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By

Taiyo Fukai (The University of Tokyo)
Masato Ikeda (The University of Tokyo)
Daiji Kawaguchi (The University of Tokyo)
Shintaro Yamaguchi (The University of Tokyo)

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COVID-19 and the Employment Gender Gap

Taiyo Fukai, Masato Ikeda, Daiji Kawaguchi,
and Shintaro Yamaguchi*

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Abstract

This paper examines how the COVID-19 pandemic affected female employment in Japan. Our estimates indicate that the employment rate of married women with children decreased by 4 percentage points, while that of those without children decreased by only 1 percentage point, implying that increased childcare responsibilities caused a sharp decline in mothers' employment. Further, mothers who left or lost their jobs appear to have dropped out of the labor force even several months after school reopening. In contrast to women, the employment rate of married men with children was not affected, which hindered progress in narrowing the employment gender gap.

Keywords: Labor Force Participation, Employment, Gender Gap, COVID-19, Childcare

JEL Codes: D13, J13, J16, J21

*Taiyo Fukai is a Researcher at the Economic and Social Research Institute, Cabinet Office, Government of Japan, and Project Researcher in the Department of Economics at the University of Tokyo. Masato Ikeda is a PhD student and Daiji Kawaguchi and Shintaro Yamaguchi are Professors in the Graduate School of Economics at the University of Tokyo. The use of data in this paper is approved by the Statistics Bureau of Japan, and we thank the Gender Equality Bureau Cabinet Office for help in accessing the data and JSPS KAKENHI (20H01510) for financial support. Editing services have been provided by Philip C. MacLellan. All conclusions, errors and omissions remain the responsibility of the authors.

1 Introduction

The COVID-19 pandemic has significantly affected labor markets around the world. For example, in April 2020 in the U.S., the pandemic pushed the unemployment rate to a record high of 14.8% and caused millions to leave the workforce, causing the labor force participation rate to decline to 60.2%.

One of the key differences of the pandemic recession from previous ones is that women's employment has been more severely affected than men's (see Alon et al. (2020)). The literature so far has offered two major explanations for this 'shecession.' First, the pandemic decreased the demand for labor in the hospitality and tourism industries in which the female employment share is high. Second, many schools and daycare facilities were closed to prevent the spread of COVID-19, which increased parents' childcare responsibilities. Because women typically have more childcare responsibilities than men, the closures were likely to have caused many working mothers to leave their jobs at least temporarily.

The objective of this paper is to estimate the extent to which women's employment and labor force participation have been affected during the COVID-19 pandemic in Japan to date, and how the effects depend on childcare responsibilities. Our approach is to construct a counterfactual outcome such as the employment rate in the absence of the pandemic by modeling labor force status as a linear trend with month effects, and estimating it using pre-pandemic data. We define the disemployment effect of the pandemic as the deviation of the observed employment rate from its counterfactual (or predicted) counterpart.

We find that the employment rate of married women with children began to decrease in March 2020 when a nation-wide school closure took place and decreased further in April 2020 when the government declared the first COVID-19 state of emergency. Although the government lifted the state of emergency on May 25 and reopened most schools by the beginning of June, the mothers' employment rate had not recovered even by December 2020. In contrast, the employment rate of married women without children was only modestly affected during the same period in that they were temporarily on leave in April and May during the first state of emergency.

To isolate the effects of increased childcare responsibilities during the pandemic, we compare the disemployment effects of the pandemic between married women with and without children aged 0-12 years. We find that the employment rate of married women with children decreased by 4 percentage points while that of married women without children decreased by only 1 percentage point. Because we control for demographic characteristics and pre-COVID-19 occupation/industry, the difference between the two is explained by childcare responsibilities. Our estimates indicate that the unemployment rate of married women with children did not change, but the fraction of those out of labor force increased, which implies that married women with children who left or lost their jobs dropped out of the labor force rather than becoming unemployed.

These results suggest that the COVID-19 pandemic has dealt a blow to the momentum reducing the gender employment gap in Japan, which had been narrowing for more than three decades since the Equal Employment Opportunity Law was enacted in 1985. While the gender gap in the employment rate among those who are married with children was 33 percentage points in 2015 and steadily decreased to about 25 percentage points in 2019, this progress stalled during the pandemic because married men with children were not affected by the pandemic while married women with children were severely affected. The pandemic thus increased the gender employment gap by about 3 percentage points relative to what would have occurred with no pandemic.

We also analyze possible heterogeneous effects of the pandemic across subgroups, and find that the unemployment rate of single mothers rose while their labor force participation rate remained the same, suggesting that single mothers remained in the labor force after a job separation while married mothers left the labor force. This different labor force participation between single and married mothers is likely to be accounted for by non-labor income through their spouses. We further show that the pandemic did not widen the existing employment gaps between the subgroups by education (university vs non-university), region, and employment contract (limited-term vs permanent) among married women with children.

The strength of our research compared to some other studies (discussed below) that use *ad hoc* surveys is our use of the Japanese Labor Force Survey (LFS), a nation-wide survey conducted

monthly since 1947 and with a large sample size of about 40,000 randomly chosen households. This enables us to predict counterfactual outcomes with reasonable precision, based on the previous five years before the COVID-19 pandemic. Because the employment and labor force participation rates of married women with children have been steadily increasing (Kawaguchi et al., 2021), merely using 2019 outcomes as the comparison would underestimate the effects of the pandemic. We account for the pre-pandemic trend and month effects to address this issue. Second, the LFS has a short panel structure which, unlike *ad hoc* surveys, enables us to control for the previous industry, occupation, and hours of work before the pandemic without relying on retrospective questions.[1]

Our contribution to the literature is to offer another piece of evidence from Japan that increased childcare responsibilities decreased women's employment and labor force participation rates disproportionately during the pandemic. A growing body of studies is reporting a gender gap in the disemployment effects of the COVID-19 pandemic. Alon et al. (2020) find that women's unemployment in the U.S. increased by 12.8 percentage points between February and April 2020, while that of men increased by a smaller 9.9 percentage points. While some countries did not experience a 'shecession' like the U.S,[2] Alon et al. (2021) find that women's employment was disproportionately hurt in 18 out of 28 countries, which is different from previous recessions in which men lost more jobs than women. Similarly, Bluedorn et al. (2021) also find that two thirds of 38 developed and developing countries suffered a 'shecession.'

The literature provides two major explanations for the different impact of the pandemic on men and women. The first explanation is a gender difference in the industrial and occupational composition of the labor force. Disproportionately more women work in jobs that require more interpersonal contact and/or cannot be performed remotely. Using the April and May 2020 Current Population Survey (CPS) in the US, Montenovo et al. (2020) find that a sizable portion of the

[1] Admittedly, the Labor Force Survey has several weaknesses relative to *ad hoc* surveys. First, data become available several months later, while *ad hoc* surveys can provide data more quickly. Second, it does not ask questions highly relevant to the pandemic such as the incidence of working from home, while many ad hoc surveys include such questions.

[2] Adams-Prassl et al. (2020) find a 'shecession' in the US and UK, but not in Germany, and Casarico and Lattanzio (2020), Hupkau and Petrongolo (2020), and Farré et al. (2020) find no evidence of a 'shecession' in Italy, the UK, and Spain, respectively.

gender gap in the unemployment rate can be explained by occupations and industries. A second explanation is the increased childcare responsibilities for women. Albanesi and Kim (2021) find that married women with children have been affected more severely than men throughout the pandemic in the US, even when occupational gender differences are controlled for, and Fabrizio et al. (2021) confirmed this pattern using the U.S. CPS until November 2020. Further, Qian and Fuller (2020) also find that gender gaps grew more for parents of school-aged children in Canada.

To advance this line of argument, some papers explicitly estimate the effect of school and childcare closures. Russell and Sun (2020) find that the closure of childcare centers or imposed class size restrictions increased the unemployment rate of mothers with children aged 5 years and under in the U.S. Moreover, exploiting the variation in the timing of school closures between the U.S. states, Heggeness (2020) find that married women with school children were more likely to be temporarily off work, while men and women with no children were unaffected by school closures. School closures seem to have affected Canadian parents, too, as Beauregard et al. (2020) find that school reopening in May 2020 in Canada increased the employment of parents, particularly that of single mothers. Nevertheless, unlike fathers', mothers' employment did not fully recover to the pre-pandemic level.

In light of the development of the literature, our findings from Japan provide additional evidence that the gender imbalance in childcare responsibilities widened the gender gap in the labor market effects of COVID-19. Although the increase in the unemployment rate due to COVID-19 was limited in Japan compared with other developed countries,[3] we find a sharp contrast in the employment responses between men and women with children. This substantial gender gap reflects well the pre-existing gender gap in family responsibilities in Japan that is the largest among OECD countries, according to OECD (2020) and Cabinet Office of Japan (2020). Examining Japanese mothers' labor supply thus provides an interesting case study from a country with the largest gender division of labor, which may have exacerbated the pandemic's negative effects for women.

[3]According to the International Labor Organization, working hours lost due to COVID-19 in 2020 relative to the pre-COVID-19 quarter was 5.4% in Japan, 9.2% in the US, 12.8% in the UK, 8.4% in France, and 6.3% in Germany.

Some studies on the COVID-19 pandemic have focused on women in the Japanese labor market. Using data from an *ad hoc* survey, Dang and Nguyen (2021) find more permanent job loss for women than men in late April, 2020, while Kikuchi et al. (2021), using the LFS, find that more women aged 25-64 lost employment than men in April and May 2020. Neither of these papers examine the role of increased childcare responsibilities during the pandemic on the labor supply of Japanese women. Further, Yamamura and Tsutsui (2021) find that mothers are more likely to work from home than fathers when both parents work, and while they do not estimate the disemployment effect of the pandemic, they show that mothers shoulder the burden of working remotely and caring for children at home.[4]

The rest of the paper is structured as follows. In Section 2, we lay out the econometric model to evaluate the effect of the COVID-19 pandemic on employment outcomes. In Sections 3 and 4, we describe our data from the LFS and present our estimation results. In Section 5, we examine how the pandemic affected the gender employment gap, and we conclude the paper in Section 6.

2 Econometric Model

In this study, we estimate the effect of the COVID-19 pandemic on mothers' employment. The challenge is that because the pandemic has affected the entire labor market, it is hard to find an appropriate comparison group that is unaffected by the pandemic. Our approach is to instead construct a counterfactual employment rate in the absence of the pandemic by modeling and estimating an employment process using pre-COVID-19 data from the LFS. We then estimate the impact of the pandemic by comparing the actual employment rate and the counterfactual one. This approach is based on the standard method for estimating excess mortality.[5]

[4] Another paper worth mentioning is Takaku and Yokoyama (2021), who examined the impact of school closure on family life including the incidence of domestic violence, marital quality, and outcomes for children, drawing on data from their *ad hoc* survey, but they do not examine the impact on mother's employment.

[5] A similar approach is also used in previous studies related to COVID-19, including estimating the number of child abuse cases (Baron et al., 2020) and the impact on the labor market in Japan (Fukai et al., 2021).

Specifically, we estimate the following regression equation;

$$y_{it} = \beta_0 + \sum_{\substack{l \in \{Jan20, \\ ..., Dec20\}}} \delta_l D(t = l) + x'_{it}\beta + \sum_{\substack{m \in \{Jan, \\ ..., Dec\}}} \mu_m D(t = m) + f(t) + u_{it}, \tag{1}$$

for each individual i and month t. The dependent variable y_{it} is an outcome indicator variable of employment that takes one if individual i was employed in period t and takes zero otherwise, and the indicator variable $D(\cdot)$ takes one if the condition in the bracket is satisfied and zero otherwise. The control variable x_{it} includes education, age, the number of adults in the household, and industry and occupation 12 months ago. The month fixed effects μ_m account for seasonality in employment status, the function $f(t)$ is a linear time trend, and u_{it} is the error term. Note that the intercept (β_0), the coefficients for the control variables (β), the month fixed effects (μ_m), and the linear trend ($f(t)$) are estimated from observations up to 2019 because the parameter δ_l is dedicated to observations in 2020. Deliberately, we do not allow for a nonlinear time trend to avoid overfitting. We construct the counterfactual employment rate in 2020 in the absence of the pandemic by assuming $\delta_l = 0$, and hence, the parameter δ_l captures the difference between the actual and counterfactual employment rates, which we interpret as the effect of the pandemic.

The disemployment effect of the pandemic is likely to be different between women with children and those without children because many schools closed for an extended period, increasing mothers' childcare responsibilities as they spent additional time at home with their children. To examine the heterogeneous effects of the pandemic by childcare responsibilities, we test whether the disemployment effects differ by the presence of school-aged children. To do this, we extend the estimation equation to allow for heterogeneous effects of the pandemic on employment between married women with and without children. Let K_{it} be an indicator variable that takes one if an individual has a child aged between 0 and 12 and takes zero otherwise. We estimate the following

regression;

$$y_{it} = \beta_0 + \pi K_{it} + \sum_{\substack{l \in \{Jan20, \\ ..., Dec20\}}} \delta_l D(t = l) \times K_{it} + \sum_{\substack{l \in \{Jan20, \\ ..., Dec20\}}} \gamma_l D(t = l) + \sum_{k \in \{0,1\}} (x'_{it}\beta_k + \sum_{\substack{m \in \{Jan, \\ ..., Dec\}}} \mu_{km} D(t = m) + f_k(t)) D(K_{it} = k) + u_{it}. \tag{2}$$

Our parameter of interest is δ_l that captures the difference in the disemployment effect of the pandemic between women with and without children. Because women with children were more affected by increased childcare responsibilities, δ_l is expected to be negative from March 2020 on.

