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COVID and Mothers Leaving the Labor Force in Egypt

Ali Abboud,
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Where have all the mothers gone? COVID and mothers leaving the labor force in Egypt*

Ali Abboud[†], Serena Canaan[‡], Mahyar Rezazadeh[§], Nisreen Salti[¶]

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Abstract

This paper looks at the effect of COVID on the gender gap in labor market outcomes in Egypt, where the female employment rate has chronically been low. Using data from Labor Force Surveys in Egypt (2017-2021), we calculate the difference-in-differences (DD) in the employment rate, weekly hours worked, and labor earnings between men and women before and after COVID to estimate the COVID effect on gender gaps. We then estimate a triple differences (DDD) estimator separating out the effect for mothers, using men and childless women as two different control groups. DD estimates show a significant worsening of the gender gap in employment and weekly hours worked after COVID. Our DDD estimates, however, show that for women without children these gaps remain stable. The comparison of the DD and DDD results suggests that the worsening of gender gaps is largely explained by a significant drop in the employment of mothers, over and above any changes for childless women. Among mothers, the gap widens more for mothers of school-age children, and the number of children is inversely related to mothers' employment. A large age difference between the youngest and oldest child is protective of mothers' employment. On the intensive margin, COVID's labor market effects fell disproportionately on Egyptian women, whose hours of work declined more than men's. The effect was especially sharp for mothers, as their labor supply also fell on the extensive margin. Our findings suggest this loss of employment is largely due to the added childcare burden during COVID, which exacerbated an already highly gendered distribution of unpaid care work.

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[†] Assistant Professor, Department of Economics, American University of Beirut; email: aa184@aub.edu.lb

[‡] Assistant Professor, Department of Economics, Simon Fraser University; email: scanaan@sfu.ca

[§] PhD Candidate, Department of Economics, Simon Fraser University; email: smr20@sfu.ca

[¶] Associate Professor, Department of Economics, American University of Beirut; and Economic Research Forum research fellow; email:nisreen.salti@aub.edu.lb

1 Introduction

The Egyptian labor market has historically had persistent gender gaps in many labor market outcomes (Krafft et al. (2019)). The effects of COVID on the labor market have been reported to fall disproportionately on the shoulders of women workers globally (Lim and Zabek (2024), Russell and Sun (2020), Corsi and Ilkkaracan (2023)). Following COVID, the South West Asia and North Africa (SWANA) region saw the 2nd highest drop in women's employment worldwide (ElBehairy et al. (2022)). In this study, we assess the effect of the pandemic on the gender gap in labor market outcomes in Egypt. We use individual-level data from Egypt's annual labor market surveys from 2017-2021, focusing on three primary labor market outcomes: weekly hours worked, the employment rate, and labor market earnings.

A rich literature has documented the gender gap in Egypt, by age group, sector of activity, and educational attainment (Assaad et al. (2020), Krafft et al. (2019)). Persistently low female labor force participation has also been examined over time, as well as by education and marital status (Sayre and Hendy (2016), Hendy (2015)). Analyses of time-use surveys have shown a disproportionate allocation of women's time to unpaid care work at home, particularly for married women and mothers (Atallah and Hesham (2024)).

Looking at the effect of COVID, we find that after controlling for sociodemographic characteristics of the respondent and their household, and using a difference-in-differences (DD) approach, the gender gaps for three main labor market outcomes are wider after the pandemic, confirming the higher incidence of the burden of the pandemic on active women in terms of the employment rate, weekly hours worked, and labor market earnings. The results of our estimation for the gender gap in the employment rate show a drop 2.6-4.7 percentage points sharper for women. For other labor market outcomes, like weekly hours worked, women are more affected by the negative shock of COVID, with women's weekly hours worked decreasing by 4.5-5 percentage points more than men's, conditional on being employed. The COVID shock is shown to lead more women to both completely leave employment and to simply adjust their working hours downward, compared to men. Our findings are consistent with the results of other studies that have looked at gender differences in the susceptibility of labor market outcomes to COVID in Egypt (Rodriguez et al. (2023)).

However, while the literature has only looked at the effect of COVID on labor market outcomes disaggregated by sex, we examine the effect more closely for different groups of workers. Because the nature of the COVID shock and related pandemic containment measures are likely to have affected different segments of the workforce differently, we look at the heterogeneity in the response to the shock for different groups of women. We exploit the fact that COVID increased the cost of childcare due to mandated closures of schools and daycare centers (Fadlalmawla et al. (2022), Russell and Sun (2020), Dutra Carolino et al. (2023)). In line with the findings of Atallah and Hesham (2024), we postulate that these pandemic containment measures affect mothers more than they do men and non-mothers. Our approach is similar to the one used by Couch et al. (2022), which analyzes the labor market response to COVID for mothers in the United States.

We leverage thte DD results to derive a triple difference-in-differences (DDD) estimator (Gruber (1994)), using women without children as an additional control group. This identification strategy is used to measure the effect of changes in the childcare burden during COVID on the gender gap, after controlling for confounding factors. Comparing our DD and DDD results, our analysis identifies the additional childcare burden as the primary mechanism contributing to a more significant decrease in the employment rate for women compared to men. The COVID shock caused a higher decline of 2.5 percentage points in the employment rate for mothers of children aged 0-14 years, compared to women without children and men. We find that most of the change in the gender gap in the employment rate is due to mothers leaving their jobs, while the change in the employment rate for childless women around the pandemic parallels that of men. For women who stay in the work force, DDD results show a decline in hours worked for all women, with no significant differences between mothers and non-mothers.

Finally, we examine the effect of the shock over time to assess how this motherhood-specific response changes during the peri-COVID period. Our seasonal DDD estimations compare the season-specific employment outcomes of mothers with those of the two other control groups, using data from the same season before COVID occurred. Consistent with our initial DDD estimation, mothers' employment rates continuously decrease over time, up to four quarters after the shock begins.

We test the robustness of our findings by verifying that the labor market losses for mothers are not due to other effects, by estimating the effect for households with different age and generational compositions. We are also able to rule out that the larger shock to mothers' work is due to mothers being concentrated in sectors or types of employment that are more vulnerable to COVID.

Our analysis therefore offers a more granular account of the widely reported drop in women's employment in Egypt during the pandemic (ElBehairy et al. (2022), Krafft et al. (2022), Rodriguez et al. (2023)). The comparison of DD and DDD results suggests that much of the effect of COVID-19 on gender gaps is driven by the increase in the childcare burden that pandemic containment measures caused. Our results are also consistent with other studies that have attempted to estimate the impact of COVID on mothers' labor market outcomes in industrialized countries (Couch et al. (2022); Russell and Sun (2020); Heggeness (2020)).

In terms of magnitude, our main finding for the employment rate is of note because it is both larger than the declines found for mothers in industrialized countries, and because the employment rate for women in Egypt was already low (around 17%). The additional decrease for women represents a 14 percent drop in the employment rate. We also observe a more persistent effect on labor outcomes for mothers than in other contexts, with effects seen on the extensive rather than the intensive margin in the supply of mothers' labor.

2 Empirical Methodology

2.1 Data

We use data from five Egypt Labor Force Surveys (HLFS (2017-2021)) covering the period 2017-2021. In every calendar year, data is collected over four rounds, allowing us to exploit quarterly variations. We restrict the sample to individuals between the ages of 17 and 60. Students, permanently retired individuals, and people with disabilities were excluded from the sample. The final sample is comprised of 1.5 million observations across 400,000 household-quarters.

