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## COVID-19, Labor Demand, and Government Responses: Evidence from Job Posting Data<sup>1</sup>

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## ABSTRACT

Using high-frequency job advertisement data, this paper evaluates dynamics among COVID-19, labor market, and government policies. We found that COVID-19 has caused a significant decline in labor demand by as much as 30%, measured by the number of job advertisements. But the pandemic did not result in noticeable changes in advertised wages. Regarding the roles of government policies, the study found the "stay-at-home" measures implemented by states appear to suppress labor demand. The Paycheck Protection Program (PPP) program helps to stabilize the advertised wages, but also suppresses labor demand. Finally, the pandemic may increase labor demand for certain healthcare related occupations.

RRH: COVID-19, Labor Demand, and Government Responses

Key Words: COVID-19, Labor Demand, Government Policy, Job Advertisement

<sup>&</sup>lt;sup>1</sup> Data for this paper were collected at the end of June of 2020.

## 1. Introduction

The COVID-19 pandemic has attacked the national economy in a manner not experienced in modern times. This pandemic has impacted every community and industry in the United States. Information about the pandemic's spread, effective treatment and prevention, and government response are evolving rapidly. Consequently, any economic analysis of the pandemic should be considered preliminary. Even with this uncertainty, it is clear that this pandemic has affected the economy in significant ways.

Similarly, state and federal government actions and policies are also changing quickly, which have a profound influence on the national and regional economies. As the pandemic started to spread in the United States, in March and April of 2020, almost all states (with the exception of a few such as South and North Dakota, and Nebraska) implemented "stay-at-home" orders,<sup>2</sup> which essentially closed major components of their economies. Essential businesses such as food and agriculture, energy, and healthcare were allowed to remain open while industries such as recreation, entertainment, and restaurants were under restrictions (Mervosh et al. 2020). Since early May, many states, led by those in the south such as Georgia and Texas, started the process of reopening their economies. By late June, all states were in different phases of reopening (Mervosh et al. 2020).<sup>3</sup>

Federal actions also have profound influences on the economy. On March 27, 2020, the U.S. Congress passed—and the President signed into law—the Coronavirus Aid, Relief, and Economic Security (CARES) Act. The CARES Act temporarily expanded unemployment insurance benefits by offering an additional \$600 per week of pandemic unemployment compensation (PUC) to unemployed workers through the end of July 2020. The CARES Act also provided payments of up to \$1,200 per person to eligible Americans. In addition, this law includes the Paycheck Protection Program (PPP) that allocated \$349 billion as loans to small businesses<sup>4</sup> to help them continue to pay their employees (Werner

<sup>&</sup>lt;sup>2</sup> Some states call it "shelter-in-place" orders.

<sup>&</sup>lt;sup>3</sup> The cut-off point for data collection is the end of June. As a result, the latest surge in infections are not captured in this paper.

<sup>&</sup>lt;sup>4</sup> Small businesses are defined as those employing 500 or fewer people.

2020).<sup>5</sup> In late April, Congress passed, and the President signed another legislation that injected \$310 billion to replenish the PPP program.<sup>6</sup> The PPP loans will be forgiven as long as borrowers use them to cover payroll, mortgage interest, rent, and utilities; and if their employee and compensation levels do not decrease during the covered period of the PPP loan.<sup>7</sup> The expanded unemployment benefits and PPP policies aim to moderate the effects of the COVID-19 pandemic on the economy. In October, Congress continued to consider another relief package for American people and businesses.

The impact of COVID-19 and the effectiveness of government policies have received intense interest from economists and policy makers. To contribute to this discussion, we utilized high-frequency, real-time job advertisement (posting) data to analyze the effect of the COVID-19 pandemic on key labor market indicators, such as labor demand and wage rates, during the early phases of the pandemic, namely the business lockdown and initial economic recovery from March to June 2020.<sup>8</sup> The real-time job advertisement data are updated daily from many online job-sites, thus providing the most timely signals of the labor market. Job ads are considered a leading indicator of employment because businesses only place ads for jobs when they expect demand for their goods and services to grow. Once an ad is placed, it takes days if not weeks to fill the position.

While the U.S. labor market suffered massive job losses during the pandemic, we are interested to learn whether different government policies are effective in stabilizing the labor market, particularly the PPP program and expanded unemployment benefits. We hypothesized that due to expanded unemployment compensation (PUC) offered by the CARES Act, reservation wages for those losing jobs due to the pandemic will increase, pushing up market wages.

<sup>&</sup>lt;sup>5</sup> This program provides forgivable loans to small businesses so they may pay their employees during the pandemic. The loans will be forgiven as long as they are used to cover payroll, most mortgage interest, rent, and utilities over an eight-week period and if employee and compensation levels do not decrease. Source: https://home.treasury.gov/system/files/136/PPP--Fact-Sheet.pdf.

<sup>&</sup>lt;sup>6</sup> Source: <u>https://www.marketwatch.com/story/house-set-to-pass-bill-that-replenishes-coronavirus-aid-program-for-small-businesses-2020-04-23</u>.

<sup>&</sup>lt;sup>7</sup> The covered period is 24 weeks beginning with the PPP loan disbursement date, or 8 weeks if borrowers received its loan before June 5, 2020. Source: U.S. Treasury.

<sup>&</sup>lt;sup>8</sup> The job ads are obtained from Chmura's proprietary JobsEQ software. Due to the deadline of this paper, only the short-term effect can be analyzed.