Note that our approach differs from a difference-in-differences (DID) estimation. When estimating the effects of increased childcare responsibilities by DID, a researcher might choose women with children as those treated and women without children as the control. This choice leads to a common trend assumption between women with and without children which we doubt is satisfied because the children's school calendar only affects women with children. The Japanese fiscal year begins in April, and people often enter the workforce and children begin attending schools and childcare centers in April. Because of this institution, women with children tend to return to work in April because they start using childcare centers in April. In addition, during holidays and long vacations in summer and winter, when children are out of school, the labor supply may differ between women with and without children. Indeed, we reject the null hypothesis that seasonality is the same between women with and without children (see Figures 43 - 46 in Appendix D.2).

Addressing this problem of using a DID approach, our method estimates the seasonality effects for each group separately, drawing upon the regression discontinuity design (RDD) studies of the effects of a policy change in parental leave (e.g. Lalive et al. (2013)). Because the female employment rate exhibits seasonality, the parental leave studies use data from years before the policy change as a comparison to control for seasonality. However, as seasonality can bias estimates even in the RDD analysis unless the bin width is very narrow, a hybrid method known as DID-RDD is often adopted in policy evaluations of parental leave, and this is the basic idea behind our analysis

as well.[6]

3 Data

For our analysis, we use the monthly Labor Force Survey (LFS), a household survey conducted by the Statistics Bureau of the Ministry of Internal Affairs and Communications (MIC) and which is the Japanese counterpart of the Current Population Survey (CPS) in the United States. The target population of the LFS is all residents of Japan[7], and about 40,000 households are randomly surveyed each month. We use the LFS from January 2015 to December 2020.

The LFS asks about the employment status of each member of the household aged 15 and over in the last week of each month. The employment status includes five catetegories: mainly work, work besides housework or study, absence from work, unemployed, and out of the labor force. The category "absent from work" includes leaves both with and without compensation.[8] Other demographic variables such as age, gender, and marital status are also collected.

The sampling structure of the LFS enables us to construct a short panel data set that allows us to observe the labor force status of the same individual before and after the COVID-19 pandemic. Similar to the CPS, the LFS has a rotating sample structure in which the sample households are surveyed a total of four times: two consecutive months in the first year and the same two months in the following year.[9] As long as the surveyed household members do not move or refuse to answer the questionnaire, the information on employment for the four surveys can be connected. With this capability, our analysis also examines the heterogeneous effects of the pandemic by workers' pre-COVID-19 employment status.

[6] A minor difference is that we use data for five years to estimate month fixed effects (or seasonality, equivalently), whereas a typical DID-RDD approach uses observations only a year prior to a policy change. Hence, we can estimate the month fixed effects more precisely.

[7] Except for diplomatic missions of foreign governments, areas with prisons and detention centers, and areas with special circumstances such as Self-Defense Force zones

[8] Typically, leaves *with* compensation are prevalent during normal economic conditions, and include parental leave and eldercare leave. Under COVID-19, however, anecdotal evidence suggests that temporary leave *without* compensation became prevalent. The survey item does not allow us to distinguish these two types of leave, however.

[9] The first, second, third and fourth waves of the survey each comprise roughly one quarter of the 40,000 households each month.

We constructed our main analysis sample as follows. First, we restricted our main sample to married men and women between ages 25 and 54 because our primary interest is in the labor supply of parents. Households with children are defined by whether or not there is a child in the household 15 years old or younger, the age just before entering high school. Second, we excluded observations with missing variables that are necessary for our analysis such as employment status and educational background. As educational background is only asked in the fourth survey, only households that continued to respond to the survey throughout the fourth wave are included in our sample. Third, as our analysis uses the employment status a year ago as a control variable, the analysis sample includes only the third and fourth waves. Finally, a sample of single mothers was also taken for an additional analysis.

Table 1 presents the descriptive statistics. About half of the sample is female, indicating that the couples mostly live together. The average age is 42.4 years, and about 65 percent of the sample have children. Looking at the presence of children by the age of the youngest child, 30.2 percent have a preschooler, 18.7 percent have a child attending elementary school, and about 16 percent have a child attending junior or senior high school. This latter group is smaller than those with preschool or elementary school children because our sample includes relatively young individuals between ages 25 and 54. The percentage of people with a university degree or higher is about 46 percent. The employment rate for the current year is about 85 percent, and the number of people who are absent from work or unemployed is very low at about 2 percent. The employment rate for the previous year was 84 percent, which is almost the same as that of the current year.[10]

4 Results

This section presents the estimation results for the effects of the COVID-19 pandemic on labor force status, which is comprised of employment, temporary leave, unemployment, or out of the labor force. We begin by examining the effects on married women with children in subsection 4.1.

[10] As the LFS uses rotational sampling, the employment rate for the previous year is known.

Then, to isolate the effects of increased childcare responsibilities, in subsection 4.2 we compare the disemployment effects of the pandemic between married women with and those without children. We then analyze how the pandemic affected single mothers and married mothers differently in subsection 4.3.

4.1 Effects of the COVID-19 Pandemic

Figures 1 and 2 show the employment rate and the rate of temporary leave from 2015 to 2020 for married women with children. The solid line in Figure 1 shows the observed employment rate for each month from 2015 to 2020, while the dashed line shows the counterfactual employment rate in the absence of the pandemic. Figure 2 presents the observed and counterfactual rates of temporary leave. As detailed in Section 2, we construct the counterfactuals based on a function of individual attributes, the linear time trend, and month effects using the observations until 2019. To be more precise, we use the estimates for Equation (1) under the assumption that $\delta_l = 0$. As expected, the predicted outcomes closely trace the observed outcomes until 2019 in both figures.

We interpret the differences between the observed and counterfactual employment rates in Figure 1 as the effect of the pandemic, which is shown in Figure 3. Note that these are estimates for parameter δ_l in Equation (1). The estimates indicate that the pandemic decreased the employment rate of married women with children by 4.4 percentage points in April and that the disemployment effects continued to be around -3 to -4 percentage points. This is a significant drop relative to the mid-70 percent employment rate of the group before the pandemic. Because the COVID-19 outbreak occured at the end of February 2020 in Japan, the estimates for January and February 2020 can be used for placebo tests for the effects of the pandemic. As expected, the effects in January and February are zero, which provides evidence in support of the validity of our method.

The effect in March 2020 is modest at -1.3 percentage points, which is consistent with a finding by Kikuchi et al. (2021). As discussed earlier, the nationwide school closure was initiated at the beginning of March 2020. However, we may not necessarily expect a large and immediate effect for at least two reasons. Firstly, about two weeks of spring vacation in March is scheduled annually

regardless of the COVID-19 pandemic. Thus, married women with children may be used to having children at home during this period anyway. Secondly, married women with children may expect the March school closure to be temporary. While it is true that the prime minister declared the first state of emergency in April and the school closure continued until the end of May, this may not have been fully anticipated by working parents in March.[11]

Figure 4 shows the effect on the rate of temporary leave, which rose sharply in April by 7.6 percentage points but completely disappeared from June onward. This pattern sharply contrasts with the persistent effects on the employment rate. Note that the temporary leave in our data includes leaves from the workplace due to various reasons, including furloughs, sickness, and caregiving. With the economic downturn under the state of emergency in April, we expect that furloughs accounted for a large portion of the spike in Figure 4.

In the LFS, those not in employment are categorized as either unemployed or out of the labor force. Next, we examine to which of these two possibilities those who lost or left their employment moved. Figures 5 and 6 show the effect on the unemployment rate and the rate of being out of labor force, respectively. The estimates show that the pandemic substantially affected only the rate of being out of labor force, but not the unemployment rate. Specifically, increases in the rate of being out of labor force account for 83.0% to 98.7% of the decrease in the employment rate after the outbreak of COVID-19.[12]

Although we cannot directly examine why mothers exited the labor force, we consider three possible explanations. The first is that mothers may have decided not to seek a job because they believed it was difficult to find one given the weak labor demand under the pandemic. The second is that mothers chose to stay at home to take special care of their children under the continuing stress of the pandemic. The third is that mothers chose not to seek a job to prepare for future closures of schools and childcare facilities. The last two channels are related to childcare responsibilities and can explain the persistent increase in the rate of being out of labor force. We explore the role of

[11]The state of emergency was declared for 7 major cities in Japan in April 7, 2020, and nationwide in April 16, 2020.

[12]By definition, in each month, summing up the effects on these two outcomes yields the effects on the employment rate shown in Figure 3

increased childcare responsibilities in accounting for the disemployment effect of the pandemic in the next subsection.

While our analysis focuses on the extensive margin of labor supply, we also estimate the effects on hours worked, or the intensive margin. Figure 18 in Appendix A shows the effect of the pandemic on weekly hours of work for those who did work positive hours, and we see that they decreased by about two hours in April and May, but the effects are negligibly small from June to November. More results on hours of work are available in Appendix A.

In sum, for married women with children, both the intensive and extensive margins of the labor supply were negatively affected in April and May when the first state of emergency was declared. The negative effects on the extensive margin remained throughout 2020, but the intensive margin was not affected from June onward.

4.2 Heterogeneity by Childcare Responsibilities

In this subsection, we examine the extent to which childcare responsibilities account for the disemployment effects of the pandemic on married women. The literature offers two major explanations. The first one is a decrease in the labor demand for female-dominated industries such as hospitality and tourism. The second one is an increase in childcare responsibilities. We expect that the latter plays a particularly important role in Japan because the traditional view of gender roles demands mothers to bear the burden of childcare responsibilities disproportionately.

We apply Equation (2) to isolate the effects of increased childcare responsibilities by comparing the disemployment effects of the pandemic between married women with children aged 0-12 (i.e. elementary school students or younger) and married women with no children. In our estimation, we control for individual characteristics such as education, age, the number of adults in the household, and industry and occupation one year prior.

Figure 7 shows the estimated effects on each subgroup.[13] For married women with children,

[13]The effects on married women with children differ slightly from those in Figure 3 because we condition on covariates in the Figure 7.

the negative effect appears in March when school closure began and continues throughout the year. In contrast, the effects on those without children remain at zero in nearly every month in 2020. Figure 8 shows the differences between the two, which are the estimates for the coefficient δ_l in Equation (2). Our estimates indicate that the effects of the pandemic on the employment rate differ between married women with and without children by -3.3 percentage points in April, which is statistically significant. Although the estimates are noisy, we find that the negative effects of increased childcare responsibilities persisted throughout 2020.

Figure 9 shows the effect of the pandemic on the rate of temporary leave, which increased sharply in April, but faded out by July for both groups. Figure 10 presents the difference between the two groups, and it is significant at 3.3 percentage points in April. This implies that the effect through childcare responsibility alone accounts for 45%[14] of the overall effect on temporary leave of married women with children in April.

To see whether or not those who left or lost their employment stayed in the labor force, we show the effect of increased childcare responsibilities separately on the unemployment rate and the rate of being out of labor force in Figures 11 and 12, respectively. As mentioned earlier, the overall effect of the pandemic on the employment rate is accounted for by changes in the rate of being out of the labor force. The point estimates for the unemployment rate are close to zero.

To further analyse the effects of increased childcare responsibilities, we compare the effects of the pandemic by the number of children (i.e., one child or two or more children). We expect the effect is stronger for those with two or more children because they bear a greater childcare burden. As shown in Figures 24-27 in Appendix B, the employment effect of the pandemic tends to be stronger for those with two or more children than those with only one child, although the estimates are not statistically significant.

Finally, we examine whether increased childcare responsibilities widened the existing employment disparities among mothers across education, employment contract, and region. To answer this question, we test whether the disemployment effects of increased childcare responsibilities

[14] $3.331/7.340 = 45.38\%$. This overall effect is slightly different from the estimate mentioned in the main text earlier because here we restrict the estimation sample to mothers with children in elementary school.

differ across the subgroups. As extensively discussed in Appendix C, our estimates do not indicate the effects are heterogeneous, which implies that the pandemic has not widened the existing gaps among married women with children.

In summary, we find that increased childcare responsibilities significantly decreased mothers' employment. These effects account for most of the decline in their employment rate in the pandemic, and the weakened labor demand does not seem to be a primary reason. Our results suggest that the negative effects were slightly stronger for those with more children.

4.3 Heterogeneity by Marital Status

In this section, we examine the effects of the pandemic on the labor force status of single mothers as compared with married mothers. Figure 13 shows the effect of the COVID-19 pandemic on the employment rate of single mothers, which was 5.2 percentage points in the third quarter, but it disappeared in the fourth quarter. We also present the effects on the unemployment rate and the rate of being out of labor force in Figures 14 and 15, respectively. While we find no effect on the rate of being out of the labor force, we find a significant increase in the unemployment rate in the third quarter of 2020.

This result contrasts with that of married women with children who experienced a persistent decline in the employment rate of 2.6 and 3.3 percentage points in the third and fourth quarters[15]. Another key difference is that while single mothers became unemployed but remained in the labor market, married mothers left the labor force. We suspect that non-labor income from spouses accounts for this difference in labor force participation.

5 Consequences for the Gender Gap in Employment

In this section we examine how the COVID-19 pandemic influenced the gender gap in employment between married men and women with children. The gender employment gap is a relevant issue

[15]These estimates as well as those for single mothers are estimated by controlling for education, industry, and occupation in estimation Equation 1.

because Japan has more pronounced gender inequality than other developed countries. In 2016, the time per day spent on unpaid domestic and care work by women was 4.6 times longer than that by men.[16] This number is strikingly larger than, for instance, that of the U.S., where women spend 1.6 times more than men in home production.

Before we look into the gender employment gap itself, we highlight the difference in the effects of the pandemic between married men and women with children. Figure 16 shows how the pandemic affected the employment rate of married men with children, and in contrast to married women with children (see Figure 1), the pandemic did not affect the employment rate of married men with children. It is true that women were more negatively affected than men in many other countries including the US as well (Alon et al. (2021)), this gender difference in Japan stands out.