The survey contains detailed information on labor market status and sociodemographic characteristics of individuals. The main outcomes of interest are employment status, weekly hours worked, and labor market earnings (log of monthly labor income). Weekly hours are measured conditional on being employed, and labor market earnings are reported in Egyptian pounds.[1]

Table 1 presents summary statistics of the three outcomes disaggregated by sex and parental status. It also reports the average household size and years of education. Statistics are reported separately for the pre- and peri-pandemic periods in panels A and B, respectively.

Table 2 shows the mean difference in the three labor market outcomes of interest between women and men in the different groups of our study. In the pre-pandemic period, men's average labor supply is significantly higher than that of women, with higher rates of employment and weekly hours worked. Moreover, in a simple test of equality of means

[1] The average inflation rate in Egypt during the years covered by our study is approximately 9%.

Table 1: Summary statistics of demographic characteristics

	All	Urban		Rural	
		Men	Women	Men	Women
Panel A. Pre-pandemic					
Age	28.8	29.5	30	31.30	27.13
Marriage Rate	0.65	0.61	0.61	0.65	0.69
Household size	4.85	4.64	4.55	5.05	4.97
Number of kids	2.74	2.55	2.48	2.91	2.86
Years of education	6.8	8.5	7.7	6.8	5.3
No. observations	982,032	191,470	190,317	304,800	295,445
Panel B. Post-pandemic					
Age	27.14	28.67	29.47	25.64	26.22
Marriage Rate	0.68	0.64	0.63	0.69	0.73
Household size	4.7	4.6	4.5	4.8	4.7
Number of kids	2.69	2.57	2.51	2.79	2.76
Years of education	7.2	8.5	8	7.1	5.9
No. observations	594,920	115,243	114,814	184,767	180,096

Source: Authors' calculations.

Table 2: Table of Labor Market Gender Gaps

	Full sample (1)			Parents (2)			Non-parents (3)		
	W (4)	M (5)	Difference M-W (6)	W (7)	M (8)	Difference M-W (9)	W (10)	M (11)	Difference M-W (12)
Panel A. Pre Covid									
Employment Rate	0.19	0.94	0.74***	0.19	0.94	0.74***	0.16	0.95	0.78***
Employment income	2051	2505	453***	2040	2520	479.4***	2198	2329	131.67
Weekly Hours Worked	39.8	46.26	6.42***	39.8	46.23	6.4***	39.9	46.7	6.76***
Panel B. Post Covid									
Employment Rate	0.17	0.94	0.77***	0.17	0.94	0.77***	0.17	0.95	0.77***
Labor Market Earnings	2629.17	3162.3	533.14***	2634	3180	545*	2578	2941	362.92
Weekly Hours Worked	36.75	43.04	6.29***	36.77	43.02	6.25***	36.5	43.3	6.79***

Notes: The table shows the average market outcomes for different groups of men and women.
Columns 6, 9, and 12 show the differences in the averages for each group before and after the shock (Panels A and B).
* denotes significance at 10%, ** at 5%, and *** at 1%.

(columns 6, 9 and 12), having children was associated with significantly higher employment rates among women.

At the aggregate population level, there was a noticeable decline in weekly hours worked after the onset of the pandemic. Employment rates, on the other hand, remained relatively constant. Disaggregated data show that women had a relatively larger drop in weekly hours worked compared to men. Moreover, women with children were the only group with a significant decline in the rate of employment.

There was a significant increase in labor market earnings of employed men and women, as shown in Table A.1.[2] Among women, the increase in average earnings is greater for mothers. At the same time, working mothers had a 3.4 percentage point decline in employment between the two periods; therefore, it is likely that at least a proportion of the documented increase in labor earnings is due to selective dropout from employment, as working mothers with lower wages are more likely to leave employment when the opportunity cost of work increases. Overall, the changes in labor earnings during the pandemic show an increase in the average labor earnings gap between men and women.

2.2 Empirical Framework

Women bear a heavier childcare burden than men for a variety of reasons, one of which is that men typically have more bargaining power within the household (García-Mainar et al. (2011)). This gender disparity in childcare responsibilities appears to have worsened during the pandemic. The closures of schools and daycare centers led to an increase in the time children spend at home, increasing demand for childcare in households with children of schooling age (Zamarro and Prados (2021), Fadlalmawla et al. (2022)).

In a first step, we look at the heterogeneity in the effect of COVID on men and women by tracking the effect of the pandemic shock on the gender gap in labor market outcomes.

In a second step, we take a more fine-grained look at the labor force by allowing for more heterogeneity in the effect of COVID on different groups of workers of the same sex: we look at mothers and childless women separately. We use a triple difference method to identify the effect of COVID on the gender gap in employment for mothers in comparison to that for non-mothers. We then try to confirm our hypothesis that the differential effect observed for

[2] The Egyptian government introduced a number of in-kind and in-cash assistance programs during COVID, including public health interventions, economic and social support, business relief, etc Baloch et al. (2020); Jrad et al. (2023).The increase in average labor earnings earning after the shock may be reflecting some of this social assistance.

mothers is due to the increase in the childcare burden.

2.3 Empirical strategy

We start by using the Difference-in-Differences (DD) method to investigate whether COVID affected the gender gap in the labor market. The DD specification, represented in equation (1), allows us to estimate the effect of the COVID shock on the gender gap in various labor market outcomes.

$$y_i = \alpha_0 + \alpha_1 Female_i + \alpha_2 Covid_i + \gamma_{DD} Female_i \times Covid_i + \beta' X_i + \epsilon_i \quad (1)$$

where y_i is the labor market outcome of individual i. We focus on three main job market outcomes: employment rate, weekly hours worked, and labor earnings. The employment rate allows us to measure the effect of the shock on women's labor market status on the extensive margin, while weekly hours worked allow us to measure it on the intensive margin. Relative changes in the weekly hours worked are estimated conditional on remaining employed, and can be considered a less severe labor supply response compared to the employment rate. $Covid_i$ takes the value 1 if the date is after the first quarter of 2020 (begining from the second quarter), when the government implemented restriction policies, including closing schools, daycare centers, and many other sectors.[3] $Female_i$ is the indicator of whether individual i is male ($Female = 0$) or female ($Female = 1$). X_i is a vector of individual-level characteristics, such as age, years of education, sector of employment (where appropriate), and marital status, and household level characteristics such as household size and age of children. It also includes sets of region-by-quarter and sector-by-quarter fixed effects that account for time-varying regional and sectoral heterogeneity in the job market.

[3]The government instituted a lockdown from March 5th and it remained in place until the first quarter of 2022, when the Robert Koch Institute (RKI) removed Egypt from the list of international high-risk areas. For more information see https://global-monitoring.com/gm/page/events/epidemic-0001959.eI8QFDmrQAeG.html?lang=en.

We are interested in the coefficient γ_{DD} in equation 1. A negative γ_{DD} means that the COVID shock has had a stronger negative impact on women than on men, and the gender gap has worsened. The identifying assumption here is that the difference in labor market outcomes between men and women would have remained stable if the COVID shock had not occurred. [4]. To test this identifying assumption, we report the results of event studies for the employment rate across different groups in our sample in Figures 1, 2, and 3. As evident from the figures, women in all groups experience a decline in the employment rate when the shock occurs. The negative effect starts two quarters after the shock (last quarter of 2020), and the gap in employment continues even 5 quarters after the shock begins. A comparison between Figures 2 and 3 reveals that the main negative effect following the shock is due to mothers exiting the labor market (Figure 2). Meanwhile, the gap in the employment rate is closing for non-mothers after the shock happens. For other market outcomes, such as weekly working hours and employment income, the corresponding event study graphs are presented in the Appendix.