After a brief summary of existing research on COVID-19 and the labor market, we first utilized a difference-in-difference (DID) approach to examine the effect of COVID-19 on labor demand and advertised wages. We then construct an econometric model to evaluate the effect of different government policies on labor demand and wages.

We found that COVID-19 has caused a significant decline in labor demand by as much as 30%, measured by the number of job advertisements. But the pandemic did not result in noticeable changes in advertised wages. The econometric analysis yields some interesting results. The lock-down measures (or "stay-at-home" orders) implemented by states appear to suppress labor demand. The PPP program helps to stabilize the advertised wages, but also suppress labor demand. Finally, the pandemic may increase labor demand on certain healthcare related occupations. Those results are of tremendous interests to policy makers and applied economists as they develop strategies to help Americans and businesses navigate this pandemic.

## 2. Studies on COVID-19

In the short period since COVID-19 broke out, this pandemic and its economic impacts have received a tremendous amount of attention, with the literature expanding daily. Some of those early papers were collected in the book *Economics in the Time of Covid-19* edited by Baldwin and Mauro (2020). Those papers focused on the impact of COVID-19 on trade, global supply chain, finance and banking, and travel.

The initial research on the labor market impact of COVID-19 focused on understanding the scale and magnitude of this pandemic (Dalton 2020). In a report published in April 2020, the International Labor Organization (ILO) estimated that global working hours in the second quarter of 2020 were expected to be 10.5% lower than in the last pre-pandemic quarter. This is equivalent to 305 million fulltime jobs lost in the world (ILO 2020). Among the most vulnerable in the labor market, almost 1.6 billion informal economy workers such as free-lance or gig-economy workers would be significantly impacted by government lockdown measures and consumer demand collapse (ILO 2020).

In the United States, the COVID-19 pandemic also resulted in millions of job losses. The U.S. Department of Labor reported that over 60.0 million workers filed for unemployment insurance from mid-March to the end of September (U.S. Department of Labor 2020b). Further, the Bureau of Labor Statistics (BLS) reported in March and April of 2020, the U.S. economy lost 1.4 million and 20.7 million jobs.<sup>9</sup> While the monthly employment number rebounded, adding a total of 11.3 million jobs from April to September, the number of individuals remaining unemployed was still 12.6 million in September (Bureau of Labor Statistics 2020). Those are job losses not seen since the Great Depression, and are directly caused by the COVID-19 pandemic (Dvorkin 2020). Using real-time data of job advertisements and weekly unemployment claims, Kahn, Lange, and Wiczer (2020) estimated a 30% decline in online job postings across the United States.

The long-term or permanent job losses due to the pandemic are not clear. The available research is anecdotal with conflicting results. Data from BLS and a Gallup survey suggested that roughly 80% to 85% of layoffs in the United States could be categorized as temporary. However, by the end of May, another Gallup survey found that though 80% of laid-off workers reported that it is very or somewhat likely that they will return to their job after the pandemic, only 3% have actually been recalled (Rothwell 2020). Using data from previous downturns, Barrero, Bloom, and Davis (2020) estimated that between 32% to 43% of all job losses during COVID-19 could be permanent, and one-tenth of all workdays (one-fifth for office workers) will shift from working at their place of business to their residence post-pandemic.

Outside the broader effects of the pandemic, some research investigated the effect of the pandemic on certain jobs. Focusing on essential food sector workers, Cho, Lee, and Winters (2020) found that the pandemic significantly reduced the probability of those workers staying in the industries such as food manufacturing and grocery stores. The considerable risk of infection drives many previous food sector workers to stop working altogether. This suggests a potential labor shortage for risky occupations, which will impact wages in those industries.

<sup>&</sup>lt;sup>9</sup> The BLS employment report measures national employment at a particular time in a month, while unemployment claims reports measure the cumulative claims filed.

Dalton (2020), using confidential employment data from BLS, investigated the effect of infection on employment at the county and industry level. The study confirmed that the greatest declines in employment were in counties with higher incidence of COVID-19. Not surprisingly, these effects vary by industry, with leisure/hospitality and other services industries having the largest declines in employment. Meanwhile, finance and insurance, a very telework-friendly industry, is largely unaffected by the incidence of the COVID-19 pandemic.

While there is consensus that COVID-19 has caused severe employment losses, the effects of policy seem to be mixed. So far, government "stay-at-home" or lockdown measures received the most attention. Kahn, Lange, and Wiczer (2020) found that state "stay-at-home" measures had no effect on labor demand, while Baek et al. (2020) found 25% of unemployment claims can be explained by the implementation of stay-at-home orders. Chetty et al. (2020) also discovered limited impact of lockdown measures on employment. They found that individuals began changing their behavior prior to state governments issuing shutdown orders, which lead them to conclude that individuals are responsive to information about the virus, even if the government did not immediately act. Recent papers on the Paycheck Protection Programs also showed mixed results. Using business survey results, one study indicated the PPP loans led to a 14-30 percentage point increase in small business' expected survival rates, and its effect on employment is positive but imprecise (Bartik et al. 2020). But another study did not find that PPP had a substantial effect on employment (Granja et al. 2020).

Due to the short time since the pandemic broke out, many of the papers referenced here are descriptive in nature. Our paper adds to the fast-evolving literature on COVID-19 and the labor market in several ways. First, this paper incorporates the latest job advertisement data in May and June, while many prior studies utilized only April data. As a result, our study provides insights as the labor market climbed out of the "abyss" as states reopened their economies. In addition, with the data related to the PPP program published, this study examines the effect of this policy on the labor market, as well as state lockdown measures. We also investigated the effect of expanded unemployment benefits provided by the CARES Act. Finally, our study not only evaluates the changes in the size of labor demand, but also changes in wages.