Finally, Figure 17 shows the gender employment gap from 2015 to 2020, which is defined as the difference in the employment rate between married men and women with children. Before the pandemic, the gender employment gap had steadily narrowed over the last several years in Japan from 33 percentage points in 2015 to about 25 percentage points in 2019. However, this progress stalled during the pandemic, with the gender employment gap remaining at around 25 percentage points until the end of 2020. Our estimates indicate that in the absence of the pandemic, the gender employment gap would have been 21.6 percentage points in the fourth quarter of 2020, while the actual gender employment gap was 24.9 percentage points.

6 Conclusion

Using the LFS, we estimated the effects of the COVID-19 pandemic on Japanese mother's employment and labor force participation. Our estimates indicate that the pandemic decreased the mothers' employment rate by about four percentage points from 75 percent before the pandemic. Most of this decrease is accounted for by increased childcare responsibilities. Our estimates suggest that most mothers who left or lost their jobs dropped out of the labor force rather than becoming

[16]The fraction is calculated by the author using the following source: https://www.worldbank.org/en/data/datatopics/gender

unemployed. These negative effects are persistent even six months after school closures ended.

We also find that the employment effect of the pandemic is strikingly different between men and women, as the labor force status of married men with children was unaffected by the pandemic. Consequently, the progress in narrowing the gender employment gap has stalled completely. In fact, the pandemic increased the gender employment gap by three percentage points relative to what would have occurred in the absence of the pandemic.

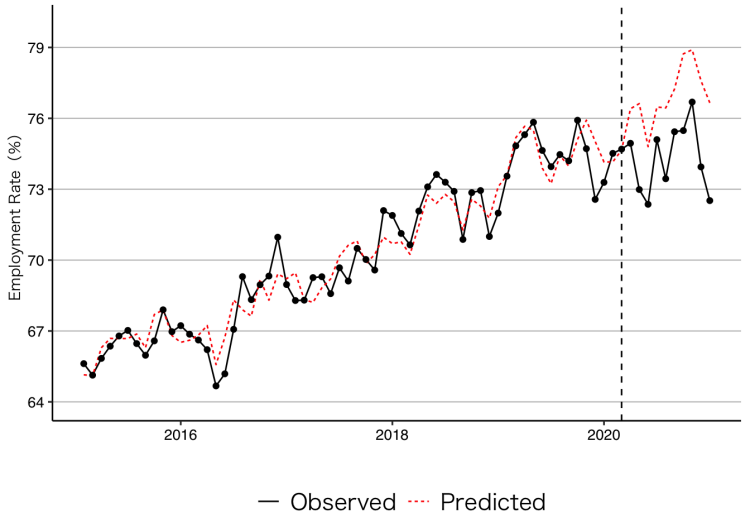
Our finding provides a lesson to policy makers that goes beyond the current context. The empirical results indicate that schools offer two important practical functions: educating children and freeing up parents from child care at home. Thus, school closures not only deprived children of learning opportunities, but also increased the child care burden of parents. While the temporary loss of learning opportunities due to school closures can be made up to a certain extent through online learning (see Ikeda and Yamaguchi (2021)), the extra child care burden is an irreversible blow to mothers' labor force participation in a society such as Japan in which the responsibility for child care is placed disproportionately on mothers. Especially during crises such as COVID-19, policy makers should pay careful attention to the often overlooked child care function of schools to avoid unintended consequences of school policies.

Table 1: Descriptive Statistics

Variable	Obs	Mean	St. Dev.
Woman	1,459,145	0.527	0.499
Age	1,459,145	42.399	7.485
With Child in Pre-school	1,459,145	0.302	0.459
With Child in Elementary School	1,459,145	0.187	0.390
With Child in Jr. High School	1,459,145	0.075	0.263
With Child in High School	1,459,145	0.086	0.281
Employment	1,459,145	0.847	0.360
Temporary Leave	1,459,145	0.024	0.153
Unemployment	1,459,145	0.011	0.102
Out of Labor Force	1,459,145	0.142	0.349
Re-openings	1,459,145	0.539	0.401
High Education	1,069,369	0.459	0.498
Employment in Previous Year	544,967	0.844	0.363
Permanent in Previous Year	403,686	0.798	0.402

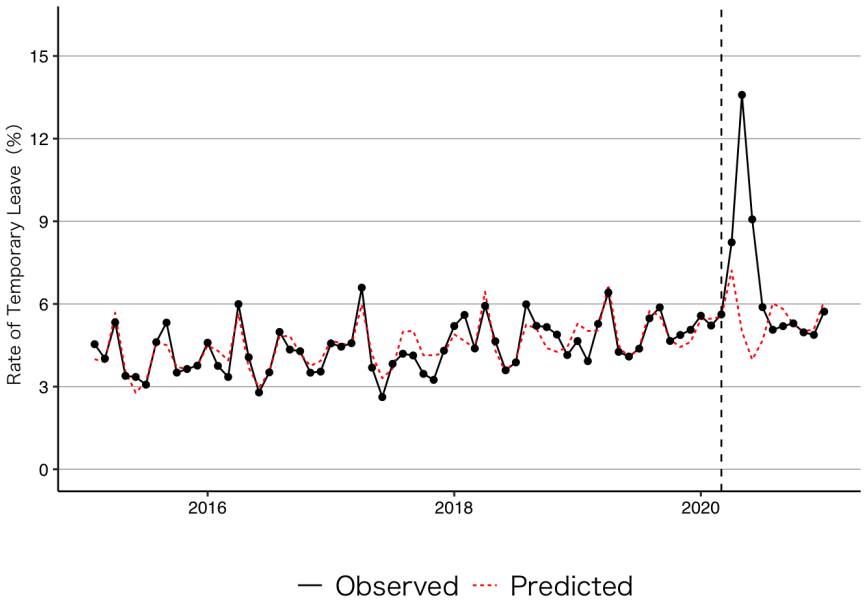
Notes: The sample is restricted to married individuals aged 25-54. Woman represents the fraction of women in the sample. With Child in Pre-school/Elementary School/Jr. and High School/High School represent the proportion of individuals in the household where the youngest child is in the respective educational category. Employment, Temporary Leave, Unemployment, and Out of Labor Force represents the fraction of individuals who are in that respective labor force category. Re-openings represents the fraction of individuals living in a prefecture where the proportion of elementary schools re-opening on June 1 is higher than 50%. To construct this variable, we use the information from government statistics: `https://www.mext.go.jp/content/20200603-mxt_kouhou01-000004520_4.pdf`, and merge it with the LFS using a prefecture identifier. High Education represents the fraction of individuals who have a bachelors degree or higher. Employment/Permanent in Previous Year represents the fraction of individuals who are under an employment/permanent contract when the first wave of the LFS was conducted.

Figure 1: The Predicted and Observed Monthly Employment Rates for Married Women with Children



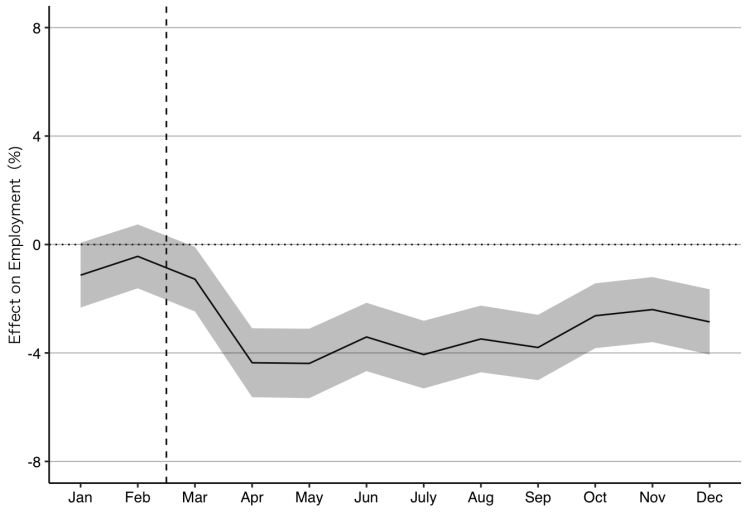
Notes: The solid line represents the employment rate of married women with children from 2015 to 2020. The dashed line represents the predicted employment rate from 2015 to 2020 calculated from Equation (1) with $\delta_l = 0$. The vertical line indicates March 2020 when the nationwide school closure took place. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year was available.

Figure 2: The Predicted and Observed Rates of Temporary Leave for Married Women with Children



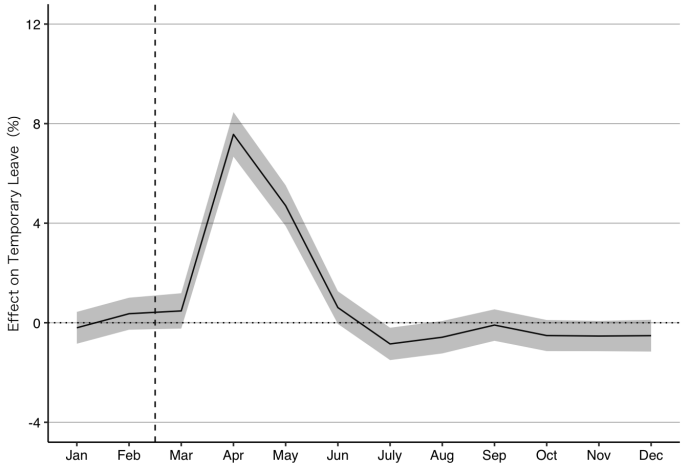
Notes: The solid line represents the employment rate of married women with children from 2015 to 2020. The dashed line represents the predicted employment rate from 2015 to 2020 calculated from Equation (1) with $\delta_l = 0$. The vertical line indicates March 2020 when the nationwide school closure took place. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year was available.

Figure 3: The Effect of the COVID-19 Pandemic: Employment Rate



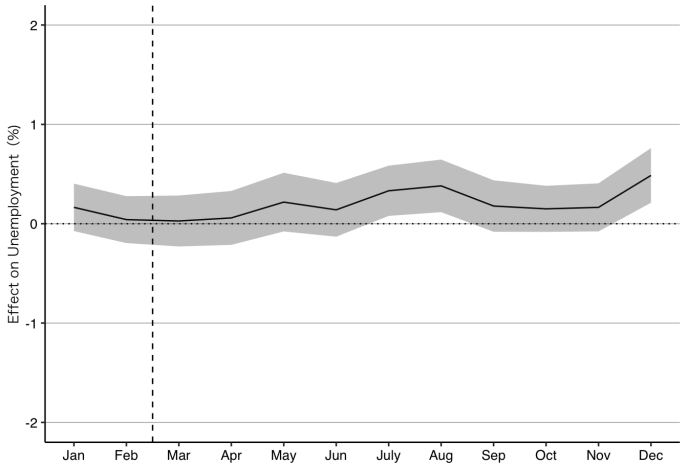
Notes: The solid line represents the effect of the COVID-19 pandemic on the employment rate, defined by the difference between the actual and counterfactual employment rates of married women with children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 4: The Effect of the COVID-19 Pandemic: Rate of Temporary Leaves



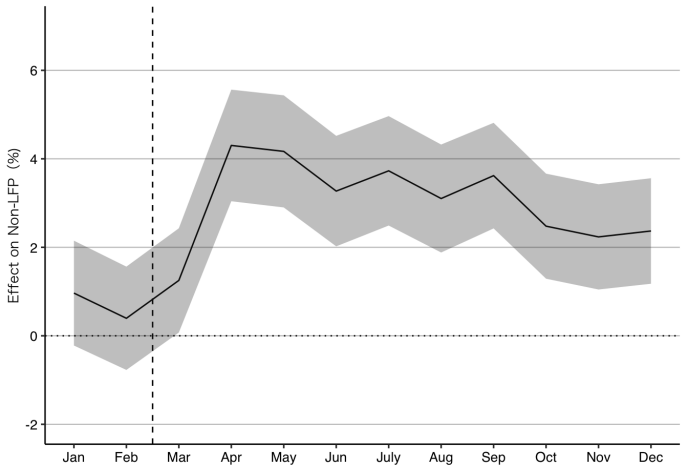
Notes: The solid line represents the effect of the COVID-19 pandemic on the rate of temporary leave, defined by the difference between the actual and counterfactual rates of temporary leave for married women with children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 5: The Effect of the COVID-19 Pandemic: Unemployment Rate



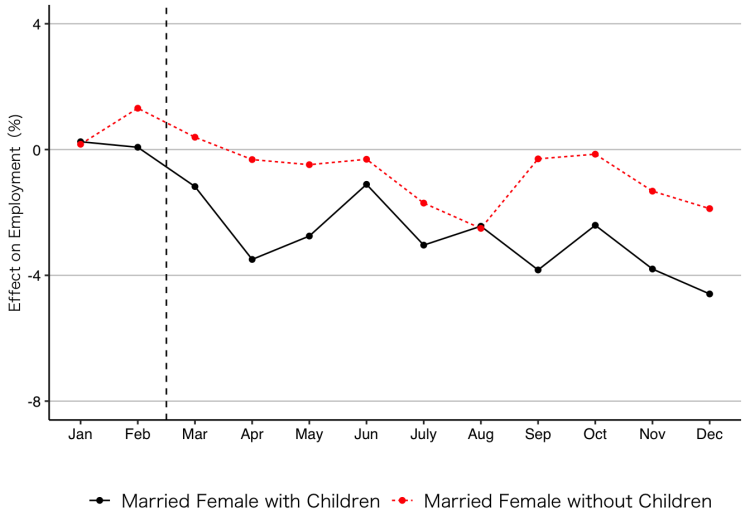
Notes: The solid line represents the effect of the COVID-19 pandemic on the unemployment rate, defined by the difference between the actual and counterfactual unemployment rates of married women with children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 6: The Effect of the COVID-19 Pandemic: Rate of Being out of the Labor Force