[4] It should be noted that any unobservable time-varying variables that affect the gender gap would bias the estimation of the COVID effect as measured by γ_{DD}

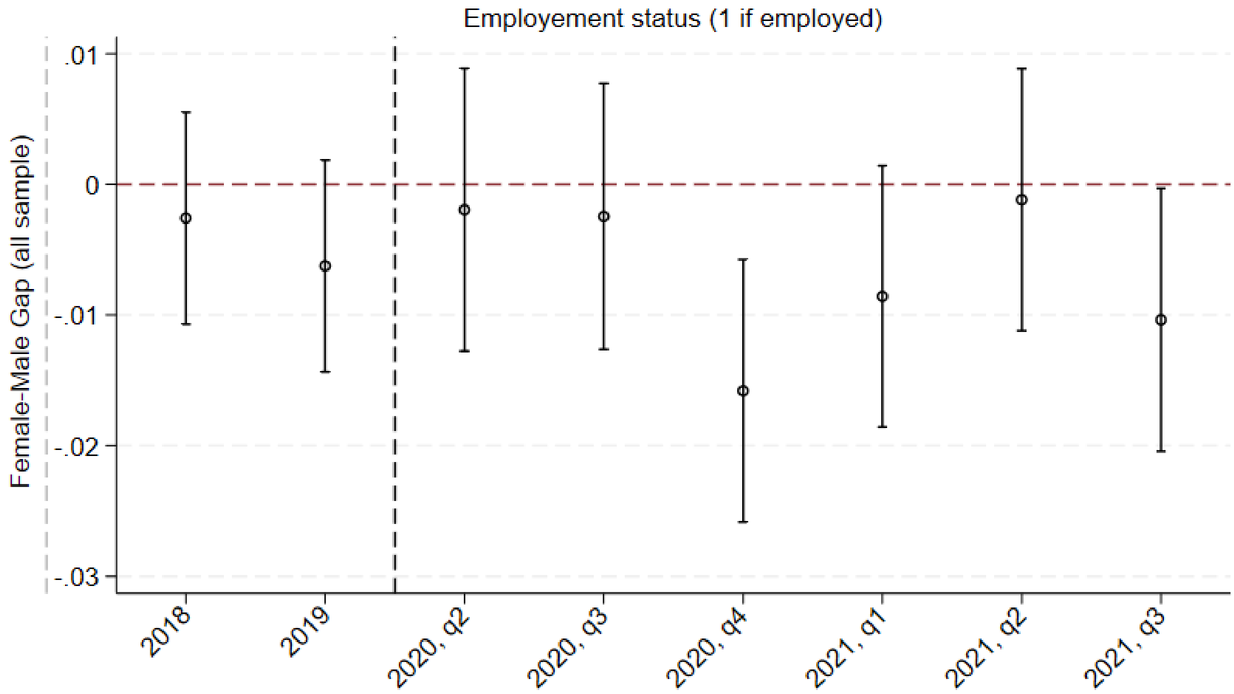

Figure 1: Event study, all sample(women and men)