## 3. Data

During a pandemic like COVID-19, timely data are essential for economists and policy makers. However, traditional government data on employment and consumer spending are reported monthly, while gross domestic product (GDP) is released quarterly. The unprecedented speed of changes in the labor market during the COVID-19 pandemic calls for higher frequency data than are traditionally available from government sources. While weekly initial claims for unemployment insurance collected by the Department of Labor provide information to help understand labor market developments, claims provide a partial picture because they only measure job destruction, not job creation.

Economists in government agencies have the advantage of gaining access to confidential firm and individual data to conduct research (Dalton 2020), but many other economists have relied on commercially available high-frequency data to analyze the impact of COVID-19. For example, Cajner et al. (2020) utilized payroll microdata from ADP, a payroll processing firm, to construct a weekly employment index to track the labor market changes during the pandemic. Kahn, Lange, and Wiczer (2020) utilized job vacancy data from Burning Glass. Similarly, Chetty et al. (2020) used a range of commercial data, including credit and debit card transactions from Affinity Solution and job vacancy data from Burning Glass in their research of the impact of the pandemic.

We utilized a similar approach for this analysis with job advertisement data: Real-Time-Intelligence (RTI) from Chmura Economics & Analytics. RTI is a job posting database that is updated daily. It collects online job advertisements from over 15,000 sources. These job advertisements are analyzed and classified to into occupations, job titles, locations, certification and skill requirements, education levels, and wages, along with other relevant information. After classifications, job postings are compared against each other to remove any duplicate records.

While job advertisement data are direct manifestations of labor demand for new workers, the RTI job posting data are also good indicators of the overall labor market conditions in the United States. The size and trend of the RTI job posting data are closely correlated with total employment published by BLS. The correlation coefficient between monthly job postings and official U.S. non-agricultural employment series (both seasonally adjusted) is 0.75, significant at a 99% confidence level. While job postings are not

a perfect substitute for actual national employment and wages, they nevertheless are an early and timely signal of the broad labor market, especially during the COVID-19 pandemic when market conditions change rapidly.

## 4. COVID-19 Effects

Figure 1 plots weekly online job postings for the first half of 2020 (orange line), as compared with the same period for 2019 (blue line). These two series are not seasonally adjusted, showing that weekly job posting dipped for the weeks with federal holidays, specifically Martin Luther King Day, President's Day, and Memorial Day in the first half of the year. The total jobs postings in the first half of 2020 were 13.1 million, roughly 12.5% lower than 15.0 million for the first half of 2019. However, for January and February of 2020 before the pandemic, total job postings in 2020 were 7.9% higher than the same period in 2019. In March of 2020, the COVID-19 pandemic spread quickly and many states issued "stay-athome" orders. Job posting data started declining in early March, reaching the trough in the week of April 8 (Week 14 in Figure 1), when most of the country was under the lockdown and only essential businesses were allowed to open (Mervosh et al. 2020).<sup>10</sup> For the week of April 8, the total job postings were 50% lower than the pre-pandemic weekly average. The number of job postings started to grow in the second half of April through June, likely due to many states reopening their economies. Weekly job postings dipped in the last week of June, possibly reflecting the fact that infection numbers in many states rose again, and some states slowed their reopening. As a comparison, there was no decline in weekly job postings in March and April in 2019, with advertisements increasing in May and June before the summer vacation season.

#### (Figure 1 Here)

For the rest of the analysis, we took a random sample of all job advertisements, totaling 200,000 observations. This represents less than 1% of the total job posting for the first half of 2019 and 2020. We classified January and February of 2020 as pre-pandemic, and March through June of 2020 as being in

<sup>&</sup>lt;sup>10</sup> Based on data from New York Times, only the following states did not impose a "stay-at-home" order in April: Arkansas, Iowa, Nebraska, North Dakota, Oklahoma, South Dakota, and Utah.

the pandemic. Though there were occasional community spreads of COVID-19 in February 2020, it is in the March 2020 where the spread intensified and many states implemented "stay-at-home" orders. It is also in March 2020 where unemployment numbers skyrocketed. As a result, we classified March as the first month of the pandemic.

To isolate the impact COVID-19, we performed a difference-in-difference (DID) analysis for two key labor market indicators—job postings and advertised wages. Using job postings (JP) as an example, we first calculated the difference in this variable during pandemic (March through June of 2020), as compared to the same metric before the pandemic (January and February of 2020). We then compared this difference with the difference calculated for the same period last year. This difference-in-difference research design has been used by other studies on the effect of pandemic (Chetty et al. 2020).

More specifically, let t represent the months during the pandemic (March through June), and t-1 represent the months before the pandemic (January and February). As a result, the change ( $\Delta$ ) in job postings between pandemic and pre-pandemic levels for 2020 can be expressed as:

$$\Delta(JP)_{2020} = \frac{Avg(JP)_t}{Avg(JP)_{t-1}}$$
(1)

We computed the difference in job positing for the same period last year:

$$\Delta(JP)_{2019} = \frac{Avg(JP)_t}{Avg(JP)_{t-1}}$$
(2)

The differences between above two changes, defined as difference-in-difference (DID) of job postings, can be expressed as:

$$DID (JP) = \Delta (JP)_{2020} - \Delta (JP)_{2019}$$
(3)

The difference-in-difference for advertised wages were computed in the same fashion.