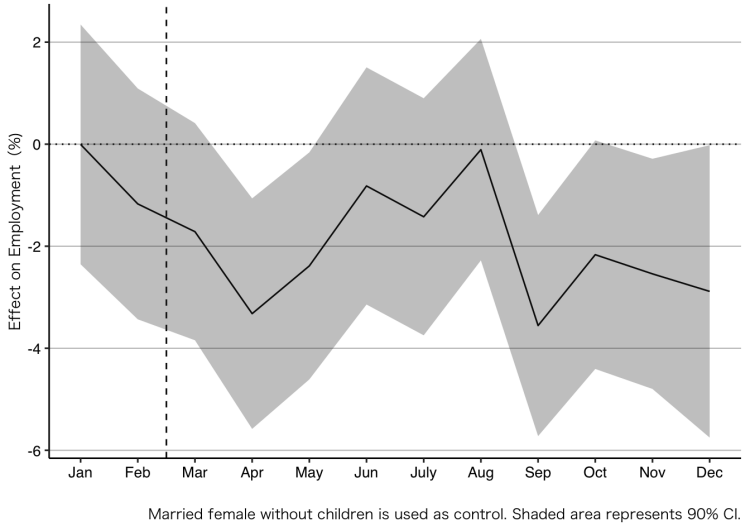
Notes: The solid line represents the effect of the COVID-19 pandemic on the rate of being out of labor force, defined by the difference between the actual and counterfactual rates of being out of labor force for married women with children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 7: The Effect of the Pandemic on the Employment Rate: Married Women with and without Children



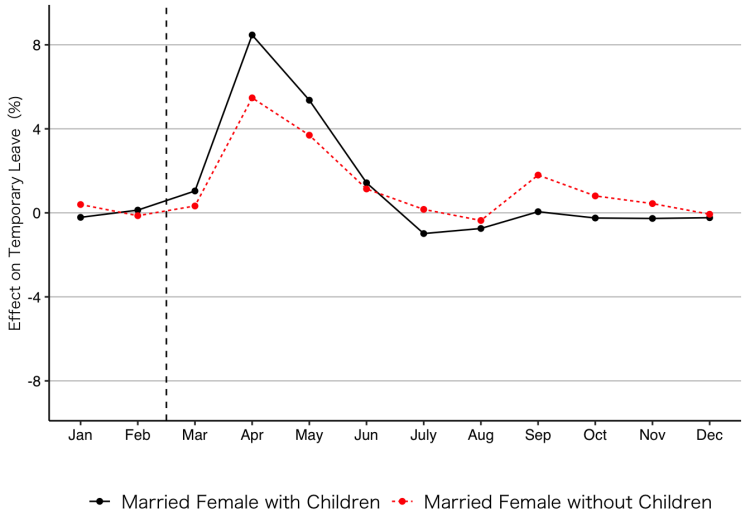
Notes: The solid and dashed lines represent the effect of the COVID-19 pandemic on the employment rate for married women with and without children in 2020, respectively. The effect of the COVID-19 pandemic on the employment rate is defined by the difference between the actual and counterfactual employment rates in 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 8: The Effect of the Pandemic through Childcare Responsibilities: Employment Rate



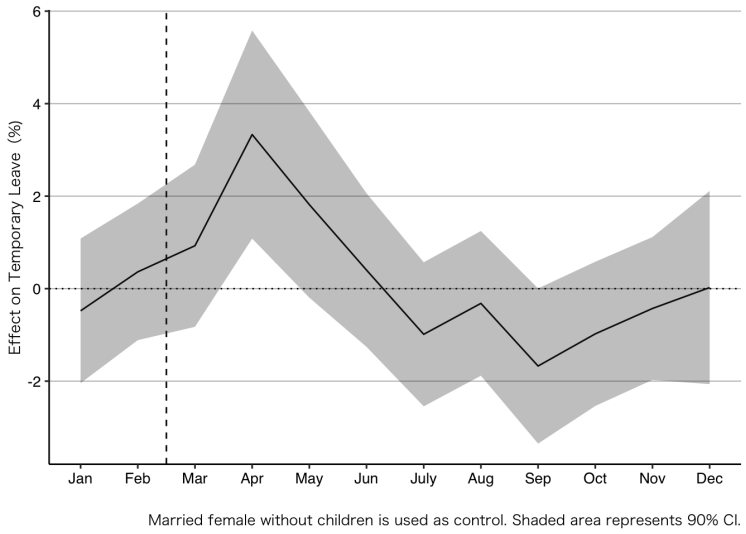
Notes: The solid line represents the effect of the COVID-19 pandemic through childcare responsibilities on the employment rate for married women with children in 2020. This effect is defined as the difference between the effect of the pandemic on the employment rates of married women with and without children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 9: The Effect of the Pandemic on the Rate of Temporary Leave: Married Women with and without Children



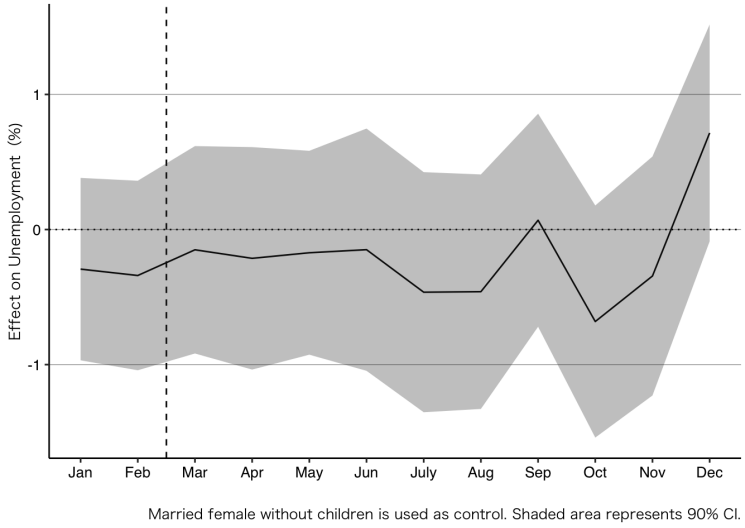
Notes: The solid and dashed lines represent the effect of the COVID-19 pandemic on the rate of temporary leave for married women with and without children in 2020. This effect is defined by the difference between the actual and counterfactual rates of temporary leave in 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 10: The Effect of the Pandemic through Childcare Responsibilities: Rate of Temporary Leave



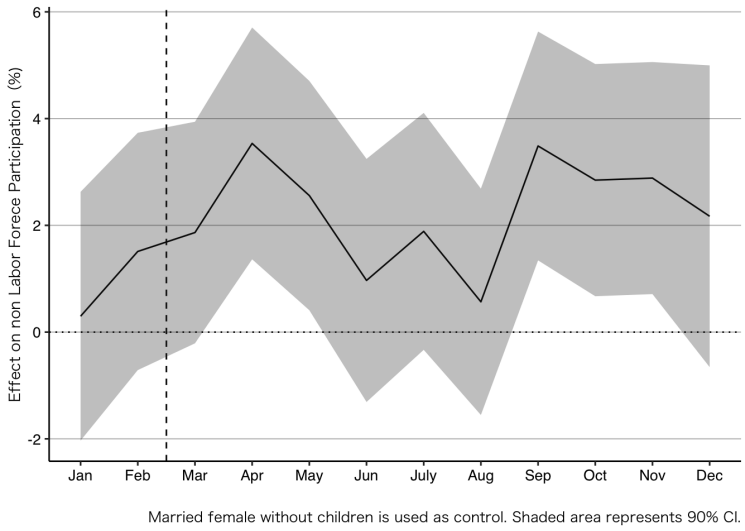
Notes: The solid line represents the effect of the COVID-19 pandemic through childcare responsibilities on the rate of temporary leave for married women with children in 2020. This effect is defined as the difference between the effects of the pandemic on the rate of temporary leave for married women with and without children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 11: The Effect of the Pandemic through Childcare Responsibilities: Unemployment Rate



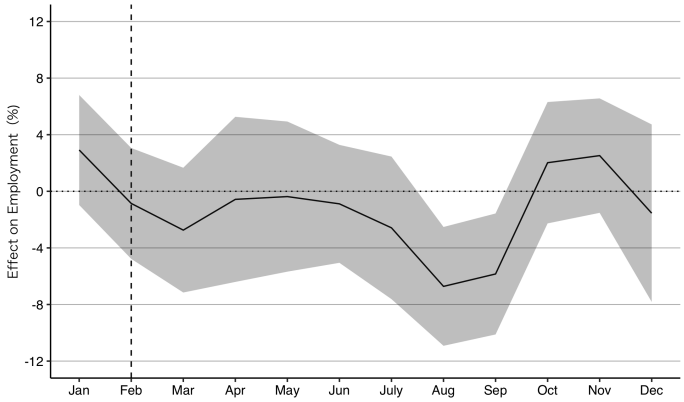
Notes: The solid line represents the effect of the COVID-19 pandemic through childcare responsibilities on the unemployment rate for married women with children in 2020, which is defined as the difference between the effects of the pandemic on the unemployment rate for married women with and without children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 12: The Effect of the Pandemic through Childcare Responsibilities: Rate of Being out of the Labor Force



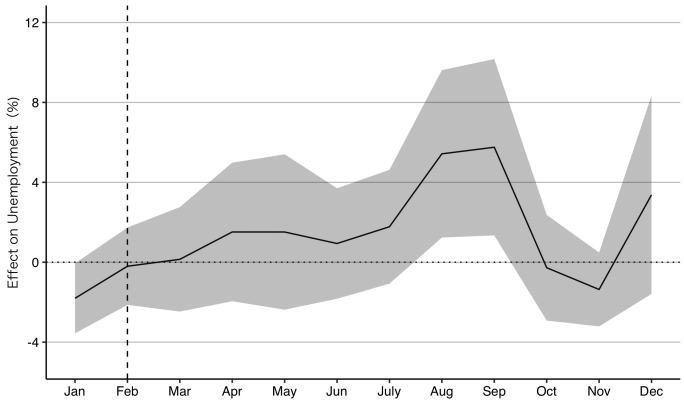
Notes: The solid line represents the effect of the COVID-19 pandemic through childcare responsibilities on the rate of being out of labor force for married women with children in 2020, which is defined as the difference between the effects of the pandemic on the rate of being out of labor force for married women with and without children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 13: The Effect of the COVID-19 Pandemic: Single Mother Employment Rate



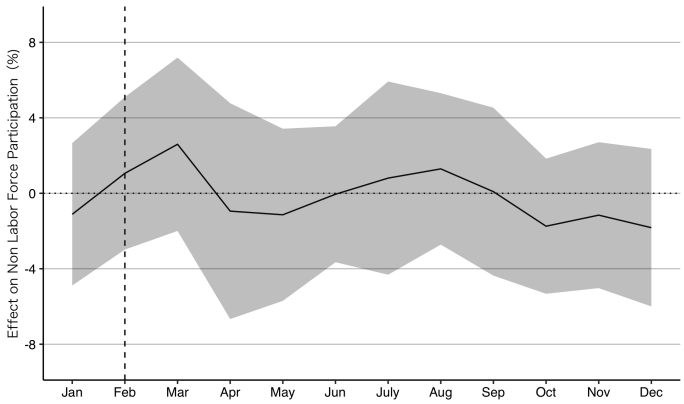
Notes: The solid line represents the effect of the COVID-19 pandemic on the employment rate for single mothers, defined as the difference between the actual and counterfactual employment rates of single mothers in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 14: The Effect of the COVID-19 Pandemic: Single Mother Unemployment Rate



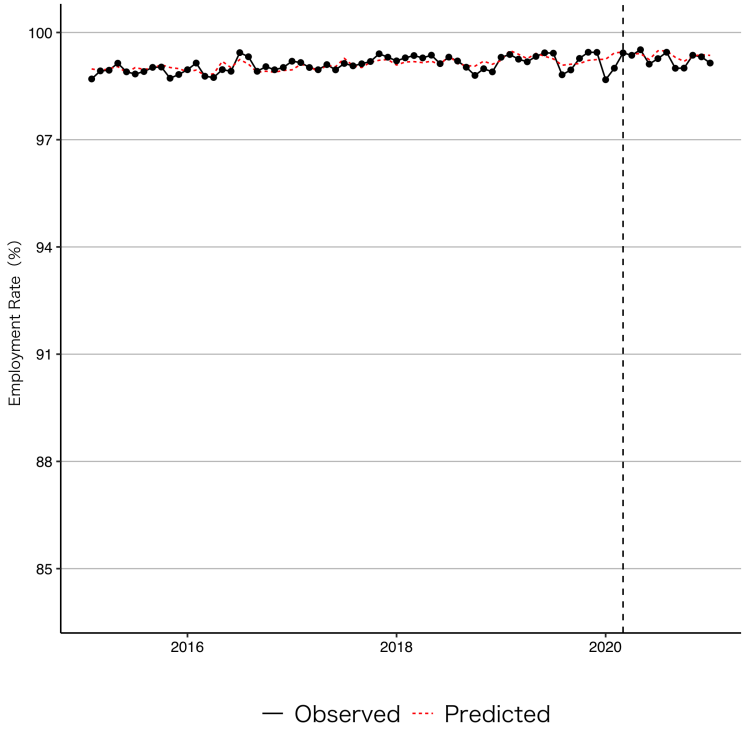
Notes: The solid line represents the effect of the COVID-19 pandemic on the unemployment rate for single mothers, defined as the difference between the actual and counterfactual unemployment rates of single mothers in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 15: The Effect of the COVID-19 Pandemic: Single Mother Rate of Being out of the Labor Force



