Impact of COVID-19 pandemic control on the employment market of service industry

—Empirical analysis based on COVID-19 US state policy and OEWS data

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Abstract: The outbreak of COVID-19 has brought drastic pressure on economic development around the globe. With the introduction of pandemic control policies, its impact on economic development and labor force has also received worldwide attention and extensive discussion in academic circles. Using COVID-19 US state policy data and OEWS data, this paper constructs a fixed effect model to empirically investigate the effects of state COVID-19 control policies on the job market of service industry. Results show that: government's pandemic control policies have an elevating effect on wages in service industries; it has a divergent impact on employment in different types of service industries, with negative impact on employment in traditional service industries, boosting employment in digital services and healthcare industries, and a non-significant impact on employment in education. The robust test by replacing dependent variables proves that the research conclusion is robust. Therefore, the government should firstly, adopt diverse control policies for different industries, providing policy support to enterprises and workers adversely affected by the pandemic while achieving efficient prevention and control of COVID-19; secondly, the government should accelerate the digitization of producer services, promote digital economy to serve real economy, relieve the adverse impact of pandemic control on the service industry, and solve employment issues.

1. Introduction

Employment is the foundation of people's livelihood and an important factor affecting economic development and social stability. The year 2020 has witnessed fundamental changes to people's work and social lives as the virus spread across the globe. Millions of workers suddenly found themselves unemployed or furloughed as labor intensive businesses struggled to meet costs (Lewis and Hsu, 2020). Most of the affected countries introduced several policies such as "city lockdown" and "social isolation" to control the spread of the pandemic, while due to the contact-heavy nature of the service industry (Benzell et al., 2020), these policies will inevitably have an impact on its development, which in turn will affect the employment of the service industry workforce. For example, the US state governments have issued pandemic control policies in order to control COVID-19. While there is evidence that the state mitigation policies to combat COVID-19 have reduced the spread of the virus (Courtemanche et al., 2020), it has come at a cost. Because of the severe political difference, extreme and one-size-fits-all state policies in the form of stay-at-home orders (SAHOs) and non-essential business closure policies have been adopted, which has had profound effects on economic activity (Makridis et al., 2020). In February 2020, the US job market has 9.5 million fewer jobs than it did, and compared to where it would be absent COVID, the economy is 11.9 million jobs below its pre-pandemic trend. It is of great theoretical and practical significance to study the impact and characteristics of the government's pandemic control policies on the service industry job market using COVID-19 US State Policy Data and OEWS data from the US Bureau of Labor Statistics,which will help promote the restorative growth of the service industry.

This paper is organized as follows: Part II discusses the progress of relevant domestic and foreign research, thus presenting the research perspective of this paper and pointing out the innovation of this paper; Part III analyzes the theoretical mechanism of pandemic control policies affecting employment in the service industry and proposes hypotheses; Part IV introduces the data used in this paper and

Part V introduces the key variables and models in this paper; In Part VI the baseline regression results are analyzed and robust tests are conducted; Part VII concludes the whole paper and provides relevant policy recommendations.

2. Literature Review

The global spread of COVID-19 has had a significant impact on the service sector labor market. The existing literature has studied the impact of governments' pandemic control policies on employment mainly from the perspectives of the overall job market, corporate employment and the job market of different worker groups.

Regarding the research of the impact of governments' COVID-19 control policies on overall job market, based on statistical comparisons, Shen et al. (2021) used the DID model and found that the adverse impact of COVID-19 restriction policies on employment in 31 major cities in China was relatively smaller than that of towns. Zhang et al. (2020) analyzed the impact of COVID-19 on employment based on a study of the pandemic's impact on supply and demand, as well as market wage rates and employment probabilities from three aspects: industrial development, enterprises, and employment groups. In addition to the supply and demand side, the pandemic also affects the job market from the distributional side. Cortes et al. （2020）used CPS data on stocks and flows to study the distributional consequences of the COVID-19 pandemic's impacts on employment. They found that the pandemic has exacerbated pre-existing inequalities。Bartik et al. （2020） measured the collapse and partial recovery of the U.S. labor market, contrasted this downturn to previous recessions, and provided preliminary evidence on the effects of the policy response.Bernstein et al.（2020）considered the labor market as a whole，examined the response of the U.S. labor market to a large and persistent job separation rate shock caused by COVID-19 control policies.