## Labor Demand

We first evaluated DID in job postings to understand the effect of COVID-19 on labor demand (Table 1). In our sample, the average monthly job postings were 21,210 in 2020 before the pandemic, which declined by 32% to 14,395 during the pandemic. In 2019, the monthly job postings in the first two months averaged 18,826, which remained almost unchanged, to an average of 18,819 from March to June. The difference-in-difference for job postings is estimated to be 32.1 percentage points, representing significant deterioration in labor demand. This number is consistent with the study using Burning Glass

job advertisements, where Kahn, Lange, and Wiczer (2020) estimated a 30% decline in online job postings across the United States during the pandemic.

#### (Table 1 Here)

The job posting data by major occupations confirmed the expectation that certain jobs are affected more by the pandemic than others. During the pandemic when the "stay-at-home" orders were in effect for many states, only essential businesses were allowed to open, which included grocery stores, healthcare, utility, and some manufacturing. Many non-essential retail stores, food services establishments, personal services, and entertainment businesses were either closed or under severe restrictions.

Table 1 shows that the occupations impacted the most, in the difference-in-difference method, are those in food preparation and serving occupations, with a DID value of 67.0 percentage points. While the number of job advertisements for these occupations declined by 33% in 2020, job postings for the same period in 2019 rose 33%. Occupations in arts, design, entertainment, sports media and media were also impacted significantly, with a DID measure of 60.6 percentage points.

On the positive side, occupations that are out-doors and for which it is easy to maintain social distance are less affected, compared with jobs that are in-doors and require face-to-face interactions. For example, transportation and material moving occupations experienced a relatively mild decline (DID of 10.0 percentage points) in labor demand, reflecting the trend that many consumers shifted to on-line shopping during the pandemic, increasing demand for transportation and delivery workers. Similarly, production workers were doing relatively well during the pandemic. In 2020, monthly job postings for those workers decreased by 20%. Yet last year, monthly job advertisements increased by 11% for the same period. The DID for this occupation group is -29.3 percentage points, better than most occupations. Many manufacturing businesses are classified as essential businesses, and it is relatively easy to keep social distancing.<sup>11</sup>

<sup>&</sup>lt;sup>11</sup> Please note that there was an unusually large number of job postings in education in early 2019, which caused the COVID-19 effect to be positive. We think this is a data anomaly. Similarly, there might be weather-related increases in job advertisement for construction workers; but the main driver for the DID measure is COVID-19.

Studies have found that jobs in professional services are less impacted by the pandemic, as workers can easily work remotely. While those are true in terms of overall employment level and revenues (Chetty et al. 2020), our analysis indicates labor demand for those workers deteriorated significantly during the pandemic. As Table 1 shows, DID for professional occupations, such as business and finance; and computer and mathematics are slightly higher than overall demand for all occupations.

## Advertised Wages

Comparing the changes in advertised wages reveals that the COVID-19 pandemic did not negatively impact wage levels.<sup>12</sup> As Table 2 shows, the average advertised wage for all jobs in January and February of 2020 was \$42,241, while advertised wages during the pandemic (March through June of 2020) averaged \$42,372. As a comparison, in 2019, the average wage for job postings in January and February was \$40,932, while that for April through June was \$39,951. The difference-in-difference measure of advertised wages implies a positive effect of 3.7 percentage points from the COVID-19 pandemic. Considering normal inflation, it can be concluded that the pandemic did not affect wages offered by businesses. Similar results have been reported by other studies that tracked real time labor market data. For example, Chetty et al. (2020) found that wage rates remained unchanged through the COVID-19 pandemic for those workers who retained their jobs.

#### (Table 2 Here)

Examining DID in wages for different occupations, the wages offered during the pandemic were consistently at the same level of, or higher than pre-pandemic wages for a majority of occupations. The noticeable exception is transportation and material moving occupations, for which the pandemic appears to decrease the advertised wages.<sup>13</sup> For sales and related; and healthcare practitioner and technical occupations, the pandemic appears to have a positive effect on advertised wages, possibly due to the risk premium of working in businesses with a high risk of exposure to the virus.

Economic theories indicate that with millions of job losses during the COVID-19 pandemic, increased labor supply would put downward pressure on wages. This does not appear to be true during

<sup>&</sup>lt;sup>12</sup> Please note that only a portion of job advertisements provided information of wages offered.

<sup>&</sup>lt;sup>13</sup> Please note that DID for wage in education is also negative. There were an unusually large number of job postings in in education in early 2019. We think this is a data anomaly.

this pandemic. One hypothesis can be attributed to the risk premium. COVID-19 is a highly infectious disease that can lead to hospitalization and death for certain individuals. When the safest measure of being healthy is staying at home, it may require extra effort for businesses to entice people to work, especially for those in healthcare, grocery, and other essential industries that have contact with the public. During the pandemic, many businesses in retail and delivery implemented pandemic or hazardous pay, valued at a 10% to 20% increase in wages. This practice contributed to the elevated advertised wages for those occupations during the pandemic (Corkery 2020). Our data in Table 2 showed sales and healthcare occupations had the largest positive DID wage in job ads. However, some companies are ending hazardous pay premium.<sup>14</sup> It will be interesting to track whether removing this extra pay will reduce advertised wages.