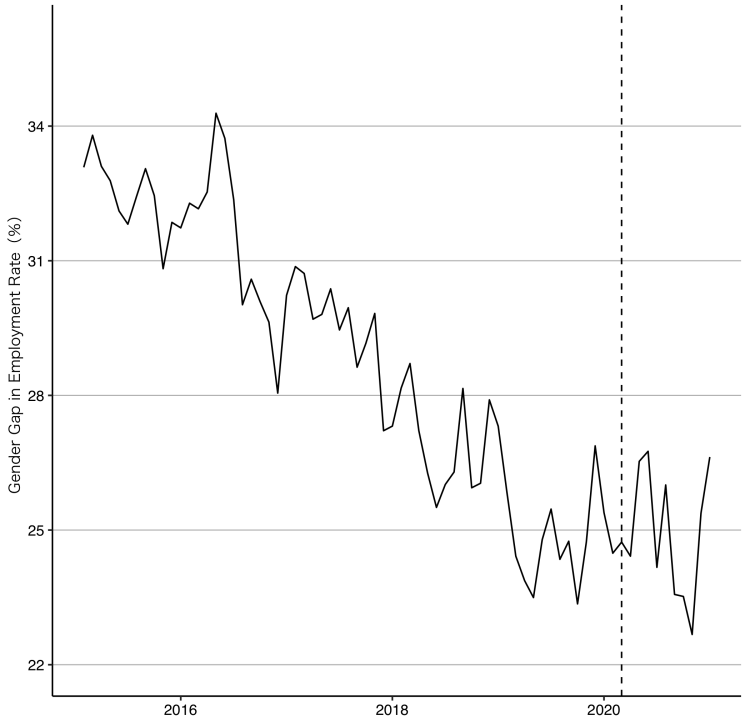
Notes: The solid line represents the effect of the COVID-19 pandemic on the rate of being out of labor force for single mothers, defined as the difference between the actual and counterfactual rates of being out of labor force for single mothers in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 16: The Predicted and Observed Employment Rates for Married Men with Children



Notes: The solid and dashed lines represent the actual and predicted employment rates of married men with children from 2015 to 2020. The predicted employment rate is calculated from Equation (1) with $\delta_l = 0$ from 2015 to 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married men aged 25-54 with children whose information on their education and working status in the previous year was available. Throughout the sample period, the employment rates remain high at 98.7-99.5%. The high employment rate of married men with children is consistent with the 98.6% employment rate for the same population calculated using the 2015 Population Census (Source: `https://www.e-stat.go.jp/stat-search/files?page=1&layout=datalist&toukei=00200521&tstat=000001080615&cycle=0&tclass1=000001095955&tclass2=000001100295&stat_infid=000031569376&tclass3val=0`).

Figure 17: The Gender Employment Gap between Married Men and Women with Children



Notes: The solid line represents the gender employment gap between married men and women with children from 2015 to 2020. The employment gap is defined as the difference in the employment rate between married men and women with children, or the difference between the solid lines in Figure 16 and Figure 1. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married men and women aged 25-54 with children whose information on their education and working status in the previous year were available.

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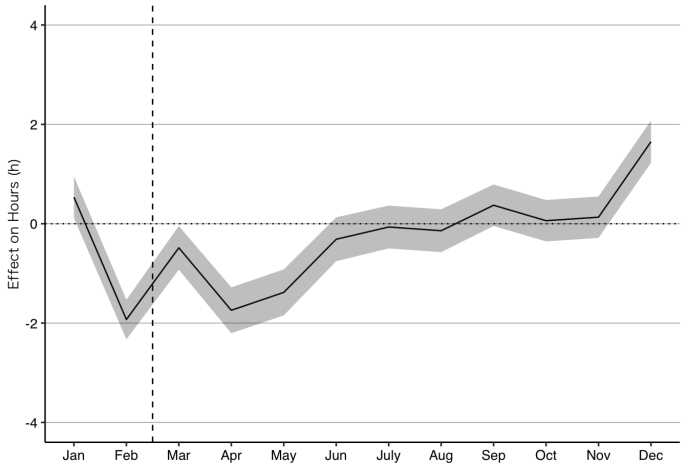
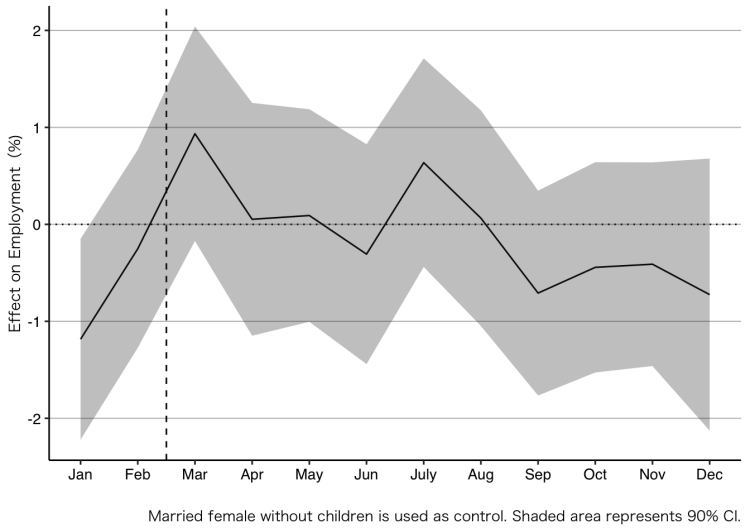
A Effects of the COVID-19 Pandemic on Hours Worked

Figure 18: The Effect of the COVID-19 Pandemic: Weekly Hours Worked (Conditional on Working)



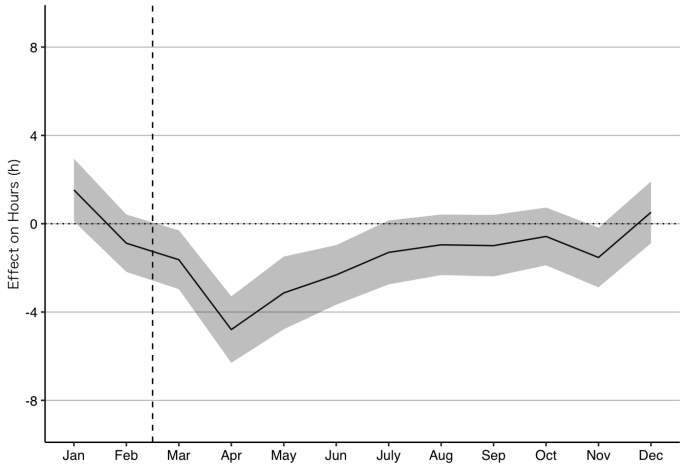
Notes: The solid line represents the effect of the COVID-19 pandemic on the hours they work in the last week of each month, defined as the difference between the actual and counterfactual hours worked for married women with children in 2020. The hours worked are computed conditional on working; that is, we restrict the estimation sample to those whose hours worked is strictly more than zero. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year was available.

Figure 19: The Effect of the Pandemic through Childcare Responsibilities: Hours Worked (Conditional on Working)



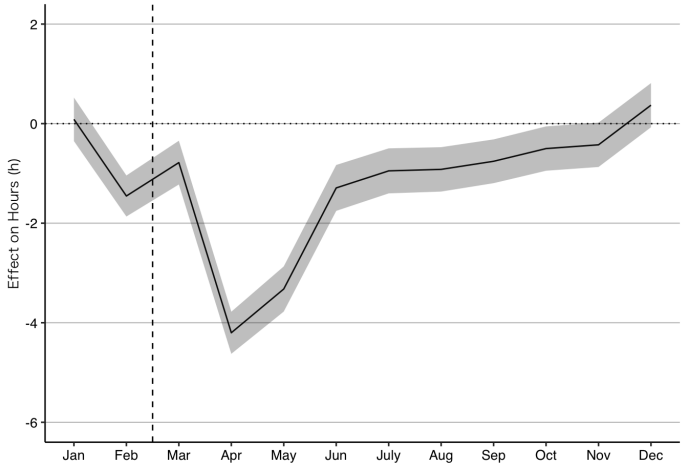
Notes: The solid line represents the effect of the COVID-19 pandemic through childcare responsibilities on the hours worked for married women with children in 2020, which is defined as the difference between the effects of the pandemic on the hours worked for married women with and without children in 2020. The hours worked are computed conditional on working; that is, the estimation sample is restricted to those whose hours worked is strictly more than zero. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year was available.

Figure 20: The Effect of the COVID-19 Pandemic: Single Mother Weekly Hours Worked (Conditional on Working)



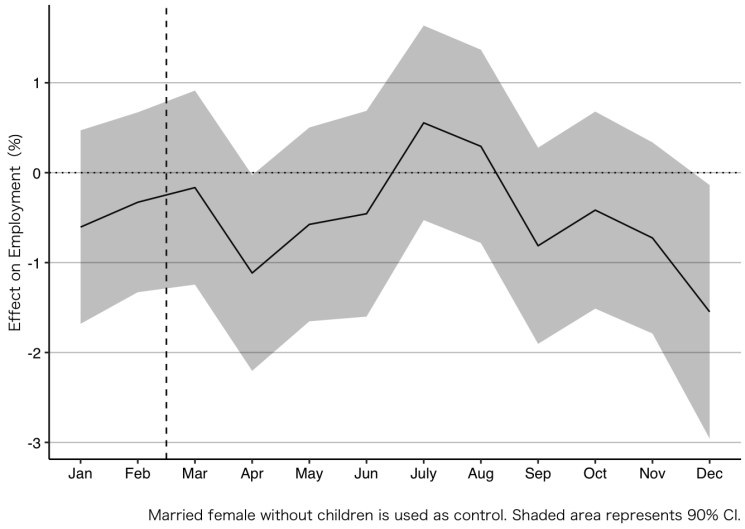
Notes: The solid line represents the effect of the COVID-19 pandemic on the hours single mothers work in the last week of each month, defined as the difference between the actual and counterfactual hours worked for single mothers in 2020. The hours worked are computed conditional on working; that is, the estimation sample is restricted to those whose hours worked is strictly more than zero. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year was available.

Figure 21: The Effect of the COVID-19 Pandemic: Weekly Hours Worked



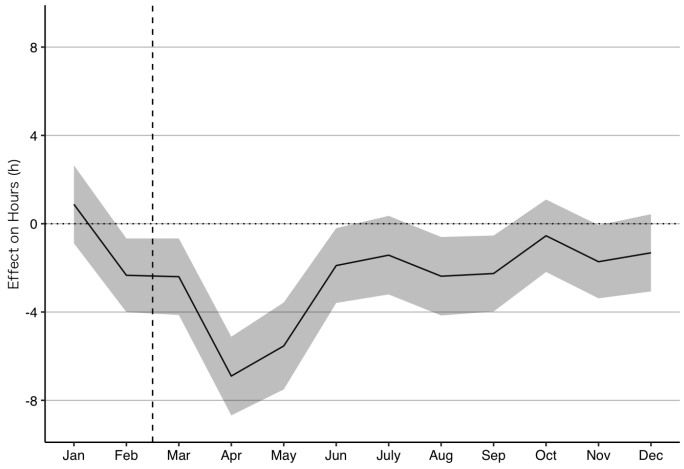
Notes: The solid line represents the effect of the COVID-19 pandemic on the hours worked in the last week of each month, defined as the difference between the actual and counterfactual hours worked for married women with children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year was available.

Figure 22: The Effect of the Pandemic through Childcare Responsibilities: Hours Worked



Notes: The solid line represents the effect of the COVID-19 pandemic through childcare responsibilities on the hours worked for married women with children in 2020, defined as the difference between the effects of the pandemic on the hours worked for married women with and without children in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year was available.

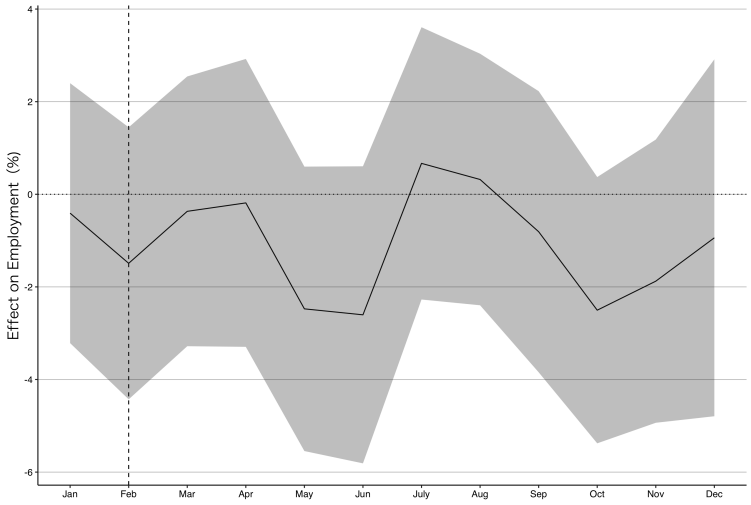
Figure 23: The Effect of the COVID-19 Pandemic: Single Mother Weekly Hours Worked



Notes: The solid line represents the effect of the COVID-19 pandemic on the hours single mothers worked in the last week of each month, defined as the difference between the actual and counterfactual hours worked for single mothers in 2020. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to single mothers aged 25-54 whose information on their education and working status in the previous year was available.