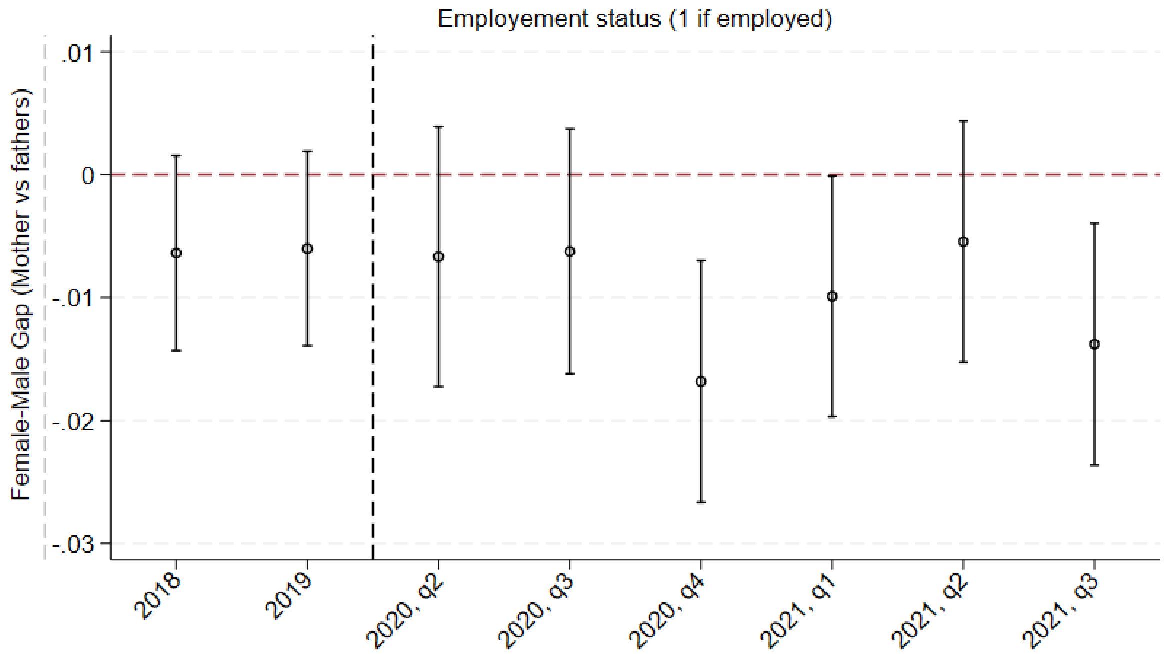

Figure 2: Event study, employment of mothers vs fathers

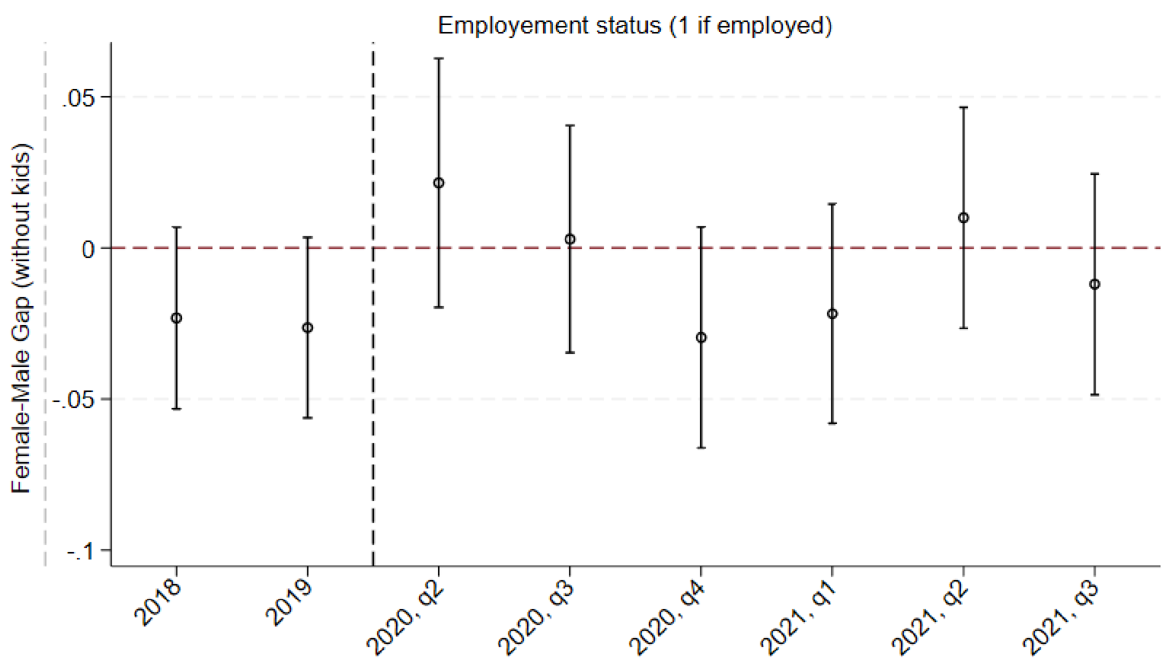

Figure 3: Event study, women and men without kids

Our second empirical strategy identifies the effect of the COVID shock on mothers separately using a DDD regression. Our identifying assumption in this step is that the COVID shock's effect on the gender gap in the employment rate is driven primarily by the shock to the childcare burden on mothers. In other words, the effect of COVID on the employment rate of non-mothers who are similar to mothers in all other characteristics (except having a child) is similar to its effect on the employment rate of men. This idea comes from comparing the numbers in columns 6, 9, and 12 of Table 2. The table shows the gender gap in the labor market before (Panel A) and after the COVID shock (Panel B). The unadjusted gender gaps in Table 2 indicate that the shock leads to a larger increase in gender gaps in employment and labor earnings for mothers compared to non-mothers. Interestingly, the gender gap in employment increases for group 2 (Parents) after the shock (from 0.74 to 0.772), but it decreases for group 3 (Non-parents) between the two panels (from 0.778 to 0.773). To further identify the effect of COVID on the labor market outcomes of mothers as compared to men and non-mothers, we use the specification in equation 2:

$$\begin{aligned} y_i = {} & \delta_0 + \delta_1 \text{Female}_i + \delta_2 \text{Covid}_i + \delta_3 \text{Female}_i \times \text{Covid}_i + \delta_4 \text{Kids}_i + \delta_5 \text{Female}_i \times \text{Kids}_i + \delta_6 \text{Covid}_i \times \text{Kids}_i \\ & + \gamma_{\text{DDD}} \text{Female}_i \times \text{Kids}_i \times \text{Covid}_i + \beta' X_i + e_i. \end{aligned} \tag{2}$$

where $Kids_i$ is a dummy variable that shows whether individual i has any children ($Kids = 1$) or not. All other variables are the same as defined in equation (1). The coefficient of γ_{DDD} estimates the specific effect of COVID on mothers. The next section provides the results of the estimations of equations (1) and (2).

3 Estimation results

3.1 Effect of the COVID shock on the gender gap

This section presents the main empirical results on the effect of the COVID shock on the gender gap in the labor market. We begin with findings from the first step DD estimation of the effect of the shock on women's labor market outcomes.

The DD results are shown in Tables 3, 4, and 5, each showing the results for a different labor market outcome. In each of these tables, the first pair of columns shows results for the full sample of working-age adults, the next pair of columns shows results for the subsample of working-age adults without children, and the last pair of columns for working-age adults with children. In each pair of columns, the first shows the results of our baseline specification with no controls and the second shows the results of a specification with controls for age, household size, years of education, and a rich set of fixed effects, such as seasonal-region fixed effects and sector-of-employment fixed effects.

Table 3 shows a larger gender gap in the employment rate following COVID. For the entire sample (first two columns), the DD estimation shows a 2.6pp−4.7pp larger reduction in the employment rate of women compared to men. Interestingly, the estimation results show no effect on the gender gap in the employment rate for women without children (columns 3 and 4); however, the gender gap in the employment rate for mothers is 2.9 percentage points (column 5, no controls) or 2.6 percentage points (column 6, with controls) larger than that for fathers during the pandemic. In other words, the main part of the shock's impact on the increase in the employment gender gap (columns 1 and 2) seems to be accounted for by the reduction in the employment rate of mothers (columns 5 and 6).

Mothers lost or left employment during the COVID shock, whereas the employment status of non-mothers did not change in a way that is significantly different from that of men, on net. This result is consistent with the findings of Aksoy et al. (n.d.) on the possibility of working from home during the pandemic. Using cross country data, they find that employment in Egypt was below the world average in the average number of days in which employees could work from home. With the lower possibility of telecommuting, mothers may have been compelled to leave their jobs altogether.

For weekly hours worked, the effect of the shock is an increase in the gender gap ($\gamma_{DD} < 0$), as shown in all columns of Table 4. The COVID shock causes a significant reduction in weekly hours worked for all workers, and a significantly larger decline for both groups of women. Women decrease their weekly hours worked, and both mothers and non-mothers are similarly affected by the shock in terms of magnitude. Columns 1-6 of Table 4 show a reduction in women's working hours by 4- to 5-percentage points more than men.

Table 5 shows the DD estimation of the COVID shock on labor market earnings. Columns 1-6 show no significant effect of the shock on the gender gap in labor market earnings. However, the results should be interpreted with caution due to a large number of missing observations in this variable, and because of potential measurement error and selection bias in respondents' willingness to answer the question. We lose around 90% of our sample when we run the regressions for labor earnings.

To further refine this result for the employment rate, we partition the sample by quarter and run the specification of our "baseline regression" from column 2 (with controls) to estimate the effect of the shock on mothers across different seasons. We look separately at mothers of any children who are 18 or younger and mothers of children who are all older than 18.[5] The results are presented in Table 6. The comparison group in each estimation is fathers in that category (Kids' age<=18 or Kids' age>18). For example, the second row of the table shows the estimate of γ_{DD} for mothers in that group (as compared to fathers)

[5] The results from running the baseline regression by season without separating households by age of children are not shown, but they yield significant negative coefficients on the interaction for mothers and post-COVID for each season.

during the spring season before and after the shock.

The findings indicate a more pronounced negative effect of the shock on mothers whose children are all of school age (18 and under). The magnitude and significance of this effect persist over four quarters after the shock begins. Interestingly, the negative impact diminishes over time for mothers with adult children. This is consistent with the findings of Couch et al. (2022), which documented the motherhood penalty of COVID for mothers with school-aged children in the US. What we find here is similar in that the results show a more negative effect for mothers with younger, school-aged children.

To further identify the channel through which the shock affects mothers' employment, we follow the method of Couch et al. (2022) of using a triple-difference estimation approach. This method estimates the effect of the shock on mothers' employment outcomes compared to two control groups: non-mothers and men.