Another hypothesis related to elevated wages could be government policies, such as expanded unemployment benefits and PPP programs provided by the CARES Act. This law provided extra benefits to individuals who lost their jobs due to COVID-19. In addition to normal weekly state-average unemployment benefits, averaging \$386 in February 2020 (U.S. Department of Labor, 2020), the CARES Act provides an additional \$600 per week for four months. Without pandemic unemployment compensation (PUC), the national average unemployment benefit is equivalent to an annual wage of \$20,107. With PUC, the UE benefits translate to an equivalent annual wage of \$51,272, higher than prevailing wages for many food service, sales, and healthcare support occupations. This extra benefit may provide the incentive for unemployed individuals in low-paying jobs to forgo seeking employment temporarily, thus offsetting the downward pressure on wages exerted due to massive job losses. Since the extra PUC benefit lasts for four months, and expired at the end of July 2020, it will be interesting to see whether wages associated with job postings start to drop, especially for those low-wage occupations. Similarly, the PPP program may also help maintain wages, as some would-be laid-off workers were kept on businesses payroll.

## 5. Effect of Government Policies

<sup>&</sup>lt;sup>14</sup> Examples include Target, Walmart, CVS, Whole Foods, Costco, Sprouts, Kroger, and Starbucks where hazardous pay ended in May. Source: <u>https://www.latimes.com/business/story/2020-05-13/starbucks-gave-its-employees-a-reprieve-amid-the-pandemic-thats-ending-now</u>

#### Model

We performed an econometric analysis to examine the effect of various government policies, along with variables related to COVID-19 infections, on labor demand and wages. In these regressions, the dependent variables are state-level job postings and advertised wages, measured in difference-indifference values from 2019 to 2020, using the formula calculated in the previous section. The analysis was performed at the state level because there are significant differences in state-varying policies, such as lockdown and re-opening schedules. Since the focus is to evaluate how the COVID-19 pandemic and policy measures affect the labor market, applying DID treatment to labor demand and wages enables us to eliminate the need to control many observed and unobserved variables that are common either across states or within states. This approach has been used frequently in COVID-19 related literature (Dalton 2020; Chetty et al. 2020). In addition, using DID measures can remove any time-specific fixed impact from 2019 to 2020, especially the seasonality that may affect labor demand and wages. Figure 2 and 3 summarize the DID in job postings and advertised wages by states.

#### (Figure 2 and Figure 3 Here)

Let JP represent job postings, and W represent advertised wages. We estimated the following two linear models:

$$DID(JP) = \beta 0 + \beta 1 * IR + \beta 2 * DR + \beta 3 * Duration + \beta 4 * UE + \beta 5 * PPP + \beta 6 * Ind + \varepsilon$$
(4)  
$$DID(W) = \gamma 0 + \gamma 1 * IR + \gamma 2 * DR + \gamma 3 * Duration + r4 * UE + r5 * PPP + r6 * Ind + \eta$$
(5)

For independent variables, two COVID-19 disease-related variables were used.<sup>15</sup> The first is the infection rates per 1,000 residents (*IR*) for each state. The second is the death rate (*DR*), measured as the percentage of death in total infections for each state. It is hypothesized that the higher the infection rates, the less willing consumers are to patronize businesses, thus reducing labor demand during the pandemic. The COVID-19 death rate is also included, as it is hypothesized that this variable is a better measure, than general infection rates, of demand for healthcare resources such as healthcare workers and medical supplies. Both infection and death rates are cumulative values at the end of June 2020, retrieved from a database maintained by the New York Times (New York Times 2020).

<sup>&</sup>lt;sup>15</sup> The Appendix provides a summary of COVID-19 related independent variables.

For state policy variables, we included the duration of "stay-at-home" orders, measured as the number of days for which each state is in lockdown (*Duration*). The hypothesis is that the longer a state was under lock-down, the lower level of labor demand. In mid-to-late March, except for a few states such as South and North Dakota, most states issued "stay-at-home" or "shelter-in-place" orders. Those measures resulted in the closure of many non-essential businesses. One month later, some states, led by those in the south such as Texas and Georgia, started loosening restrictions and reopening their economies. By late June, most states were in different stages of re-opening, even in hard-hit New York and New Jersey.<sup>16</sup> The information on the starting and ending dates of "stay-at-home" orders was retrieved from a database maintained by the New York Times (Mervosh et al. 2020).<sup>17</sup>

The expanded unemployment benefit--Pandemic Unemployment Compensation (PUC)--provided by the CARES Act may create a disincentive for individuals to work. The expanded PUC, plus typical unemployment insurance benefits, are higher than prevailing wages for many low-paying but essential jobs, such as those in grocery stores, healthcare assistance, and food services. While labor economics theory indicates that the PUC will decrease labor supply, whether that will translate into demand for labor is uncertain. It is hypothesized that such a program may help maintain wages. The data utilized in this analysis (*UE*) was monthly unemployment benefits during the pandemic retrieved from the U.S. Department of Labor (U.S. Department of Labor 2020a).

The paycheck protection program may affect labor demand as well. PPP aims to help businesses pay two months of payroll, so that they don't layoff their employees. In addition, the already laid-off workers can be recalled back. While this policy, in theory, will help businesses avoid layoffs, thus lessening the degree of job destruction, its effect on new job demand is not clear. But we expect that this program may help maintain wage levels. The PPP data by state were from the U.S. Small Business Administration (U.S. Small Business Administration 2020). We calculated the per-capita PPP amount for each state by dividing the total PPP loan amount by the state population.

<sup>&</sup>lt;sup>16</sup> In the summer of 2020, inflections in U.S. rose again, and states are considering additional restrictions. Those data are not available for this version of the paper, but can be incorporated in future versions.

