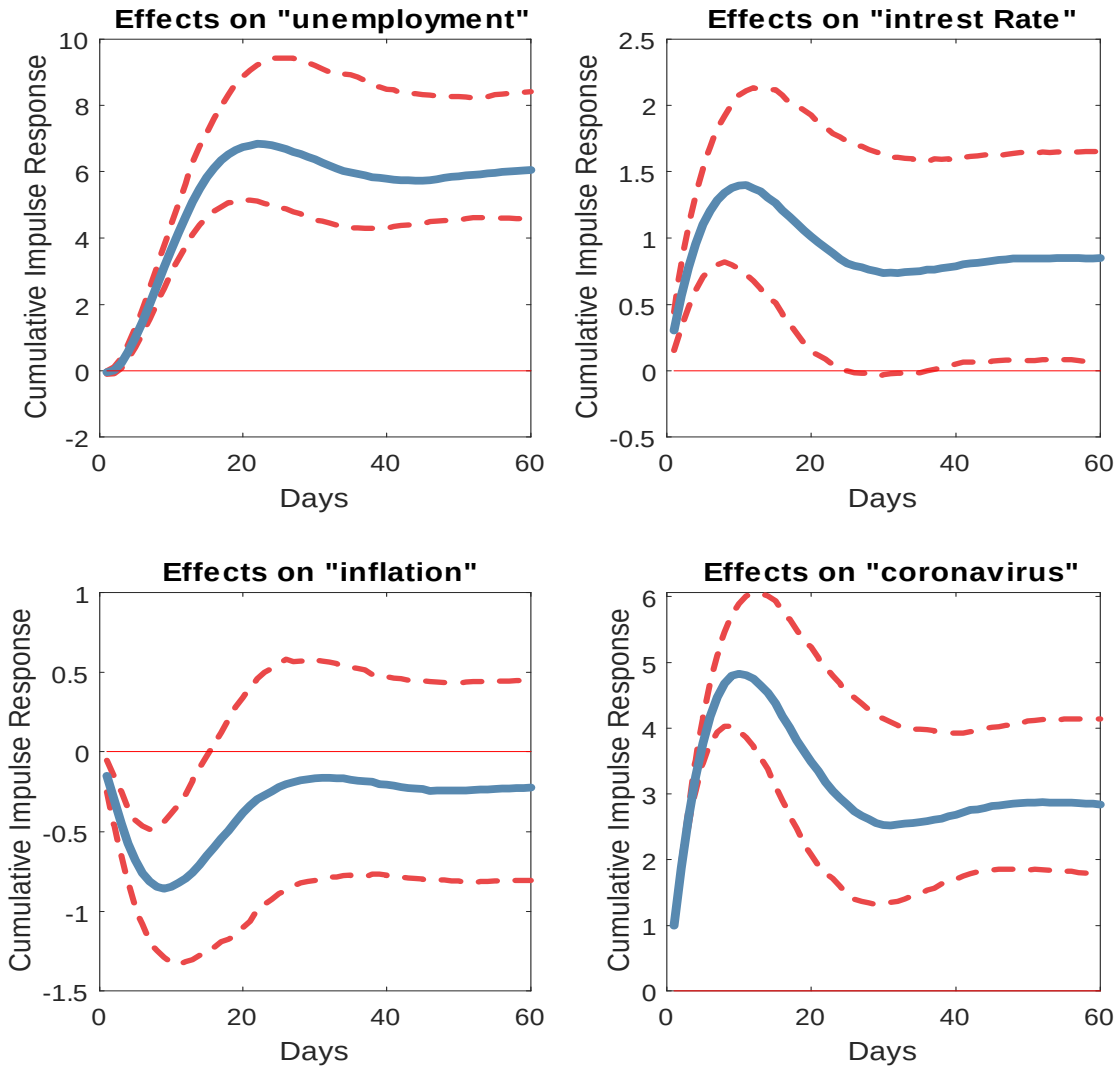
Notes: The estimates represent the median across $1,000$ draws. Lower and upper bounds in brackets represent the 68%credible intervals.

Figure 1 - Google Trends



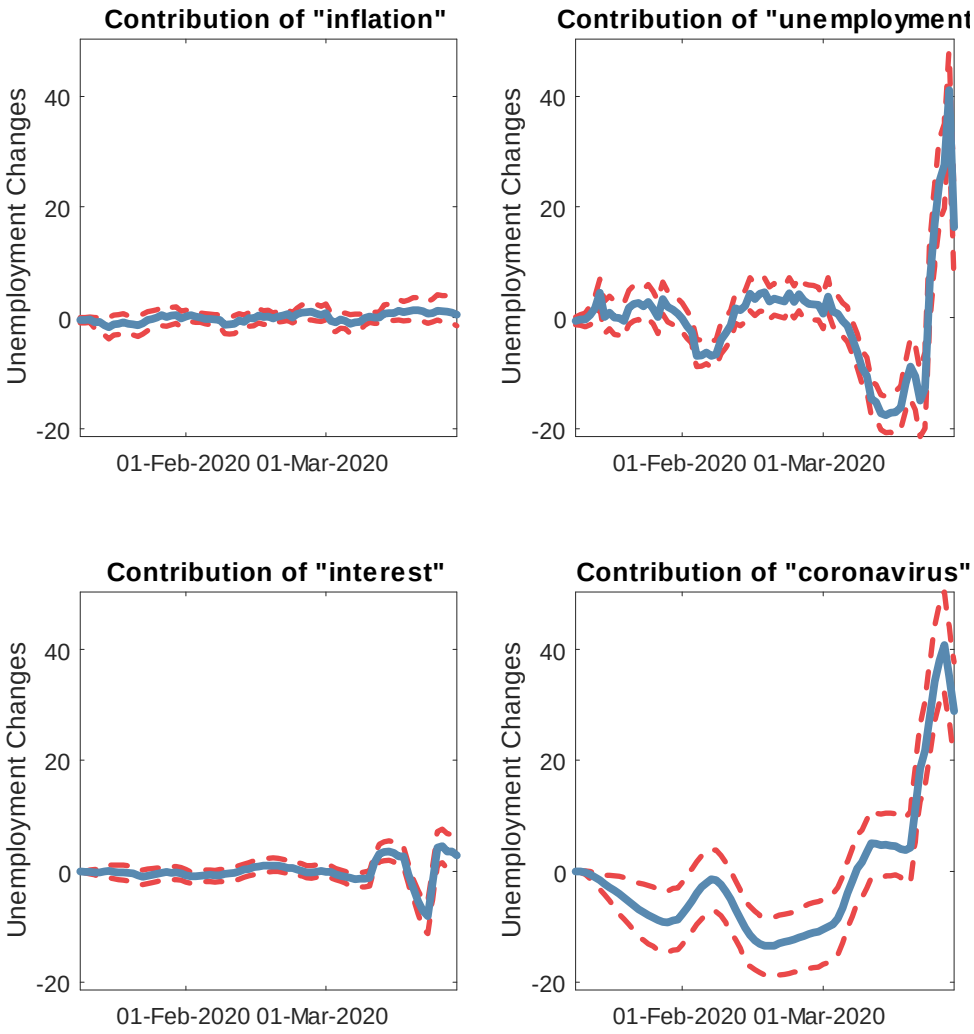
Notes: Numbers represent search interest relative to the peak popularity of 100 for the given search query in the U.S.

Figure 2 - Cumulative Effects of "Coronavirus"



Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals.

Figure 3 - Historical Decomposition of "unemployment"



Notes: The solid lines represent the estimates, while dashed lines represent lower and upper bounds that correspond to the 68% credible intervals.