Table 3: DD estimates of women relative to men (Employment rate)

	All sample		Without kids		With kids	
	(1)	(2)	(3)	(4)	(5)	(6)
Female × covid	-0.0263***	-0.0475***	-0.00523	0.0000865	-0.0289***	-0.0257***
	(-3.59)	(-3.16)	(-0.52)	(0.01)	(-3.92)	(-3.55)
Female	-0.755***	-0.745***	-0.814***	-0.796***	-0.748***	-0.740***
	(-55.22)	(-59.05)	(-73.54)	(-76.02)	(-52.65)	(-56.55)
Covid	-0.00657*	-0.00393	-0.00536	-0.00133	-0.00666*	-0.00385
	(-2.60)	(-1.55)	(-0.91)	(-0.21)	(-2.74)	(-1.54)
Individual controls	No	Yes	No	Yes	No	Yes
Region× quarter FE	No	Yes	No	Yes	No	Yes
Observations	742038	742032	76479	76474	665559	665552

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%.
Dependent variable in all specifications takes 1 if the person is employed. The omitted group in each subsample is all men, men without kids, and men with kids (fathers), respectively. Control variables include household size, marital status, years of education, age, and region × quarter fixed effects. Standard errors are clustered at the regional level. t-statistics are reported in the parenthesis

Table 4: DD estimates of women relative to men (Log weekly hours worked)

	All sample		Without kids		With kids	
	(1)	(2)	(3)	(4)	(5)	(6)
Female × Covid	-0.0404**	-0.0480***	-0.0436**	-0.0555***	-0.0399**	-0.0466***
	(-2.63)	(-3.53)	(-2.10)	(-3.00)	(-2.58)	(-3.40)
Female	-0.161***	-0.137***	-0.136***	-0.127***	-0.163***	-0.140***
	(-12.45)	(-11.31)	(-9.63)	(-7.48)	(-12.48)	(-11.61)
Covid	-0.0789***	-0.0777***	-0.0752**	-0.0765**	-0.0794***	-0.0779***
	(-4.67)	(-4.80)	(-3.30)	(-3.44)	(-4.82)	(-4.96)
Individual controls	No	Yes	No	Yes	No	Yes
Region× quarter FE	No	Yes	No	Yes	No	Yes
Observations	303853	303816	31088	31045	272765	272731

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%.
Dependent variable in all specifications is log of weekly working hours. The omitted group in each subsample is all men, men without kids, and men with kids (fathers), respectively. Control variables include household size, marital status, years of education, age, sector of employment fixed effects and region× quarter fixed effects. Standard errors are clustered at the regional level. t-statistics are reported in the parenthesis

Table 5: DD estimates of women relative to men (Log employment income)

	All sample		Without kids		With kids	
	(1)	(2)	(3)	(4)	(5)	(6)
Female × Covid	-0.0751	-0.0542	-0.101	0.0680	-0.0723	-0.0626
	(-1.26)	(-1.15)	(-0.71)	(0.53)	(-1.24)	(-1.32)
Female	-0.188**	-0.159***	-0.0161	-0.194*	-0.213***	-0.171***
	(-3.69)	(-4.12)	(-0.10)	(-2.61)	(-4.90)	(-4.11)
Covid	0.132*	0.0677	0.113*	0.0353	0.134**	0.0715
	(2.77)	(1.71)	(2.28)	(0.87)	(2.79)	(1.77)
Individual controls	No	Yes	No	Yes	No	Yes
Region× quarter FE	No	Yes	No	Yes	No	Yes
Observations	19115	18996	2532	2389	16583	16458

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%. Dependent variable in all specifications is log of employment income. The omittted group in each subsample is all men, men without kids, and men with kids (fathers), respectively. Control variables include household size, marital status, years of education, age, sector of employment fixed effects and region× quarter fixed effects. Standard errors are clustered at the regional level. t-statistics are reported in the parenthesis

Table 6: Baseline DD estimation for mothers by age of children

	Kids' ages<=18	Kids' ages>18
Winter: Mother × Covid	-0.418	-0.0043
	(-0.80)	(-0.26)
Observations	1738	26001
Spring: Mother × Covid	-0.114*	-0.054**
	(-1.68)	(-2.28)
Observations	1538	24686
Summer: Mother × Covid	-0.113**	-0.023
	(-2.13)	(-0.96)
Observations	2011	26336
Fall: Mother × Covid	-0.098***	-0.026
	(-3.44)	(-1.58)
Observations	1882	26906
All period: Mother × Covid	-0.0815***	-0.018
	(-2.60)	(-1.41)
Observations	8795	126988

* denotes significant at 10%, ** significant at 5% and *** significant at 1%. The dependent variable in both columns is the employment rate, and all controls are included in the specifications, as in the baseline model. The omitted group is fathers in each category (Kids' age<=18 and Kids' age>18). t-statistics are in the parenthesis

3.2 Estimation of the motherhood burden (DDD estimates)

To attempt to uncover the mechanism behind the COVID-induced widening of the gender gap, we separate women into two groups and run the DDD estimation of equation (2).

Results are shown in Table 7 for the three main labor market outcomes. Our estimates of the distinct effect on the employment rate of mothers are shown in columns 1 and 2, indicating a 3.4 percentage point larger decrease than for non-mothers. In other words, mothers are significantly likelier to have either lost or left their jobs than are non-mothers. A result of note is that for non-mothers, the change in employment related to COVID is not significantly different from that for men. While Table 3 had shown no significant difference in the drop in employment between non-mothers and non-fathers, Table 7 further shows that the change in the employment rate for non-mothers is no different than that for all men.

For those who remain employed on the other hand, women's weekly hours worked decreased significantly more than men's, and this reduction is not statistically different for mothers and non-mothers.

For labor market earnings, the results do not show any effect of the shock that is significantly different for mothers. As mentioned above, we should be careful when interpreting the results for labor market earnings because data on this variable are largely missing, and likely suffer from serious measurement error and selection bias.

Table 7: DDD estimates for mothers relative to men and other women

	Employment rate		Log of weekly hours worked		Log of employment income	
	(1)	(2)	(3)	(4)	(5)	(6)
Female×Covid×Having Kids	-0.0.353***	-0.0346***	0.00371	0.0106	0.0289	-0.0683
	(-3.86)	(-4.17)	(0.23)	(0.71)	(0.22)	(-0.86)
Female×Covid	0.0048	0.0063	-0.0436*	-0.0573**	-0.101	0.00558
	(0.40)	(0.53)	(-2.10)	(-3.27)	(-0.71)	(0.06)
Covid×Having kids	0.0107**	0.007	-0.00427	-0.00468	0.0209	0.0189
	(3.43)	(1.64)	(-0.40)	(-0.50)	(0.92)	(1.06)
Female × Kids	.00375***	0.044***	-0.0268**	-0.0237**	-0.197	0.00358
	(4.37)	(5.66)	(-2.86)	(-2.81)	(-1.46)	(0.05)
Having kids	-0.0096**	-0.0092**	0.0350***	0.0209*	0.106***	0.0107
	(-2.56)	(-2.45)	(3.98)	(2.47)	(5.82)	(0.29)
Female	-0.814***	-0.804***	-0.136***	-0.116***	-0.125	-0.291**
	(-73.54)	(-79.29)	(-9.63)	(-7.89)	(-0.72)	(-2.33)
Covid	-0.00560	-0.00776	-0.0752**	-0.0735**	0.113*	0.0515
	(-1.33)	(-1.86)	(-3.30)	(-3.46)	(2.28)	(1.34)
Individual controls	No	Yes	No	Yes	No	Yes
Region × quarter FE	No	Yes	No	Yes	No	Yes
Observations	742038	731879	303853	303739	19115	18977

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%.
Control variables include individual characteristics like household size, marital status, years of education, age, region× quarter fixed effects, and for columns 3-6, sector of employment fixed effects. Standard errors are clustered at the regional level. t-statistics are reported in the parenthesis.