<sup>&</sup>lt;sup>17</sup> For states with different phases of re-opening, we used the date of initial re-opening to calculate the duration of lockdown.

We did not include the household stimulus check in the model. While some studies found this policy plays an important role in maintaining household spending and possibly saves jobs (Chetty et al. 2020), we excluded it due to a technicality. On a per-capita basis, there is very little variation among states in terms of the stimulus check amount, making it highly correlated with the intercept of the model. As a result, the model was not able to identify its effect when this variable was included.

Finally, the COVID-19 pandemic strikes different industries unevenly. To capture those effects, we included two variables (*Ind*) measuring the industry mix for each state; specifically, the percentage of workers in leisure and healthcare sectors. Due to the small number of observations in these regressions (51 observations), we were not able to include industry variables for all major industry sectors.

Several diagnostic tests were run to ensure that the model specification and estimating methods are justified. First, multicollinearity among independent variables is not a serious concern in these models. The variable inflation factor (VIF) for each independent variable was calculated. Though there is no deterministic criterion for VIF, a rule of thumb is that a VIF value greater than 5 for an independent variable indicates possible high correlation between it and other independent variables. All independent variables in our model have VIF values ranging from 1.3 to 2.3.

In a cross-sectional model, heteroskedasticity is a concern. We performed Breush-Pagan test for heteroskedasticity for both regression models. The resulting  $\chi^2$  values are 7.93 and 3.43, with P-values of 0.34 and 0.84. These tests imply that we cannot reject the hypothesis of the homogeneity of error terms at 95% significance level. The specification tests indicate that ordinary least squares (OLS) method is appropriate to estimate the two models.

#### Effects on Labor Demand

Table 3 presents the results from the OLS regressions, with dependent variables being state-level DID in job postings and advertised wages. Since we have only state-wide data, the total number of observations is 51. Possibly due to the small sample size, for both equations, only a few variables are significant at 95% or 90% confidence level. The overall explaining power of those two models, measured in R<sup>2</sup>, is 0.37 and 0.23 respectively.

(Table 3 Here)

For the labor demand model, the results regarding two COVID-19 related variables are a little surprising. The model shows that the infection rate has no effect on, but the death rate has a positive and significant association with DID in job postings. Anecdotal evidence suggests that in places with higher degrees of infections, residents are afraid to go out and patronize businesses, which should reduce labor demand. Studies such as Dvorkin (2020) and Dalton (2020) found infection levels affect job losses. It is likely that our model captures the effects of reopening in June, which could mitigate the effect of infection rates, while other studies included only April data,

The positive and significant coefficient of death rate suggests that states with relatively higher death rates experienced lower levels of labor demand deterioration during the pandemic. The possible explanation is that in areas with a large number of deaths due to COVID-19, there are more seriously ill patients. Those seriously ill patients have intensive demand for healthcare resources, including manpower, such as nurses, nurse assistants, and other healthcare professionals. For example, during the early phase of the pandemic, there were calls for volunteering healthcare and related workers to the New York area as they faced a severe shortage of labor (City of New York 2020). There was also demand for workers to construct temporary field hospitals and other facilities in areas with large numbers of seriously ill patients. In addition, individuals were needed to prepare meals or deliver food and other necessities. As a result, the death rate in each state may reflect increased demand for resources that muted the labor demand deterioration.

The model indicates that the duration of lockdown has a negative impact on labor demand during the pandemic. This variable is marginally significant, with a P-value of 0.15, but the implication is clear. States without "stay-at-home" orders or those with a shorter lockdown period are concentrated in mountain west and southern states, including North and South Dakotas, Wyoming, and Nebraska, while states with longer lockdown periods include New York, New Jersey, Illinois, and Washington (See Appendix). The model indicates the job advertisements either declined less or rebounded earlier in states with shorter lockdown durations. Our result is different from other studies. For example Chetty et al. (2020) found limited evidence on the effect of state ordered lockdowns. It is possible that their study was based on data up to April, where most states were under lockdown. The effect of such a policy cannot be identified by earlier regression models as variable values for most states would be similar. However, there

are sizable variations in terms of timing at which states exit lockdown, and those variables allow us to identify some negative effects of this policy, even though it is only marginally significant.

We also found that the per-capita PPP amount has a negative correlation with DID in job advertisements. This variable is significant at a 90% significance level. It suggests that while this policy aims to help small businesses pay and maintain their payroll, it does not lead to more job openings. In fact, PPP appears to suppress labor demand. This result is counter-intuitive at first glance, but other studies also found mixed results on this program. For example, Chetty et al. (2020) concluded that the PPP program had little material impact on employment at small businesses, which contradicts the original purpose of the program. One possible explanation is the free-rider issue inherent in the design of the program. The PPP program is open to all businesses with employment below 500, regardless of how severely they are impacted by COVID-19, and the loans can also be forgiven. It is possible that many businesses received such loans that did not intend to immediately lay off workers, but did so because they did not know how COVID would impact their revenue over the remainder of the year. If this program only helps a small number of businesses truly in need over the short run, those positive effects are overshadowed by many businesses who may not need the funds during our study period. In addition, the PPP program may delay businesses reopening in May and June, as the loan can keep businesses afloat while remaining closed, thus reducing demand for labor even as the economy starts reopening. Finally, since only small businesses are allowed to apply for PPP, and they may be harder hit by the pandemic, the negative correlation between PPP and labor demand may reflect that association.<sup>18</sup>

We also found expanded unemployment benefits have a negative impact on labor demand, even though the coefficient is only marginally significant, with a P-value of 14%. Economic theory is clear that this benefit increases individuals' reservation wages, thus dampening the supply of labor. However, its negative coefficient estimate implies this effect can be transferred to labor demand as well. Businesses in states with high unemployment benefits may anticipate such reluctance from job seekers and delay hiring during the pandemic. With this benefit set to expire by the end of July, it will be noteworthy to track whether there are increases in labor demand for jobs whose prevailing wages are lower than the expanded unemployment benefit.