There are more studies on the impact of governments' COVID-19 restriction policies on enterprise employment, and it can be found that the most vulnerable one to the pandemic and policy is often the employment market of Small and medium-sized enterprises(SMEs). Huang et al. (2020) proposed that under the control of COVID-19 pandemic, SMEs were severely affected in procurement, production and sales due to employee shutdown, business activities in SMEs were halted for a long time, income has sharply reduced, rigid expenditure burden has increased, as a result, the capital gap of enterprises expanded. However, the impact on SMEs differs on account of the type of enterprises. Zhang (2020) used 116 owners and actual persons in charge of SMEs as research subjects, and selected 11 questions such as damage assessment, maintenance time, their own countermeasures and policy demands as research contents. The study found that SMEs have been severely and widely affected by COVID-19. Some enterprises are facing loss of raw materials and upstream supply; some are unable to realize sales of their products, and their business income is drastically reduced. Kalemli-Ozcan et al. (2020) evaluated the impact of the spread of COVID-19 pandemic on the operations of SMEs in 17 countries and found that in the absence of government support, the failure rate of SMEs to cope with the COVID-19 would increase by nearly 9%. Zhang et al. (2020) argued that SMEs should efficiently use the supportive policies in their development process in the original macro environment and urgently need government intervention-based financial supply support under the dual pressure of the pandemic shock. Zhu et al. (2020) found that the "labor shortage" caused by COVID-19 restriction exposed SMEs to a high risk of financial vulnerability. Although the government has intensively introduced a combination of policies to bail out SMEs, there is still a large deviation between the short-term effects of the policies and the demands of enterprises. Regarding the response of enterprises to the pandemic, based on survey research, Dai et al. (2020) found that enterprises with stronger informal networks and proximity to suppliers and customers were more resilient to the shock of COVID-19.

The impact of governments' COVID-19 control on employment varies between different labor groups. Gao (2020) proposed an output-loss discounting method to measure the impact of COVID-19 pandemic on employment in China and compared the extent of the impact by classifying employment groups according to industries. Different from the above classification methods，

Albanesi et al.（2021）documented the gendered impact of the pandemic restriction by examining real time data on employment, unemployment, labor force participation and gross job flows. Borjas et al.（2020）used data from the CPS Basic Monthly Files and found that the employment decline caused by COVID-19 restriction was particularly severe for immigrants. Hershbein et al.（2021）found low-wage and minority workers were hardest hit by COVID-19 initially, which shed light on the impacts of the COVID-19 pandemic on the labor market. Shinnosuke et al.(2021) classified service sector workers in a number of ways，they documented heterogeneous changes in employment and earnings in response to the COVID-19 shocks, observed in various data sources during the initial months after the onset of the pandemic in Japan, and found that contingent workers are hit harder than regular workers, younger workers than older workers, females than males, and workers engaged in social and non-flexible jobs than those in ordinary and flexible jobs.

In summary, existing studies have analyzed the impact of government pandemic control from the perspectives of overall job market, corporate employment, and comparing the job markets of different worker groups, but have not paid enough attention to the impact of pandemic control on employment in various service industries, which is where this paper will focus on. Therefore, from the policy perspective, this paper takes 2 aspects of government pandemic control policies into consideration, including duration of stay-at-home orders(SAHOs) and non-essential business closure policies, using COVID-19 US state policy data and OEWS data to demonstrate the impact of government's pandemic control policies on employment in specific industries in the service sector, complementing existing studies.