We also run the DDD regression separately by seasons to examine the dynamic effect of the shock for four quarters after it occurs. The results are reported in Table 8. The dynamic effect illustrates how the COVID shock affects different groups over time. For example, the number in the first row of column 1 indicates that mothers' weekly hours worked in the spring season after the shock decreased by 3 percentage points more than it did for non-mothers and men, as compared to the springs before the shock.

The employment rate shows an interesting pattern. After the pandemic, there is significantly larger drop in spring employment for mothers (by around 3 pp). The shock effect is larger in the summer after the pandemic, with a decline in the employment rate 4.4 percentage points larger for mothers. This effect persists through winter, meaning it likely lasted a full year after the initial shock. This pattern provides evidence of a long-term persistent effect of the shock on mothers. This result is consistent with the results in Table 7 pooled across seasons, as well as the results in Table 3, which show that the gender gap in the employment rate is not significantly affected by COVID for non-mothers, whereas it is significantly affected for mothers.

This result is consistent with the findings from the literature that uses time-use surveys in Egypt. Atallah and Hesham (2024) use the time-use module of the Egypt Labor Market Panel Survey from 2023. They distinguish between direct unpaid care work, which includes caring and looking after other household members, and indirect unpaid care work, which includes domestic chores and work around the house that don't involve direct care. And they find that while over 84 percent of working-age women and only 33 percent of working age men are involved in any unpaid care work, the disparities are even starker for direct unpaid care work: working-age women are 5 times more likely to be engaged in direct unpaid care work than working age men. Similarly, Hendy (2010) uses an earlier wave of the labor market panel survey to show that among working women in Egypt in 2006, marriage does not reduce the time a working woman spends doing market work, but significantly increases the time she spends on domestic work and unpaid care work as compared to single women. This effect is stable across all different levels of education.

For working hours, similar to the results pooled over seasons, we do not find a significantly different effect of the shock for mothers in comparison to non-mothers. Although the gender gap in the supply of working hours increased, as documented in Table 4, this increase in the gender gap occurs due to fewer working hours for both groups of women.

Lastly, the log of labor market earnings for mothers is negatively affected by the shock, but the effect is not statistically significant for most seasons. The one exception is summer, for which the effect is significant and large in terms of magnitude (a decrease around 68 percent larger for mothers than for non-mothers, compared to the same season before the shock). As already mentioned, the results for labor market earnings should be interpreted with caution due to measurement error and potential selection bias.

Table 8: DDD estimates of seasonal effect of shock on mothers' labor outcomes

	Employment rate	Log of weekly working hours	Log of labor market earnings
Spring: Female ×Kids × Post-covid	-0.0302**	0.0035	-0.189
	(-2.55)	(0.021)	(0.226)
Observations	167725	68513	3689
Summer: Female ×Kids × Post-covid	-0.0445***	-0.0211	-0.522**
	(-3.97)	(0.0371)	(-2.79)
Observations	173417	71579	4257
Fall: Female ×Kids × Post-covid	-0.0184	0.0213	-0.189
	(-1.44)	(0.226)	(0.206)
Observations	175476	73717	4063
Winter: Female ×Kids × Post-covid	-0.0347**	0.0213	0.532*
	(-2.17)	(0.54)	(1.71)
Observations	143315	59348	2299

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%.
All individual controls and time varying regional fixed effects are included. t-statistics are reported in the parenthesis.

3.3 Robustness checks

In sections 3.1 and 3.2, we provided evidence suggesting that the decline in women's labor supply and the widening gender gap in labor market outcomes during the pandemic are driven primarily by larger losses to mothers and not to childless women. We further suggested that the effect is larger on mothers because the COVID shock affects households' demand for childcare services because the COVID containment measures, with mothers shouldering the greater share of this additional burden.

In this section, we seek to further understand this effect, and to try to confirm that it was driven by the exogenous increase in the demand for childcare at home that accompanied the COVID containment measures, and not by other underlying heterogeneities. In particular, we seek, in turn, to i. rule out any seasonality in the pre-shock employment of mothers, ii. investigate any dose response effect of the number of kids on mothers' employment, iii. verify the heterogeneity of the effect by household age composition, and finally, iv. investigate the distribution across sectors of mothers' employment to rule out the hypothesis that mothers tended to be concentrated in sectors or types of jobs that were more exposed to the COVID shock.

We first seek to rule out any seasonality in the employment of mothers that may have driven the findings reported above. Figure A.4 represents the employment status of each sex by parental status by quarter, separately for pre-COVID and peri-COVID quarters. The figure shows a gender gap in employment for both groups of women. In addition, the figure suggests no seasonality in the employment of any of the subgroups. This result indicates that the detected change in mothers' employment after COVID is not driven by seasonal effects.

We also allow for heterogeneity in the effect of the number of children, to investigate whether the results are consistent with the hypothesis of the motherhood penalty coming from the exogenous shock to the household's need for childcare services.

In Figure A.5, we plot the fitted value (and 95% confidence interval) of mothers' employment from a regression of employment on the number of children while controlling for age, marital status, educational level, time-varying regional fixed effects. As seen in the figure, having children negatively affects women's likelihood of being employed. This negative relationship remains consistent even for a higher number of children; however, it becomes noisier for the fourth child and beyond.

If the employment effect of the COVID shock on mothers is working primarily through its increase in the household's need for childcare services at home, we would expect this effect to be larger for mothers of school-age children. As already seen from columns 1 and 2 of Table 6, when we separate out mothers of children 18 years old or younger from mothers of older children, the motherhood penalty is more pronounced (and only significant) for mothers with school-aged children.

Another way to investigate whether the effect of COVID on mothers' labor market outcomes is due to the associated increase in childcare needs is to look separately at mothers with children with large differences in age. One argument presented in the literature is that a large age difference between children might reduce the childcare burden on mothers, as the older child can help care for the younger one, as suggested in Wikle et al. (2018). On the other hand, having a second and significantly younger child may increase the childcare burden due to the challenges associated with providing care for children at different developmental stages at the same time, as reported in Frijters et al. (2009) and Jacobsen et al. (1999).

We restricted the sample to households with more than one child. We estimated a linear probability model of employment, including the age difference between the oldest and youngest child, its quadratic form, and other controls (mother's age, number of kids, mother's years of education, and household size). Finally, we plotted the the fitted value of the probability of being employed on the age difference variable in Figure A.6. Given the functional form represented in Figure A.6, we consider an age difference of 15 years as the critical value at which the mother's employment rate reaches its peak.

We then re-estimated equation 2 for two different groups: (1) households with more than one child and an age difference of 15 years or less, and (2) households with more than one child and an age difference of more than 15 years. The results in Table A.2 confirm the hypothesis that the effect of COVID on mothers' employment rates depends on the age difference between their children, with the employment rate significantly lower for mothers only if their children are less than 15 years apart in age.[6] Similarly, weekly hours worked drop by a significantly larger margin for mothers of children whose ages are less than 15 years apart than for fathers of such children. The coefficients for mothers of children more than 15 years apart in age, on the other hand, are not statistically significant.

These findings are consistent with the findings of Wikle et al. (2018), which suggest that the burden of childcare increases as the number of school-age children increases. However, our findings do not reject the conclusions of Frijters et al. (2009) and Jacobsen et al. (1999), but only show that the overall effect of the shock is greater for mothers with more school-aged children. This also aligns with the findings of Couch et al. (2022), a study estimating the motherhood penalty of COVID-19 among U.S. mothers.