<sup>&</sup>lt;sup>18</sup> The job posting data we have do not have data related to firm size.

Finally, we controlled for two industry mix variables, as studies have shown that the COVID-19 pandemic affects industries unevenly. One industry variable that is positive and significant at 90% confidence level is the percentage of state workers in healthcare. The model shows that states with higher concentration of healthcare workers experienced less labor demand deterioration. While the absolute number of job advertisements for healthcare workers fell rather sharply, compared with other industries, hospitals and other healthcare facilities still had demand for workers to handle testing and care for increased COVID-19 patients. Also, healthcare workers are more likely to be in contact with COVID-19 patients and have a higher risk of contracting the virus. When they do and need to be quarantined, there are additional needs for their replacements, thus boosting labor demand.

On the other hand, many leisure sector businesses, such as recreation, entertainment, and restaurants, were ordered to close during the pandemic when "stay-at-home" orders were in effect. As a result, it is expected that states with high concentrations of leisure workers like Hawaii or Nevada would experience a sharp drop in job postings. Our model shows that the concentration of leisure workers has a negative correlation with DID in job posting, but this coefficient estimate is not significant.

## Effects on Advertised Wage

Examining the regression results on advertised wages, the most significant impact on DID in wages is the per-capita PPP amount for each state. This variable is positive and significant at the 90% level. The implication is that with the billions of dollars of PPP distributed, this policy effectively maintains the wage level in the labor market. For individuals that could be laid off, this program prevents them from being jobless for at least two months. Even for businesses which have no plans to reduce their staff levels but received PPP loans nevertheless, they may feel less pressure to resort to a pay-cut or reduce staff hours to weather the pandemic shock. As a result, this program helps maintain wage levels.

In theory, expanded unemployment benefits (PUC) provided by the CARES Act should help maintain the wage level. The additional pandemic pay may provide incentives for unemployed individuals not to seek employment. This effectively suppresses labor supply and offsets the downward pressure on wages due to massive job losses. However, the coefficient estimate of this variable is positive as expected, but not significant.

Infection rates is the other significant variable in the wage regression. The coefficient estimate shows that this variable has a negative association with DID in wages, significant at the 90% confidence level. This seems to suggest infection rates have some negative effect on the advertised wages of the business. One possible explanation is that while overall labor demand during the pandemic was not affected by the infection rates, the composition of jobs may be different. Many essential jobs needed during the pandemic, such as grocery, delivery, or healthcare support, are low-wage workers that may bring the overall advertised wage down.

All other variables in this regression are not significant, including lock-down duration and death rates. Furthermore, the industry mix variables generally do not have any effect on DID in advertised wages. In theory, due to the heightened risks during the pandemic, it is hypothesized that industries employing more essential workers need to provide wage risk premiums to incentivize people to fill those jobs. However, our model did not detect such an impact, possibly due to the fact that essential jobs are still relatively few in total job advertisements; and thus not able to affect market wages for each state.

## 6. Conclusion

In summary, the COVID-19 pandemic caused enormous disruptions in the U.S. labor market. Job posting data shows that the pandemic resulted in a 30% decline in labor demand, as compared with the same period a year ago. But advertised wages appear to hold firm, and they did not fall dramatically during the pandemic.

The analysis also suggests that the infection rates itself do not impact labor demand; but death rates, a representation of the magnitude of severely ill patients, generated demand for resources to care for them. For government policies, the PPP programs played an important role in stabilizing market wages, but it also appears to be associated with weaker labor demand. The lockdown measures also suppressed labor demand, but the result is less significant. Similarly, the disincentive provided by the expanded unemployment benefits may also affect labor demand.

This paper adds to the fast-evolving literature on COVID-19 and its impact on the labor market, and can lead to more future research. Using high-frequency job posting data through the re-opening

period, we were able to identify the effects of some policies that were not discovered in other studies. In addition, our study not only evaluated the changes in the number of job postings, but also the changes in wage rates.

The limitation of this study is that it only addresses the short-term impact of the COVID-19 pandemic on the U.S. labor market. The situation remains fluid. Infections increased in July and there are discussions about re-imposing certain lockdown measures. There is also a possibility of a second wave of infections during the fall and winter of 2020. Meanwhile, Congress is debating additional relief measures for Americans. Finally, COVID-19 is a public health crisis and the development of a vaccine is crucial to its ending and the full economic recovery. The prospect of a vaccine varies, with optimistic scenarios showing promises for early 2021, while pessimistic scenarios put this at 2022 and beyond. Those uncertainties imply that the findings of this study may change as new data are available, and it also calls for continued research and updates using the latest labor market data.