The main contributions of this paper are twofold: Firstly, in terms of research perspective, this paper fills the gap of existing studies by measuring the impacts of pandemic control policies on wages and employment in specific service industries in three dimensions: whether stay-at-home orders were implemented or not, the duration of stay-at-home orders and the duration of non-essential business closure policy. Secondly, in terms of policy implications, this paper finds that the pandemic control policies have a shock on the employment numbers of traditional service industries, but boosting the employment in digital service industries and healthcare industries instead, and these policies have no significant impact on education industry, which provides a reference for the government to implement differentiated control policies for different sectors of the service industry.

3. Theoretical mechanism and research hypothesis

The U.S. state government's pandemic control policies include stay-at-home orders (SAHOs) and non-essential business closure policies, both of which affect service industry employment mainly through labor supply side and the consumer demand side.

Firstly, from the labor supply side, traditional service industries are typically labor-intensive industries that require labor mobility or keeping brick and mortar stores open to complete services, but because of the strict quarantine or control measures around the world (Xia, 2020), which leads to most stores shutting down and laborers not being able to work out, the supply of jobs in such service industries decreases accordingly. Also, most workers are unwilling to work in such risky occupations due to the fear associated with contracting the disease, as well as the fear connected to contributing to the diffusion of the disease(Bloom and Cadarette, 2019), so traditional service industries need higher wages to attract workers. The digital service industry has made it possible for consumption and production that would have been possible only through movement of natural persons or off-site consumption to be realized through "contactless services" via the Internet (Xia, 2020), which is in line with the "home quarantine" pandemic control measure. And this ensures the continuity of employment while greatly reduces the cost of service industry. Under the government's pandemic control, the "work-from-home(WFH)" nature of digital service industries provides convenience for workers, making more and more employees willing to work in these industries, which means that the pandemic control policy makes digital service industries more prosperous and has a positive impact on their employment and average wages. For service industries that improve the quality of science and culture(healthcare and education industries), the COVID-19 control policies will undoubtedly

promote the growth of average wages in public health services; while since the development of online education is less mature than offline education, and there are relatively less employees, the negative impact of pandemic control on offline education employment is greater than its positive effect of online education employment, which means the pandemic control policies will have a negative impact on the number of employees in the education industry overall.

Secondly, from the consumer demand side, traditional service industries' production and consumption must happen simultaneously, and most of them(such as catering and sales) require both geospatial clustering and leisure time of the customers. However, due to the mandatory control of personnel and the crowd gathering contagiousness of coronavirus, most consumers will reduce their consumption of such services (Xia, 2020), leading to a shrinking of domestic consumption market. Therefore, traditional service industries were forced to respond to the situation by reducing costs, including layoffs and closing businesses or parts of companies(Liu, 2020), which led to a reduction of jobs. For the digital service industry, pandemic control brings development opportunities for cyberspace service activities and contributes to the scale expansion of cyberspace service industries; taking China as an example, the demand for e-commerce, online meetings, and live webcasts increased significantly during the government's restriction of COVID-19, and the information service industry based on Internet technology grew by 13.2% year-on-year. The increase in demand for digital services driven by COVID-19 control will inevitably cause an increase in the number of its jobs, and its rapid development will also lead to a rise in average wage of this industry. The pandemic control policies lead to a significant increase in the demand for public health services and a rise in the number of jobs, while the average wage in this industry also increased accordingly due to the highly dangerous nature of this occupation; because of the closure of schools and training institutions as a result of COVID-19, the demand for online education increased and a corresponding decrease in demand for offline education occurred, so the total demand for education industry basically maintained at a stable level as a consequence of the offset between online and offline (Mo et al., 2020). And that means the impact of pandemic control policies on employment and average wage of education industry is relatively smaller. In summary, this paper proposes the following three research hypotheses:

H1:The state-level government pandemic control policies will have a positive impact on the average wage in all sectors of the service industry.

H2:The state-level government pandemic control policies cast differential impacts on the labor market across industries on the service sector.

H3:Government pandemic control policies have a negative impact on employment in traditional service industries and education industries, and a positive impact on employment in digital service and medical industries.