A question is how divorced and non-divorced mothers in our sample were affected by the shock. The burden is expected to be higher for divorced mothers; however, they might be more resilient if they are the primary breadwinners. To test this, we estimate the child burden separately for these two groups of mothers. The results are reported in Table A.7. Column 1 of the table shows that the effect is stronger for non-single mothers than for divorced mothers, suggesting that the second mechanism may be dominant for single mothers. This also provides further evidence that exiting the labor market is more likely driven by self-

[6] We also tried the same regressions for age difference of 10, 12 and 13 where we got similar patterns, but we used age difference of 15 as benchmark because of findings in Figure A.6, where the response function reaches its peak when the difference in kids' ages is fifteen.

selection rather than market-driven factors (such as changes in employers' preferences for hiring mothers).

As an additional robustness test for the child-burden imposed on mothers, we run the estimation on four sub-samples. The first includes families with children and at least one elderly member above 65 years old, as caring for the elderly tends to fall more heavily on women than on men (Dwyer and Seccombe (1991)). This allows us to measure the extent to which the burden arises from elderly care as well as childcare. The second subsample includes only families with at least one child below the age of 4, capturing the burden on mothers of very young children. The third is restricted to families with only children above 4 years old. The fourth subsample consists of families without children but with an elderly member above 65. We then estimate the difference-in-differences (DD) effect of the COVID shock on the employment rate of mothers in each subsample. Results are reported in Table A.4. Column (1) presents the baseline model with the full sample. The findings suggest that the additional burden is largest for mothers with children under 4 (column 2), likely due to the closures of childcare centers, nurseries, and kindergartens during the pandemic. The highest burden appears among mothers with both children and elderly members in the household (column 3), consistent with Dwyer and Seccombe (1991). Child-related burdens remain significant for mothers with school-aged children (column 4). Column (5) shows the effect of elderly care for families without children but with an elderly member over 65. For this group, the COVID shock has no significant effect on women's employment. Overall, the results provide further confirmation that the exogenous increase in the need for childcare along with women's weaker bargaining position in the household are the main mechanisms explaining the decline in women's employment during the shock.

Lastly, and to rule out the hypothesis that the measured penalty is higher for mothers because they are more concentrated in sectors that were more severely hit by the pandemic closures, we look at the sectoral distribution of employed mothers and look at the coefficient of interaction term $Mother \times Sector$. The results are represented in (Table A.9). The coefficients show the relative likelihood of mothers being employed in each sector compared to non-mothers, controlling for individual characteristics and all possible three-way interactions of variables $covid, female, havingkids$. In other words, the reported coefficients show whether there is any systematic difference between mothers and non-mothers in the likelihood of being employed in any sector, after controlling for the COVID shock and other covariates. None of the coefficients is significant, suggesting that mothers are not systematically concentrated in one specific sector. The coefficients are also small in magnitude, indicating that mothers' probability of employment compared to non-mothers does not differ much across sectors.

In Table A.5, we estimate the likelihood of mothers being employed in the government, public, and private sectors. To estimate this model, we first restricted the sample to mothers and then used a multinomial logit model to estimate the likelihood of employment in each sector (the outside option is to remain unemployed). This approach allows us to compare the probabilities of employment across sectors for mothers. Once again, there is no significant difference in mothers' employment across sectors.

4 Conclusion

A historical gender gap in labor market outcomes has been documented in both developed and developing countries. Our paper estimates the effect of the COVID shock on the gender gap in labor market outcomes. Our results confirm that the shock increased the gender gap in market outcomes in Egypt. We find heterogeneity in the effect of the shock between mothers and non-mothers. We provide evidence that mothers are affected by the shock at both the intensive and extensive margins of labor supply, whereas for non-mothers, the increase in the gap is only observed in weekly hours worked. The effect for mothers is of note because re-entry into the labor market in Egypt, as elsewhere, is rare.

We also identified that the lower employment rate of mothers during the shock can be attributed to the additional childcare burden imposed by the pandemic control measures, which led to wide scale closures of schools, childcare centers, and afterschool programs. We estimate this additional childcare burden for mothers is associated with a 2.5 percentage point larger decrease in the employment rate compared to non-mothers and men.

Interestingly, the possible mechanism identified is consistent with the observation that having older children, who can take on part of the childcare responsibilities, mitigates this burden. Restricting the sample to mothers with two children with an age difference of more than 10 years reduces the childcare burden effect, while having two children with less than a 12-year age difference makes mothers more vulnerable to the shock. Lastly, most of the adverse effects on mothers appear one or two quarters after the shock occurs, suggesting some of these exists were not temporary.

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ONLINE APPENDIX

A Additional Tables and Graphs

Table A.1: Difference in market outcomes (pre vs post covid)

	Pre-Covid		Post-Covid		Diff (Post-Pre)	
	W	M	W	M	W	M
Employment Rate	0.19	0.94	0.16	0.94	-0.023 ***	0.004***
Employment income	2051	2505	2629	3162	578.51**	657***
Weekly Hours Worked	39.8	46.26	36.7	43.04	-3.05***	-3.022***

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%.

Table A.2: Sample of mothers with more than one child

	kids' age difference >15		kids' age difference <=15	
	(log of weekly hours)	(Employment rate)	(log of weekly hours)	(Employment rate)
Female × Covid	0.0041	-0.0138	-0.0385**	-0.0264***
	(0.15)	(-1.02)	(-2.72)	(-3.76)
Female	-0.179***	-0.745***	-0.168***	-0.736***
	(-11.35)	(-46.27)	(-13.64)	(-60.70)
Covid	-0.0760***	-0.0019	-0.0858***	0.0062*
	(-4.37)	(-0.52)	(-5.48)	(1.98)
Observations	32340	229718	92317	551146

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%.
In all estimation, individual characteristics and regional-time varying fixed effects are included. Standard errors are clustered at the regional level. t-statistics in parentheses

Table A.3: Sample of mothers with more than one child

	(1) Only one kid	(2) 2 kids	(3) 2<Kids<=4	(4) More than 4
Female × Covid	-0.0298**	-0.0254***	-0.0219**	-0.0236
	(-3.09)	(-3.81)	(-2.93)	(-1.93)
Female	-0.578***	-0.567***	-0.577***	-0.690***
	(-95.26)	(-137.86)	(-127.87)	(-97.19)
Covid	0.0125*	0.0182***	0.0276***	0.0129
	(2.28)	(4.92)	(6.45)	(1.68)
Individual controls	Yes	Yes	Yes	Yes
Region× quarter FE	Yes	Yes	Yes	Yes
Observations	30138	67482	52774	15511

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%. In all estimation, individual characteristics and regional-time varying fixed effects are included. Standard errors are clustered at the regional level. t-statistics in parentheses.

Table A.4: DD estimation, different groups of families

	(1) All sample	(2) Young kids (age<4)	(3) Having kids and elderly	(4) Only school aged kids (age>4)	(5) Only elderly
Female × covid	-0.0294***	-0.0365***	-0.0522**	-0.0210**	0.00827
	(-4.04)	(-4.21)	(-3.39)	(-2.91)	(0.24)
Female	-0.755***	-0.856***	-0.715***	-0.726***	-0.699***
	(-58.04)	(-77.79)	(-36.68)	(-55.59)	(-29.32)
Covid	0.000655	0.000208	-0.0116	0.00173	0.00425
	(0.21)	(0.04)	(-1.39)	(0.46)	(0.22)
Observations	665802	36151	15583	473375	2442

Notes: * denotes significant at 10%, ** significant at 5% and *** significant at 1%. Each column reports the baseline DD estimation of the COVID shock on women's employment rate across different groups. The omitted group in each column consists of men from the same group. t-statistics in parentheses.