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# Figures



Figure 1: Weekly Job Postings, First Half of 2019 and 2020





Figure 3: DID in Advertised Wages by States

## Tables

	2020			2019			Difference in Difference
Occupation	Average Jan-Feb	Average Mar-June	% Change	Average Jan-Feb	Average Mar-June	% Change	Percentage Point
Management	760	450	59%	639	672	105%	-46.0
Business and Financial Operations	1,103	694	63%	1,002	1,018	102%	-38.7
Computer and Mathematical	730	474	65%	648	645	99%	-34.5
Architecture and Engineering	271	169	62%	226	220	97%	-34.8
Life, Physical, and Social Science	307	194	63%	264	275	104%	-40.9
Community and Social Service	1,031	581	56%	747	810	108%	-52.1
Legal	135	67	49%	95	99	105%	-55.5
Educational Instruction and Library	694	316	46%	1,822	695	38%	7.4
Arts, Design, Entertainment, Sports, and Media	456	198	43%	285	297	104%	-60.6
Healthcare Practitioners and Technical	1,111	680	61%	498	557	112%	-50.6
Healthcare Support	833	590	71%	418	504	121%	-49.7
Protective Service	473	293	62%	427	419	98%	-36.0
Food Preparation and Serving Related	1,337	889	67%	926	1,236	133%	-67.0
Building and Grounds Cleaning and Maintenance	1,003	800	80%	853	1,097	129%	-49.0
Personal Care and Service	521	247	47%	959	708	74%	-26.3
Sales and Related	1,744	1,234	71%	1,585	1,663	105%	-34.2
Office and Administrative Support	3,433	2,202	64%	3,023	3,079	102%	-37.7
Farming, Fishing, and Forestry	42	32	76%	54	65	120%	-43.6
Construction and Extraction	628	518	82%	486	620	127%	-45.1
Installation, Maintenance, and Repair	1,227	831	68%	842	1,013	120%	-52.5
Production	1,123	922	82%	951	1,060	111%	-29.3
Transportation and Material Moving	2,247	2,016	90%	2,073	2,068	100%	-10.0
Total	21,210	14,395	68%	18,826	18,819	100%	-32.1
Source: JobsEQ RTI							

## Table 1: Impact of COVID-19 on Job Advertisement (Sample)

	2020		2019			Difference in Difference	
Occupation	Average Jan-Feb	Average Mar-June	% Change	Average Jan-Feb	Average Mar-June	% Change	Percentage Point
Management	58,718	60,536	103%	62,407	59,941	96%	7.0
Business and Financial Operations	57,904	58,645	101%	56,046	55,371	99%	2.5
Computer and Mathematical	72,861	77,159	106%	77,699	72,407	93%	12.7
Architecture and Engineering	60,137	63,545	106%	59,944	62,660	105%	1.1
Life, Physical, and Social Science	49,774	54,178	109%	46,397	49,137	106%	2.9
Community and Social Service	38,928	41,157	106%	38,128	37,706	99%	6.8
Legal	52,509	54,161	103%	62,846	53,089	84%	18.7
Educational Instruction and Library	38,525	37,441	97%	32,338	36,542	113%	-15.8
Arts, Design, Entertainment, Sports, and Media	39,437	35,653	90%	41,634	39,260	94%	-3.9
Healthcare Practitioners and Technical	59,425	63,531	107%	67,100	56,870	85%	22.2
Healthcare Support	31,420	30,233	96%	32,496	28,324	87%	9.1
Protective Service	37,651	37,650	100%	35,455	37,064	105%	-4.5
Food Preparation and Serving Related	25,453	25,518	100%	25,714	25,303	98%	1.9
Building and Grounds Cleaning and Maintenance	27,929	28,998	104%	31,139	27,650	89%	15.0
Personal Care and Service	32,233	33,236	103%	28,167	29,010	103%	0.1
Sales and Related	50,684	53,742	106%	51,801	46,303	89%	16.6
Office and Administrative Support	34,434	35,545	103%	35,456	34,236	97%	6.7
Farming, Fishing, and Forestry	29,589	30,098	102%	27,094	30,667	113%	-11.5
Construction and Extraction	43,509	44,357	102%	41,065	39,814	97%	5.0
Installation, Maintenance, and Repair	43,113	44,214	103%	43,580	40,900	94%	8.7
Production	32,591	32,227	99%	32,312	31,529	98%	1.3
Transportation and Material Moving	43,243	38,045	88%	36,351	35,420	97%	-9.5
Total	42,241	42,372	100%	40,932	39,551	97%	3.7
Source: JobsEQ RTI							

## Table 2: Impact of COVID-19 on Advertised Wages (Sample)

Table 3	: Regression	Results
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	DID in Job Pos	tings	DID in Advertised Wages		
	Coefficient Estimate	P-Value	Coefficient Estimate	P-Value	
Intercept	-0.0210	0.951	-0.3411	0.215	
Infection Rates (IR)	0.0014	0.820	-0.0086	0.088	
Death Rate (DR)	3.1326	0.048	-0.8678	0.488	
Lockdown Duration	-0.0018	0.146	-0.0005	0.670	
PPP Amt per capita (PPP)	-0.0001	0.101	0.0001	0.054	
Unemployment Benefit (UE)	-0.0005	0.142	0.0002	0.410	
Leisure (Ind1)	-0.2632	0.788	-0.3019	0.702	
Health (Ind2)	2.3902	0.071	0.7643	0.466	
Number of Observations	51		51		
R-Square	0.3698		0.2300		
BP Test (Chi-Square)	7.9359		3.4172		



#### Infection per 1000 Residents by End of June

Death Rates by End of June



Lockdown Duration



Weekly UE Benefits



Industry Mix-Health





**PPP Per Capita** 



Industry Mix-Leisure