4. Data

4.1. Policy Data

Dates on non-essential business closure, business reopening, stay-at-home/shelter-inplace policies and end/relax of stay-at-home orders (SAHOs) were collected for 50 states and Washington, D.C. from COVID-19 US State Policy Database（Huang et al.,2020）. All the states and Washington, D.C. have designated specific dates for non-essential business closure and business reopening; and eight states (Arkansas, Iowa, Nebraska, New Mexico, North Dakota, South Dakota, Utah and Wyoming) did not have the stay-at-home/shelter-in-place policy. This study uses the number of days between the enactment and repeal of the above two government pandemic control policies as a proxy variable for the stringency of the government pandemic control policies.

4.2. Job market data

This study is based on data from the Bureau of Labor Statistics' Occupational Employment Statistics (OES) Survey. The Occupational Employment and Wage Statistics (OEWS) program produces employment and wage estimates for nearly 800 occupations. These estimates are available

for the nation as a whole, for individual states, and for metropolitan and nonmetropolitan areas; national occupational estimates for specific industries are also available. This paper selects state-level data, including occupations by 6-digit Standard Occupational Classification (SOC) code for the U.S. 50 states and Washington, D.C., from May 2012 to May 2020. The main variables are SOC code, estimated total employment rounded to the nearest 10 (excludes self-employed), the number of jobs (employment) in the given occupation per 1,000 jobs in the given area, mean hourly wage and mean annual wage. Referring to a new method of Chen (2008) for classifying service industries, and according to the classification of tertiary industries in China's current "National Economic Classification of Industries (GB/T 4754-2017)", the occupations belonging to service industries in the OEWS data were screened out, and they were classified into three categories: traditional service industries, digital service industries, and service industries for improving scientific and cultural quality, and some typical occupations among these industries were studied.

5. Variable Selection and Model

5.1. Variable Selection

Existing studies mostly use wage levels and employees' number to measure the conditions of job market in a given industry (Zhao, 2019); therefore, the explanatory variables selected for this paper are mean hourly wage in the studied industries and the total number of employees in that industry.

Official announcements from state governments regarding COVID-19 intervention policies and the implementation dates were identified by checking states' websites. (Arthur Huang, 2020). Most states and Washington, D.C. in the United States have policies on stay-at-home orders and closure of non-essential business, so the duration of these two policies and whether stay-at-home policies were implemented were selected as proxy variables for governmental pandemic control.

In terms of control variables, this paper controls other variables affecting employment and wage level, including state GDP per capita and higher education enrollment. To eliminate the effects of heteroskedasticity, this paper also logarithmically deals with the variables such as mean hourly wage and the duration of pandemic control policies, and calculates industry employment rates using total employment by industry and population.

This paper conducts robust test by replacing the explanatory variables, using mean annual wage and the number of jobs in the given occupation per 1,000 jobs in the given area as the new explanatory variables. By analyzing the effects of policies on these variables, the robustness of the results is tested. Table 1 is variable definitions and summary statistics.

5.2. Model construction

To assess the impact of COVID-19 control policies on the job market of the service industries, the following fixed effect regression models were constructed for state-level longitudinal data in seven typical industries after hausman tests and vif tests. Each industry is tested separately. The employment rate and mean hourly wage of each industry were used as explanatory variables, respectively. The duration of at home orders and close of non-essential businesses, and whether stay-at-home policies were implemented were selected as explanatory variables. The structure of the fixed effect regression models is represented as:

$$\ln H_{ijk} = \beta_{0j} + \beta_{1j}X_{aik} + \beta_{2j}\ln pop_{ik} + \beta_{3j}pergdp_{ik} + \beta_{4j}edu_{ik} + \varepsilon_{ik} \tag{1}$$

$$totemprate_{ijk} = \beta_{0j} + \beta_{1j}X_{aik} + \beta_{2j}\ln pop_{ik} + \beta_{3j}pergdp_{ik} + \beta_{4j}edu_{ik} + \varepsilon_{ik} \tag{2}$$