B Heterogeneity by Number of Children

Figure 24: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Employment Rate by Number of Children

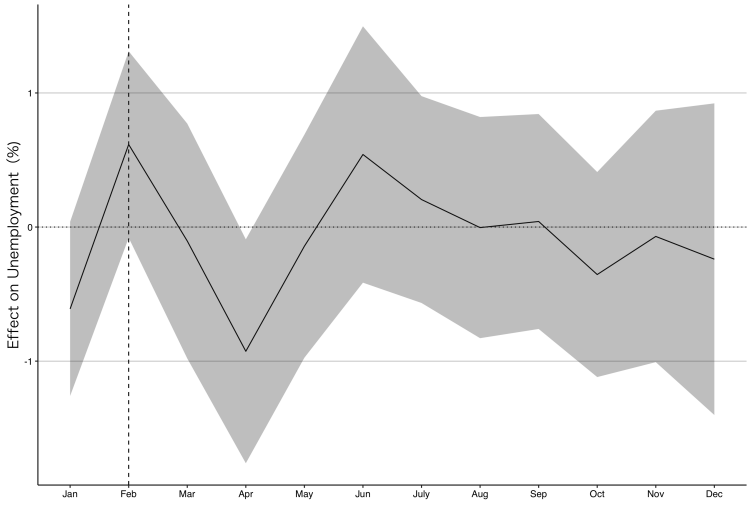


Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the employment rate of those with one child and those with two or more children. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 25: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Rate of Temporary Leave by Number of Children

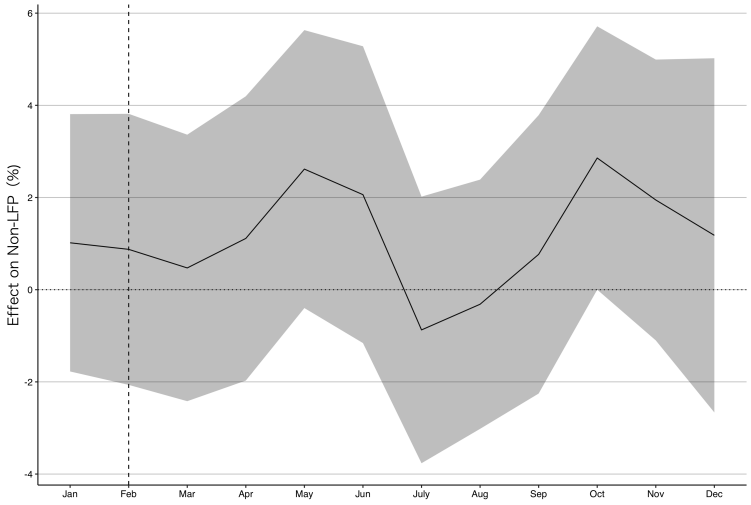
Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the rate of temporary leave of those with one child and those with two or more children. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 26: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Unemployment Rate by Number of Children



Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the unemployment rate of those with one child and those with two or more children. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 27: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Rate of Being out of the Labor Force by Number of Children



Notes: The solid line represents the difference in the effects of the COVID-19 pandemic through childcare responsibilities on the rate of being out of the labor force of those with one child and those with two or more children. The shaded area represents the 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

C Heterogeneous Effects of Increased Childcare Responsibilities

In this section we discuss whether increased childcare responsibilities widened the existing employment gaps by education, region, and employment arrangement among women with children by reporting the coefficients estimated by interacting relevant dummy variables with the treatment dummy in Equation (2) [17]. Note that here we estimate Equation (2) without conditioning on pre-pandemic variables such as industry and occupation in the previous year. This is because we consider the influences on the existing employment gaps that take into account the composition differences across subgroups. For instance, the differences in industry composition between low and high education can be a major source of disparity in the employment effect of the pandemic across education.

The first column of Table 2 reports the estimated coefficients for education. Here, we consider differences between women with a bachelor's degree or higher, defined as having high education, and the others, defined as having low education. We do not find robust evidence for heterogeneous education effects, which is consistent with earlier evidence on labor market outcomes in Japan (Fukai et al., 2021). In contrast, the literature shows that the effects of the pandemic in other countries differ across education in the short-term but this difference disappears in the long-term. Lee et al. (2021) and Adams-Prassl et al. (2020) report that in the U.S., women without a college degree were more likely to experience job loss in April, but Lee et al. (2021) also shows that, in November, the difference between women with and without a college degree had disappeared.

In the second column of Table 2, we observe rather weak evidence of regional differences in the effects through childcare responsibilities. For the regional dummy variable, we use data on the fraction of elementary schools that was reopened by June 1 in each prefecture, and we define an area with a high opening rate as one with a fraction higher than 50%. Based on this definition, we may expect differences in the effects of childcare responsibilities, as a higher rate of school

[17] In Appendix B, we present sets of figures explaining what the estimates capture. Starting from the effects of the pandemic in each subgroup, we graphically show the heterogeneity in the effects of childcare responsibilities.

openings may reflect either a less serious prevalence of the pandemic or better policy of those regional governments, which could reduce the childcare burden of mothers in those regions. The point estimate for the second column of Table 2 in April is 2.35 percentage points, although it is not statistically significant. However, the estimates are reduced to below zero in the fourth quarter of 2020. Thus, in summary, the estimates suggest that regional differences in childcare responsibilities are limited, especially in the longer term.

Finally, we examine the heterogeneity across the type of employment contracts in the third column of Table 2. For this analysis, we construct a dummy variable indicating that an employee had a permanent contract in the previous year. We observe no clear pattern of heterogeneity across contract type in the employment rate. In addition, the coefficients from almost all of the outcomes related to the labor force status of married women with children remain around zero. One exception is the rate of temporary leave, as employees with a temporary contract were 6.0 percentage points more likely to take temporary leave than employees with a permanent contract. One may expect that, during the COVID-19 pandemic, firms would be more likely to reduce their employment by firing temporary workers rather than permanent workers. However, this intuition may not be directly applicable because we focus only on the effects through childcare responsibility, rather than the overall effects of the pandemic.

Overall, we do not find evidence of heterogeneous effects through childcare responsibilities across subgroups. The results discussed above imply that childcare responsibilities under the COVID-19 pandemic equally affected the employment rate of married women with children in the different subgroups. Hence, we conclude that the pandemic has not widened the existing employment gaps across the subgroups among married women with children.

Table 2: Heterogeneity Analyses of the Employment Status

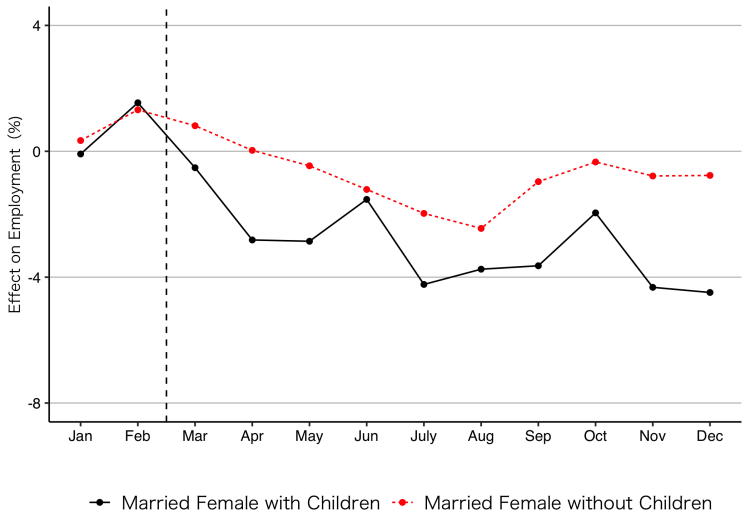
	Dependent variable: Employment Rate		
	High Educ.	More Schools Reopened	Permanent Contract
January	0.031	−1.974	1.316
	(1.584)	(1.518)	(1.761)
February	−4.535**	−0.924	0.646
	(1.799)	(1.590)	(1.825)
March	−3.208*	0.027	0.428
	(1.855)	(1.600)	(1.814)
April	−2.798	2.354	−1.499
	(1.964)	(1.715)	(2.145)
May	−0.193	1.411	−1.573
	(1.830)	(1.705)	(1.959)
June	0.549	0.359	0.171
	(1.913)	(1.788)	(1.893)
July	2.187	0.782	1.329
	(1.770)	(1.593)	(1.960)
August	2.964**	1.018	−2.373
	(1.501)	(1.464)	(1.505)
September	−0.387	2.397	0.731
	(1.760)	(1.688)	(2.152)
October	−0.617	−0.509	−0.281
	(1.687)	(1.591)	(1.888)
November	1.578	−2.688	−0.330
	(1.877)	(1.707)	(1.829)
December	−1.138	−0.142	2.750
	(2.441)	(2.204)	(2.774)
Observations	210,891	210,891	134,085

Notes: Standard errors in parentheses are clustered at the individual level. The first column in the table shows the coefficients for interaction terms between treatment dummy and high education dummy (=1 if one has college degree or above) in Equation (2). The second column in the table shows the coefficients for interaction terms between treatment dummy and high opening rate dummy (=1 if one lives in the area with the school opening rate above 50% at the beginning of June, 2020) in Equation (2). The third column in the table shows the coefficients for interaction terms between treatment dummy and permanent position dummy (=1 if one works as a permanent employee in the previous year) in Equation (2). $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$. The estimation sample is restricted to married women in age 25 to 54 with information of their education and their working status in the previous year.

D Additional Figures (Not For Publication)

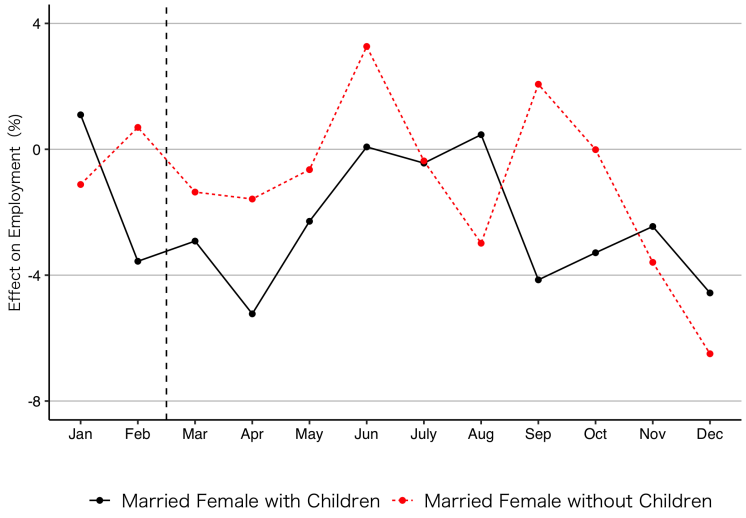
D.1 Heterogeneous Effects of Increased Childcare Responsibilities

Figure 28: The Effects of the Pandemic on the Employment Rate: Married Women with and without Children (Conditional on Low Education)



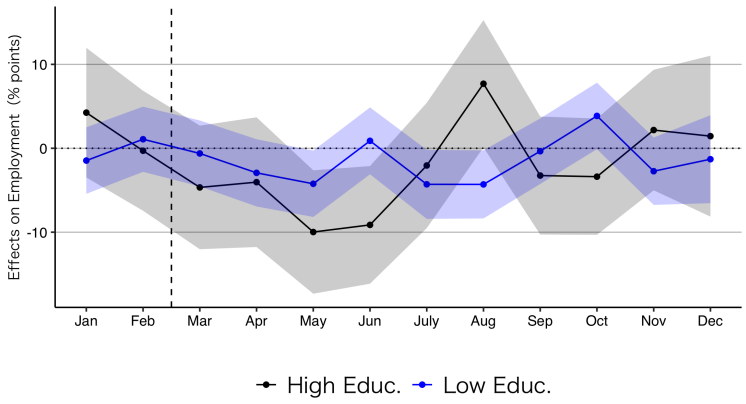
Notes: We consider married women without a college degree. The solid and dashed lines represent the effect of the COVID-19 pandemic on the employment rate for married women with and without children in 2020, respectively. The effect of the COVID-19 pandemic on the employment rate is defined by the difference between the actual and counterfactual employment rates in 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 29: The Effects of the Pandemic on the Employment Rate: Married Women with and without Children (Conditional on High Education)



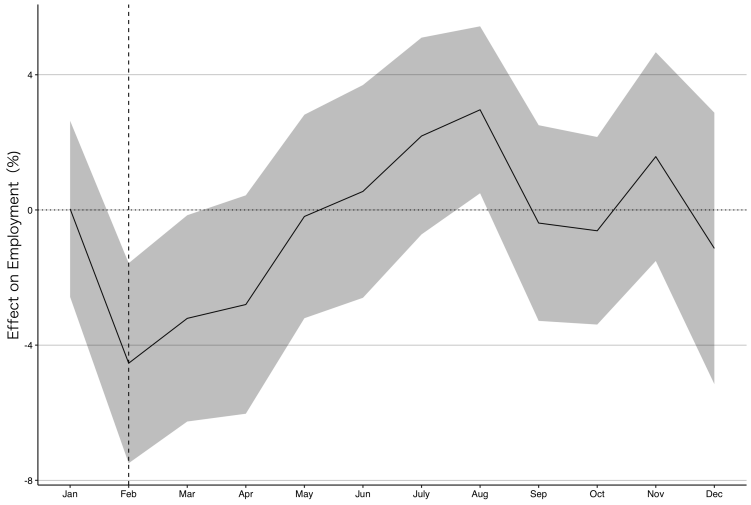
Notes: We consider married women with a college degree. The solid and dashed lines represent the effect of the COVID-19 pandemic on the employment rate for married women with and without children in 2020, respectively. The effect of the COVID-19 pandemic on the employment rate is defined by the difference between the actual and counterfactual employment rates in 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 30: The Effects of the Pandemic through Childcare Responsibilities on the Employment Rate (Conditional on Education)



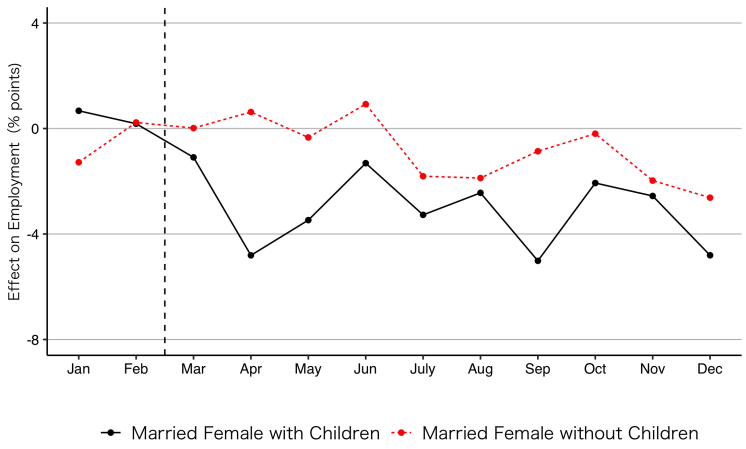
Notes: The black solid line represents the effects of the COVID-19 pandemic through childcare responsibilities on the employment rate for married women with children and with a college degree in 2020. The blue solid line represents the effects of the COVID-19 pandemic through childcare responsibilities on the employment rate for married women with children and without a college degree in 2020. The shaded area represents 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women in age 25 to 54 with children whose information on their education and working status in the previous year were available.