where H_{ijk} represents the mean hourly wage of State i,,year k, industry j; $totemprate_{ijk}$ represents the employment rate of State i,,year k, industry j; X_{aik} is the government COVID-19 control policy variable, if a=1, it represents the variable whether state i has conducted pandemic control policies in year k; if a=2, it represents the logarithm of the duration of stay-at-home orders in year k; if a=3, it represents the logarithm of the duration of non-essential business closure policy in state i, year k; pop_{ik} represents state i's population in year k; $pergdp_{ik}$ represents state i's GDP per capita in year

k; edu_{ik} represents state i's school enrollment rate; ε_{ik} is the residual term; β_{0j}, β_{1j}, β_{2j}, β_{3j} and β_{4j} are parameters (state level average) to be estimated. Larger variables are treated as natural logarithms to prevent estimation bias due to large order of magnitude.

6. Empirical Approach

Based on the construction of the above model, this section will analyze the impact of government pandemic control policies on labor force employment in specific industries in the service sector and test the robustness of the findings.

6.1. Impact of pandemic control policies on employment in selected service industries

Table 2 shows the regression results of the impact of stay-at-home orders on employment in seven industries. Table 3 shows the effect of the duration of stay-at-home orders on employment in the seven industries. Table 4 shows the effect of the duration of non-essential business closure policies on employment in the seven industries. From the fixed effect regression results, it can be seen that basically all regressions have F-values above 20 and most of the p-values are 0, indicating the rationality of the model. From Tables 1-3, it can be seen that the government's COVID-19 control policies have differentiated shocks on the service industry.

For the traditional service industry (Food Preparation and Serving Related Occupations, Personal Care and Service Occupations, Sales and Related Occupations and Installation, Maintenance, and Repair Occupations), COVID-19 control policies have affected both the demand and supply sides of traditional service industry. The implementation of stay-at-home orders has a non-significant negative impact on the mean hourly wage of Installation, Maintenance, and Repair Occupations, and a non-significant positive impact on other traditional service occupations. The duration of stay-at-home orders is negatively related to the number of jobs in the traditional service industry, with a negative effect on the number of jobs in Food Preparation and Serving Related Occupations at a 5% significance level and a negative effect on the number of jobs in Installation, Maintenance, and Repair Occupations at an 1% significance level. This is because employees and consumers of traditional service industry are unable to go out due to stay-at-home orders, thus decreasing the number of employment; and many SMEs are in survival crisis or even closed down, which also leads to the reduction of job supply. In terms of wages, the duration of stay-at-home orders has a positive effect on mean hourly wage of all traditional service industries at a 5% significance level. The duration of non-essential business closure policies is negatively related to the number of jobs in traditional service industries, and has a negative effect on the number of jobs in Food Preparation and Serving Related Occupations at an 1% significance level, while the impact of this policy on the number of jobs in other traditional service industries is not significant. The possible reason is that Personal Care and Service Occupations, Sales and Related Occupations and Installation, Maintenance, and Repair Occupations are mostly door-to-door service, therefore, they are less affected by COVID-19 control policies. The duration of this policy has a significant positive effect on mean hourly wage of each occupation in traditional service industry. Overall, the positive effect of government pandemic control policies on wages in traditional service industries may be related to employee psychology. The stricter the government policies are, the workers think they are more likely to be infected with COVID-19, and therefore, higher wages are needed to attract workers.

Government's pandemic control policies have limited shocks on the employment of digital services industry (Business and Financial Operations Occupations), which have even created new opportunities for its growth. All three dimensions of the pandemic control policies have a positive impact on mean hourly wage of Business and Financial Operations Occupations at a 5% significance level. Except for duration of stay-at-home orders, which has a non-significant impact on the number of employees, the other two dimensions of the pandemic control policies all have positive effects on the number of employees of Business and Financial Operations Occupations at a 10% significance level. This positive effect is due to the work-from-home(WFH) nature of these industries. Government pandemic control policies have a significant positive impact on mean hourly wages and

employee numbers in Healthcare Practitioners and Technical Occupations. That's because the demand for medical services during the pandemic increased significantly, resulting in higher employee numbers and wages. These policies' impact on education is not significant, only non-essential business closure policies positively influenced the mean hourly wage in education industry with a coefficient of 0.179 at an 1% significance level. The reason is that the popularity of the Internet has made distance learning more convenient, as a result, educational institutions and schools do not close when people are isolated at home, but continue to provide services through the Internet.