Figure 31: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Employment Rate by Education



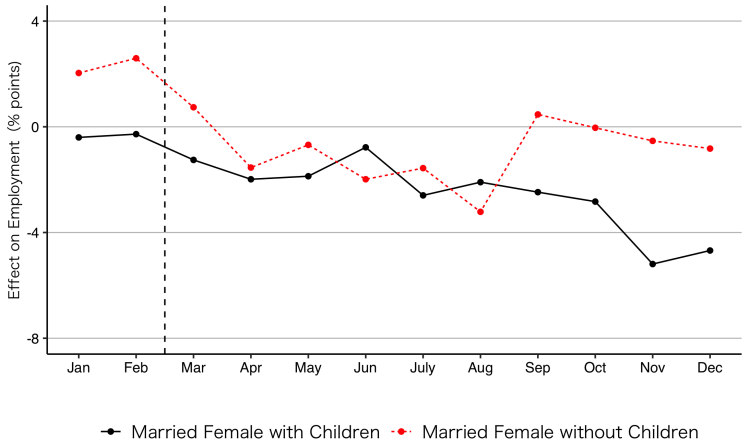
Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the employment rate for married women with and without a college degree. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level.The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 32: The Effects of the Pandemic on the Employment Rates: Married Women with and without Children (Conditional on Less Schools Reopened)



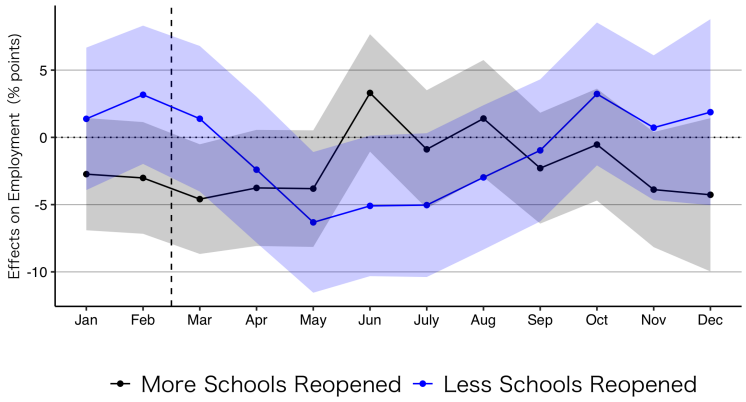
Notes: We consider married women who live in the prefectures where the rate of reopening of elementary schools is below 50%. The solid and dashed lines represent the effect of the COVID-19 pandemic on the employment rate for married women with and without children in 2020, respectively. The effect of the COVID-19 pandemic on the employment rate is defined by the difference between the actual and counterfactual employment rates in 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 33: The Effects of the Pandemic on the Employment Rates: Married Women with and without Children (Conditional on More Schools Reopened)



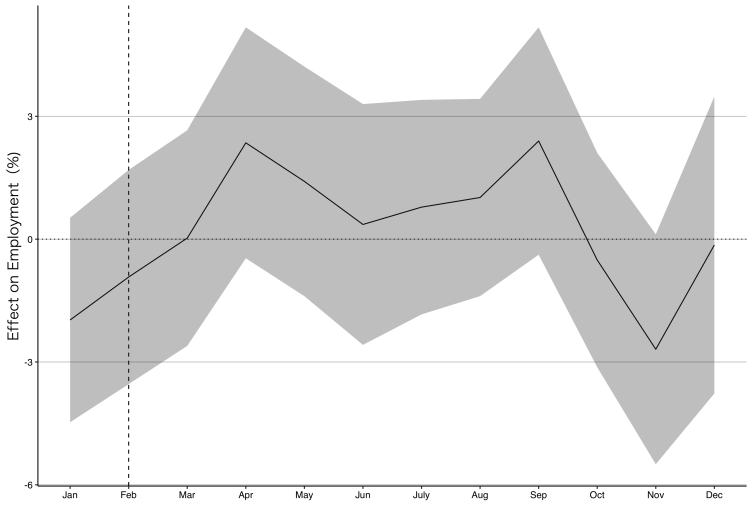
Notes: We consider married women who live in the prefectures where the rate of reopening of elementary schools is above 50%. The solid and dashed lines represent the effect of the COVID-19 pandemic on the employment rate for married women with and without children in 2020, respectively. The effect of the COVID-19 pandemic on the employment rate is defined by the difference between the actual and counterfactual employment rates in 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 34: The Effects of the Pandemic through Childcare Responsibilities on the Employment Rate: More and Less Schools Reopened



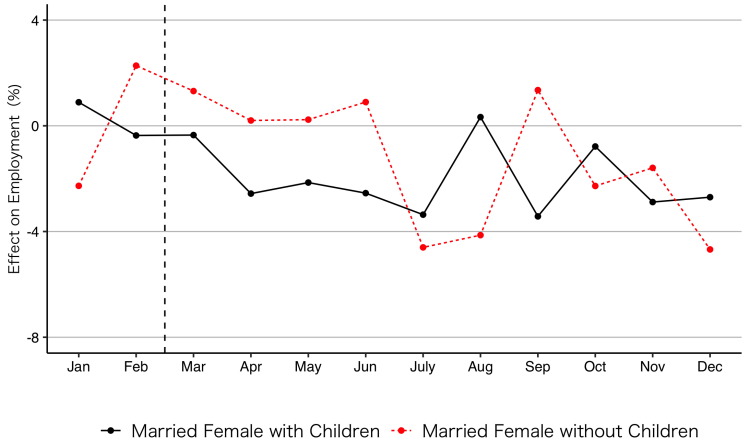
Notes: The black solid line represents the effects of the COVID-19 pandemic through childcare responsibilities on the employment rate for married women with children and who live in the prefecture where the rate of reopening of elementary schools at the beginning of June is above 50%. The blue solid line represents the effects of the COVID-19 pandemic through childcare responsibilities on the employment rate for married women with children and who live in the prefecture where the rate of reopening of elementary schools at the beginning of June is below 50%. The shaded area represents 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women in age 25 to 54 with children whose information on their education and working status in the previous year were available.

Figure 35: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Employment Rate across Region Categories



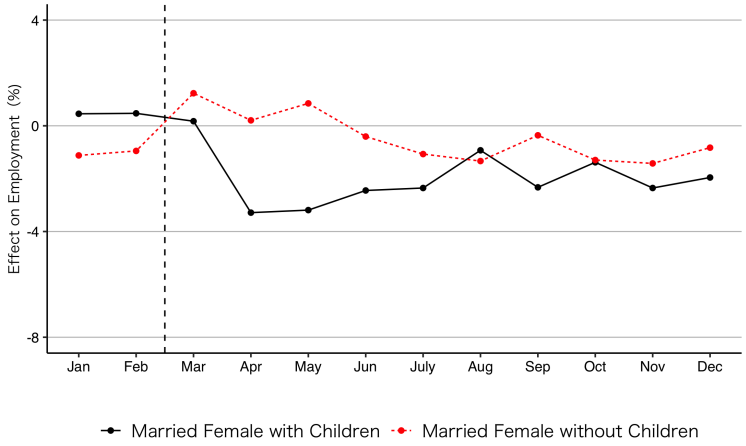
Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the employment rate across the regional category. In other words, we consider the difference in the effect through childcare responsibilities between the regions where the rate of school reopening is high and low. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level.The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 36: The Effects of the Pandemic on the Employment Rates: Married Women with and without Children (Conditional on Non-Permanent)



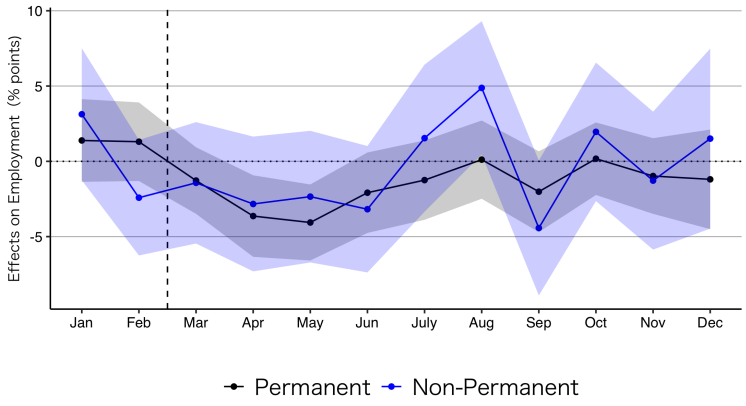
Notes: We consider married women without a permanent contract. The solid and dashed lines represent the effect of the COVID-19 pandemic on the employment rate for married women with and without children in 2020, respectively. The effect of the COVID-19 pandemic on the employment rate is defined by the difference between the actual and counterfactual employment rates in 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 37: The Effects of the Pandemic on the Employment Rates: Married Women with and without Children (Conditional on Permanent)



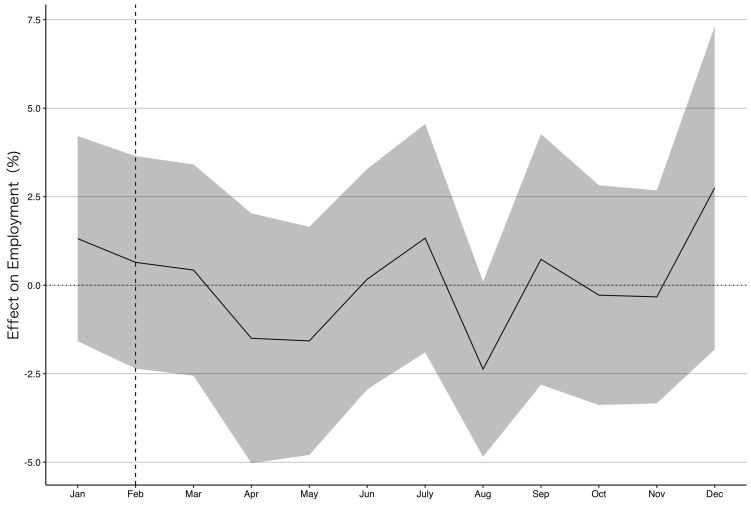
Notes: We consider married women with a permanent contract. The solid line represents the effects of the COVID-19 pandemic on the employment rate for married women with children in 2020. The solid and dashed lines represent the effect of the COVID-19 pandemic on the employment rate for married women with and without children in 2020, respectively. The effect of the COVID-19 pandemic on the employment rate is defined by the difference between the actual and counterfactual employment rates in 2020. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women aged 25-54 with children whose information on their education and working status in the previous year were available.

Figure 38: The Effects of the Pandemic through Childcare Responsibilities on the Employment Rate: Permanent and Non-Permanent



Notes: The black solid line represents the effects of the COVID-19 pandemic through childcare responsibilities on the employment rate for married women with children and who have a permanent contract in the previous year. The blue solid line represents the effects of the COVID-19 pandemic through childcare responsibilities on the employment rate for married women with children and who have a permanent contract in the previous year. The shaded area represents 90 % confidence intervals, which are computed from standard errors clustered at the individual level. The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March 2020. The estimation sample is restricted to married women in age 25 to 54 with children whose information on their education and working status in the previous year were available.

Figure 39: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Employment Rate across Employment Contract Categories

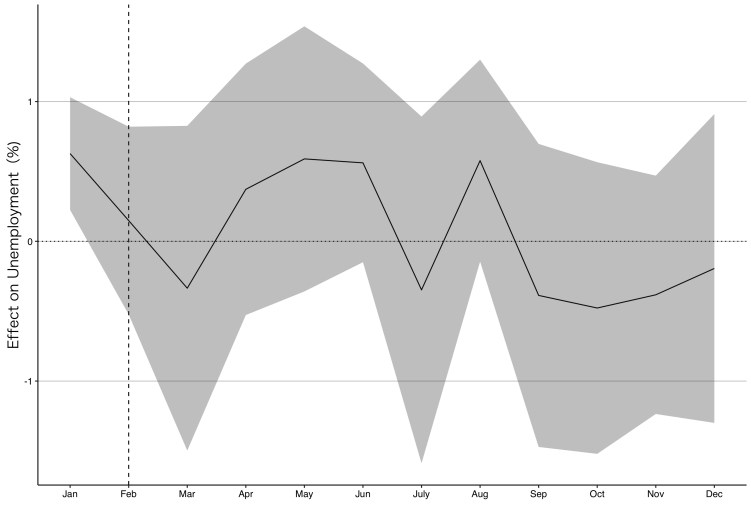


Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the employment rate of married women with and without a permanent contract. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level.The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 40: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Rates of Temporary Leaves across Employment Contract Categories

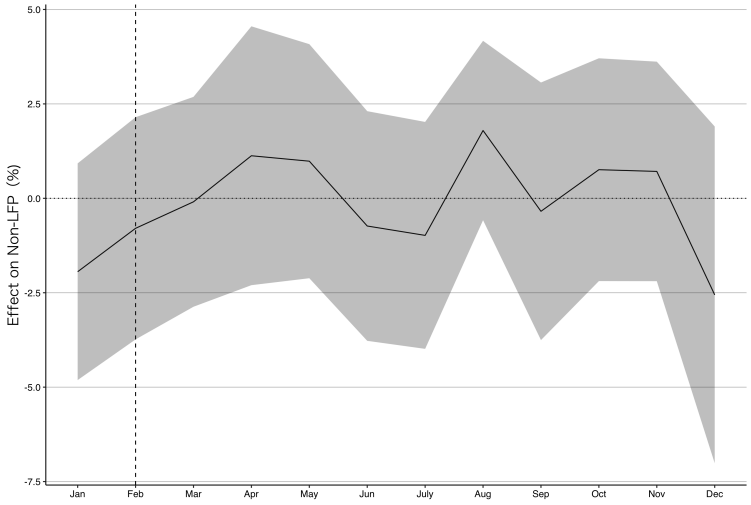
Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the rate of temporary leave of married women with and without a permanent contract. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level.The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 41: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Unemployment Rates across Employment Contract Categories



Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the unemployment rate of married women with and without a permanent contract. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level.The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

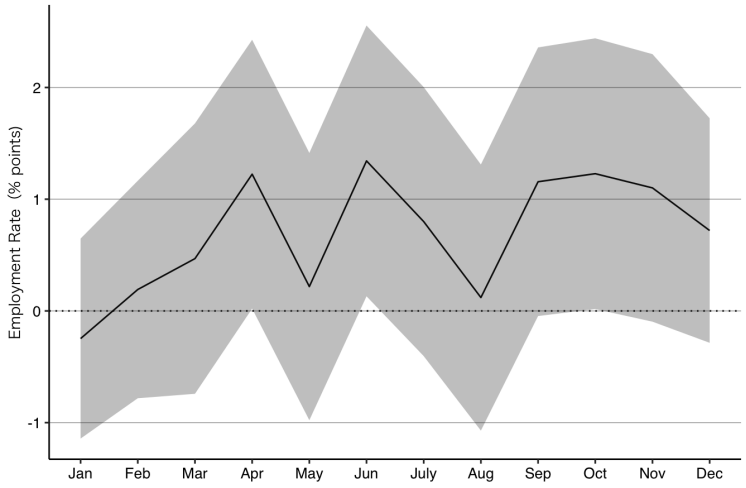
Figure 42: The Heterogeneous Effects of the Pandemic through Childcare Responsibilities on the Rates of Being out of Labor Force across Employment Contract Categories



Notes: The solid line represents the difference in the effect of the COVID-19 pandemic through childcare responsibilities on the rate of being out of labor force of married women with and without a permanent contract. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level.The vertical line in the graph represents the outbreak of the COVID-19 pandemic in Japan at the beginning of March2020. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

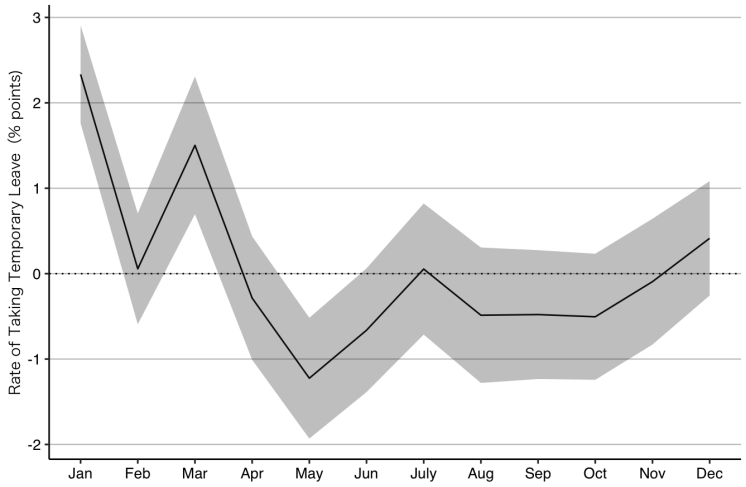
D.2 Seasonality in Labor Force Status

Figure 43: Differences in Month Effects on Employment Rate between Married Women with and without Children



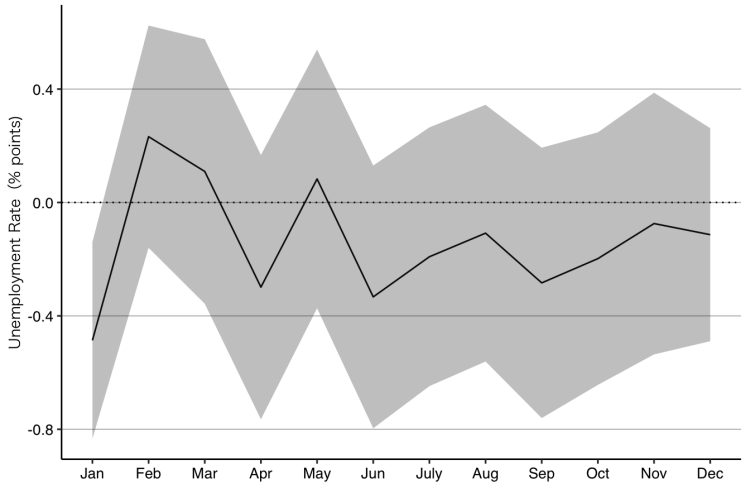
Notes: The solid line represents the difference in the employment rate of married women with and without children using data before 2020. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 44: Differences in Month Effects on Rate of Taking Temporary Leave between Married Women with and without Children



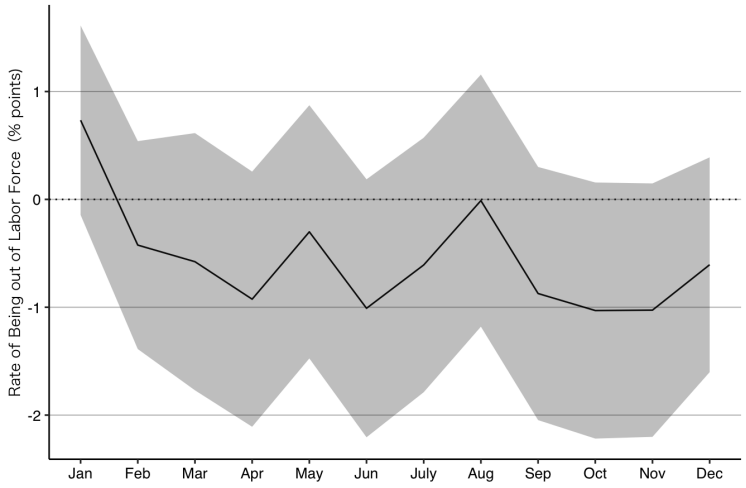
Notes: The solid line represents the difference in the rate of taking temporary leave of married women with and without children using data before 2020. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 45: Differences in Month Effects on Unemployment Rate between Married Women with and without Children



Notes: The solid line represents the difference in the unemployment rate of married women with and without children using data before 2020. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

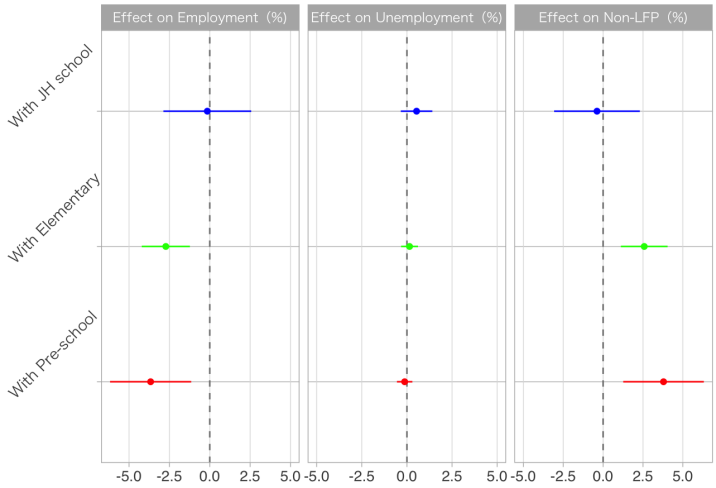
Figure 46: Differences in Month Effects on Rate of Being out of Labor Force between Married Women with and without Children



Notes: The solid line represents the difference in the rate of being out of labor force of married women with and without children using data before 2020. The shaded area represents the 90% confidence intervals, which are computed from standard errors clustered at the individual level. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

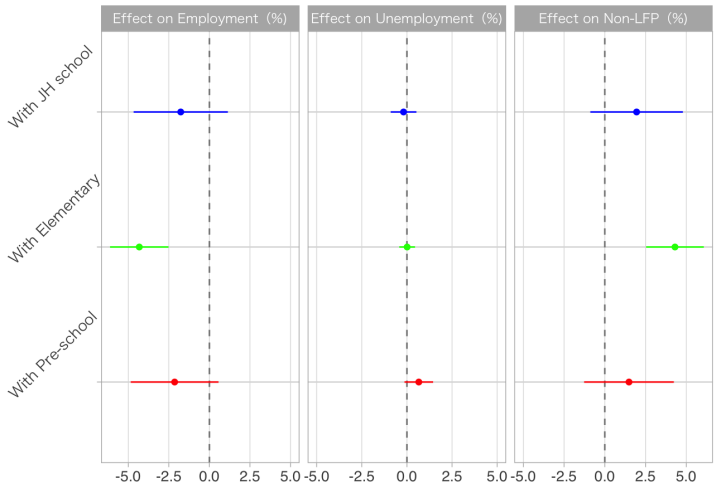
D.3 Heterogeneity by Marital Status and Age of the Youngest Child

Figure 47: The Average Effects of COVID-19 from July to September by the Age of Youngest Child



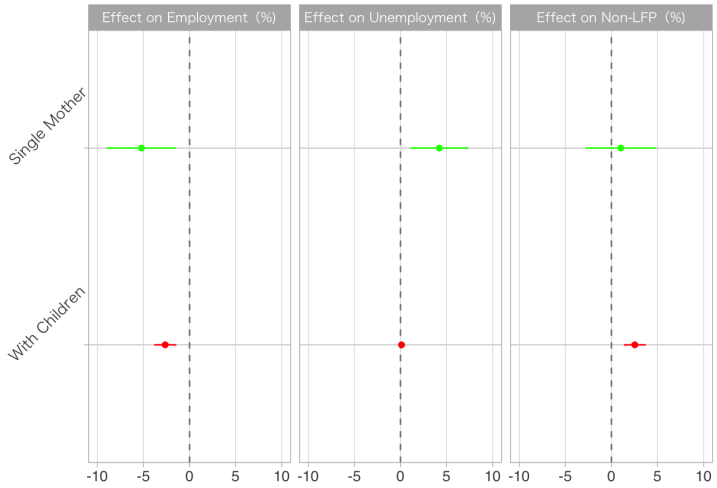
Notes: The first (leftest) graph shows the average effects of the pandemic on the employment rates. The second (middle) graph shows the average effects of the pandemic on the unemployment rates. The third (rightest) graph shows the average effects of the pandemic on the rates of being out of labor force. In each graph, the first row (highest) shows the average effects on married women with children in junior high school, 15, 14-year-old or younger. The second row (middle) shows the average effects on married women with children in elementary school, 12, 11-year-old or younger. The third row (lowest) shows the average effects on married women with children in pre-school or younger, 6, 5-year-old or younger. The solid lines represent the 90% confidence intervals for each point estimates. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 48: The Average Effects of COVID-19 from October to December by the Age of Youngest Child



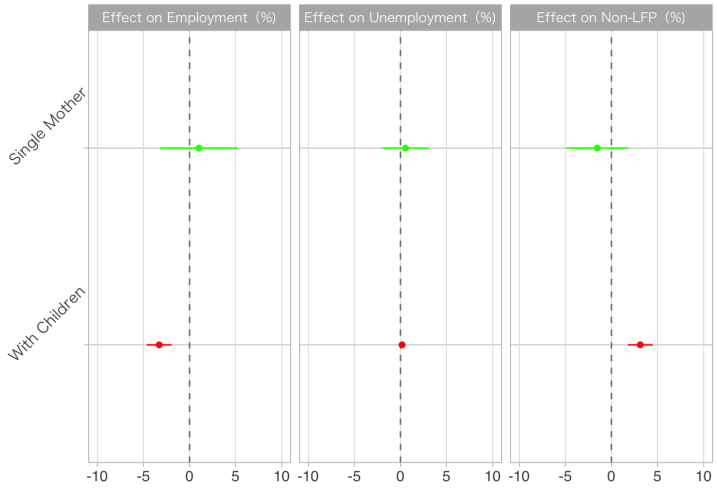
Notes: The first (leftest) graph shows the average effects of the pandemic on the employment rates. The second (middle) graph shows the average effects of the pandemic on the unemployment rates. The third (rightest) graph shows the average effects of the pandemic on the rates of being out of labor force. In each graph, the first row (highest) shows the average effects on married women with children in junior high school, 15, 14-year-old or younger. The second row (middle) shows the average effects on married women with children in elementary school, 12, 11-year-old or younger. The third row (lowest) shows the average effects on married women with children in pre-school or younger, 6, 5-year-old or younger. The solid lines represent the 90% confidence intervals for each point estimates.The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 49: The Average Effects of COVID-19 from July to September for Married Women with Children and Single Mothers



Notes: The first (leftest) graph shows the average effects of the pandemic on the employment rates. The second (middle) graph shows the average effects of the pandemic on the unemployment rates. The third (rightest) graph shows the average effects of the pandemic on the rates of being out of labor force. In each graph, the first row (high) shows the average effects on married women with children. The second row (low) shows the average effects on single mothers. The solid lines represent the 90% confidence intervals for each point estimates. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.

Figure 50: The Average Effects of COVID-19 from October to December for Married Women with Children and Single Mothers



Notes: The first (leftest) graph shows the average effects of the pandemic on the employment rates. The second (middle) graph shows the average effects of the pandemic on the unemployment rates. The third (rightest) graph shows the average effects of the pandemic on the rates of being out of labor force. In each graph, the first row (high) shows the average effects on married women with children. The second row (low) shows the average effects on single mothers. The solid lines represent the 90% confidence intervals for each point estimates. The estimation sample is restricted to married women aged 25-54 whose information on their education and working status in the previous year was available.