6.2. Robust test

The previous section examines the impact of pandemic control policies on job market in specific service industries. But the results of this paper may be biased in estimation due to measurement error, omitted variables, etc. So robust test is conducted by replacing dependent variables.

To test the robustness of the pandemic control policies' effect on wages, the mean annual wage is used to replace mean hourly wage, and it can be seen from the regression results displayed in Table 5-7 that the effects of pandemic control policies on mean annual wages in service industries are significantly positive at a 10% and above significance level, thus further confirming the robustness of the findings. The number of jobs in a given occupation per 1000 jobs in a given region are a reflection of the total number of employed people, so the variable "jobs per 1000" is used to replace the employment rate, and it can be seen from the regression results displayed in Table 4-6 that the impact of COVID-19 control policies on "jobs per 1000" in some industries are significant at a 10% and above significance level, so it can prove that the effect of pandemic control on the number of employed people is still significant.

7. Main Results and Policy Recommendations

Using OEWS data from 2012-2020, this paper examines the effects of stay-at-home orders (SAHOs) and non-essential business closure policies implemented by the U.S. state and Washington, D.C. governments on employment in various sectors of the service industry through fixed effect regression models. Results show that: (1) For traditional service industries, COVID-19 control policies lead to a reduction in job supply. The duration of stay-at-home orders has a significant positive effect on mean hourly wage for all occupations in traditional service industries and is negatively related to the number of jobs in this industries. The duration of non-essential business closure policies has a significant positive effect on mean hourly wage of all traditional service industries and is negatively correlated with the number of jobs in traditional service industries, which has a negative effect on the number of jobs in Food Preparation and Serving Related Occupations at a 1% significance level, but the impact is not significant on other traditional service occupations. (2) The governments' pandemic control policies have positive effect on digital service industry. All three dimensions of the pandemic control policies have positively affected the mean hourly wage of Business and Financial Operations Occupations at a 5% significance level. Except for the duration of stay-at-home orders, which has no significant impact on the number of employees, the other two dimensions of pandemic control policies all have a significant positive impact on employee numbers in Business and Financial Operations Occupations. (3) COVID-19 control policies have a significant positive effect on mean hourly wage and employment in Healthcare Practitioners and Technical Occupations, while its effect on Educational Instruction and Library Occupations is not significant, and only non-essential business closure policies have a positive effect on mean hourly wage in education industry at an 1% significance level. (4) Finally, the results are tested in terms of both mean annual wage and the number of jobs (employment) in the given occupation per 1,000 jobs in the given area, confirming the robustness of the results in this paper.

Based on the above conclusions, this paper puts forward the following policy recommendations: Firstly, in the face of COVID-19, for all service industries, wages should be appropriately raised to stabilize employment, which will in turn increase residents' income, improve consumption capacity, cultivate consumption sentiment, and eventually forms a virtuous cycle of consumption and employment; Secondly, government pandemic control policies have less adverse impact than

promotion on digital service industries, therefore, conditions should be created to realize the flexible office mechanism of remote&on-site interaction and collaboration, accelerating the digital transformation of productive service industries, promoting the digital economy to serve the real economy, enhancing the intelligence level of service industries, and implementing scientific data management policies; Thirdly, traditional service industries are most affected by pandemic control policies, while the impact is insignificant in education industry, and pandemic control has a positive effect on part of occupations in the service industry. Therefore, the government should adopt differentiated control policies for different types of service industries to eliminate the negative impact of pandemic control on labor force employment and maximize the effectiveness of pandemic control.

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