Table A.5: Probability of mothers employment in different job sectors, Multinomial logit model estimation

	$P(employed \mid Covid, Female, Having\ kids)$
Government	-0.093 pp
	(-0.19)
Public sector	-0.20 pp
	(-0.66)
Private sector	-2.1 pp
	(-2.73)
Other sectors	0.006 pp
	(0.04)

The dependent variable is the employment status in each sector. Control variables include household size, marital status, years of education, age, sector of employment fixed effects. The coefficients estimate the probability of being employed in each sector, compared to the base group (non-employed). z-statistics are reported in the parenthesis.

Table A.6: Probability of mothers employment in different job classification, Multinomial logit model estimation

	$P(employed \mid Covid, Female, Have\ kids)$
Employee	-0.377 pp
	(-4.63)
Employer	-0.492 pp
	(-2.31)
Own-occupant, self-employed	-0.21 pp
	(-1.79)
Contributing (unpaid) family worker	0.224 pp
	(1.11)

The dependent variable is the employment status in each category. Control variables include household size, marital status, years of education, age, sector of employment fixed effects. The coefficients estimate the probability of being employed in each category, compared to the base group (non-employed). z-statistics are reported in the parenthesis.

Table A.7: DDD estimation of child burden for single vs non-single mothers

	(1) **Non-single mothers**	(2) **Divorced or widowed mothers**
Female × Post-covid × Having Kids	-0.0159*	-0.0137
	(-2.33)	(-0.72)
Female × Post-covid	-0.000340	-0.0110
	(-0.03)	(-0.64)
Female × Having Kids	-0.0493***	0.149***
	(-5.73)	(11.96)
Post-covid × Having Kids	-0.00149	-0.00130
	(-0.22)	(-0.08)
Female (=1 if female)	-0.677***	-0.475***
	(-46.97)	(-25.75)
Having Kids	0.0204*	-0.0871***
	(2.33)	(-11.95)
Post-covid	-0.0082	-0.0005
	(-0.98)	(-0.04)
R^2	0.586	0.297
Observations	553213	272192

Notes: The dependent variable in all columns is employment status. All regressions include individual controls and set of time and location fixed effects. t-statistics in parantheses.

Table A.8: Employment status and log weekly working hours of women in formal vs informal jobs

	Employment (mothers)	Employment (non-mothers)	Weekly working hours (mothers)	Weekly working hours (non-mothers)
Female × Post-covid × Informal	-0.00117	-0.00115	0.0421*	0.0236
	(-1.01)	(-0.65)	(2.68)	(0.65)
Female × Post-covid	0.000990***	0.000782	-0.0696***	-0.0610**
	(3.87)	(0.95)	(-7.49)	(-2.88)
Post-covid × Informal	0.00323**	0.00364*	-0.0450***	-0.0500**
	(3.00)	(2.54)	(-3.82)	(-2.97)
Female × Informal	0.00130	0.00145	-0.153***	-0.0999*
	(1.34)	(0.82)	(-7.26)	(-2.74)
Female	-0.000958**	-0.00133	-0.0852***	-0.0869***
	(-2.82)	(-1.45)	(-13.88)	(-6.40)
Informal	-0.00274**	-0.00308*	0.0667***	0.0479**
	(-3.09)	(-2.33)	(4.64)	(2.87)
Observations	358029	26613	262082	23981

Notes: The dependent variables are employment status and log weekly working hours for mothers and non-mothers. All regressions include individual controls and set of time and location fixed effects. t-statistics in parantheses.

Table A.9: Linear probability model of employment in different sectors for mothers

	1 if Employed
Mother × Public sector	0.000111
	(0.14)
Mother × Private sector	-0.00100
	(-1.26)
Mother × Private investment	-0.00588
	(-1.17)
Mother × Cooperative	0.000212
	(0.17)
Mother × Others	-0.00126
	(-0.87)
Mother × Non-governmental organizations	-0.00151
	(-1.21)
Mother × Not stated	0.0000750
	(0.06)
R^2	0.756
Observations	69106

Notes: The dependent variable is employment status. The table reports estimates of the coefficients on the interaction of mother and sectors, compared to non-mothers, after including all possible interactions of $Covid \times female \times havingkids$. The omitted group is unemployed mothers. All regressions include individual controls and a set of time and location fixed effects. t-statistics in parentheses.

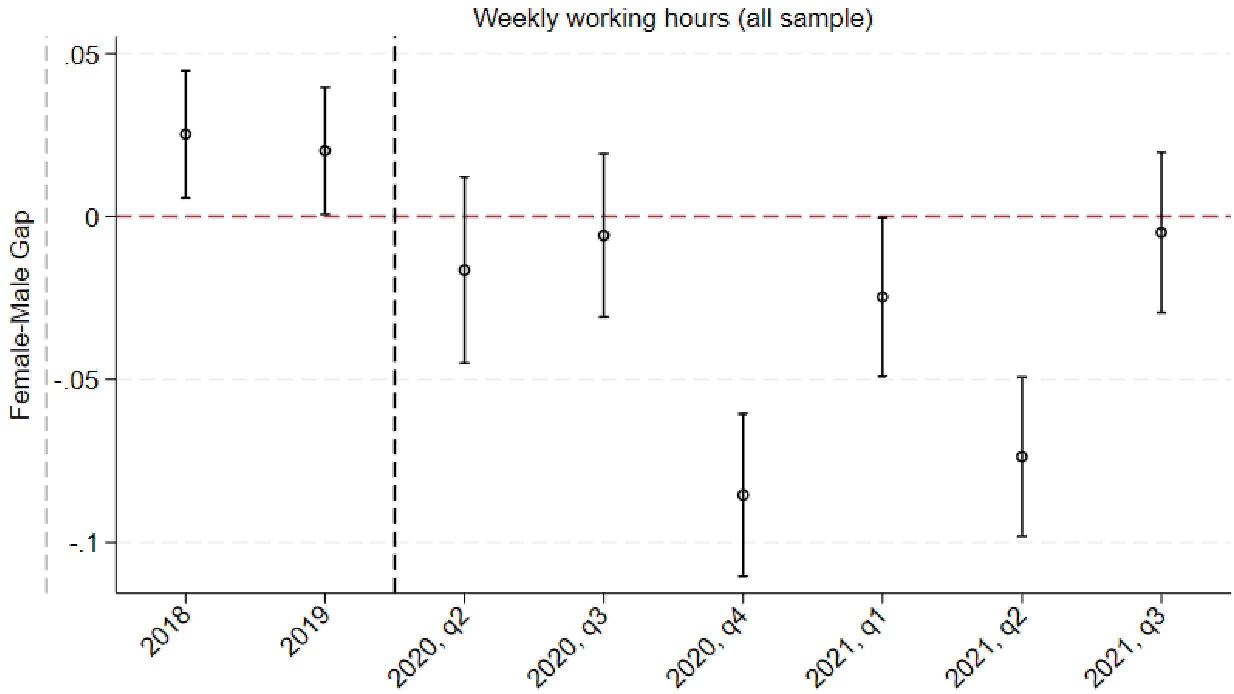

Figure A.1: Event study, all sample(women and men)

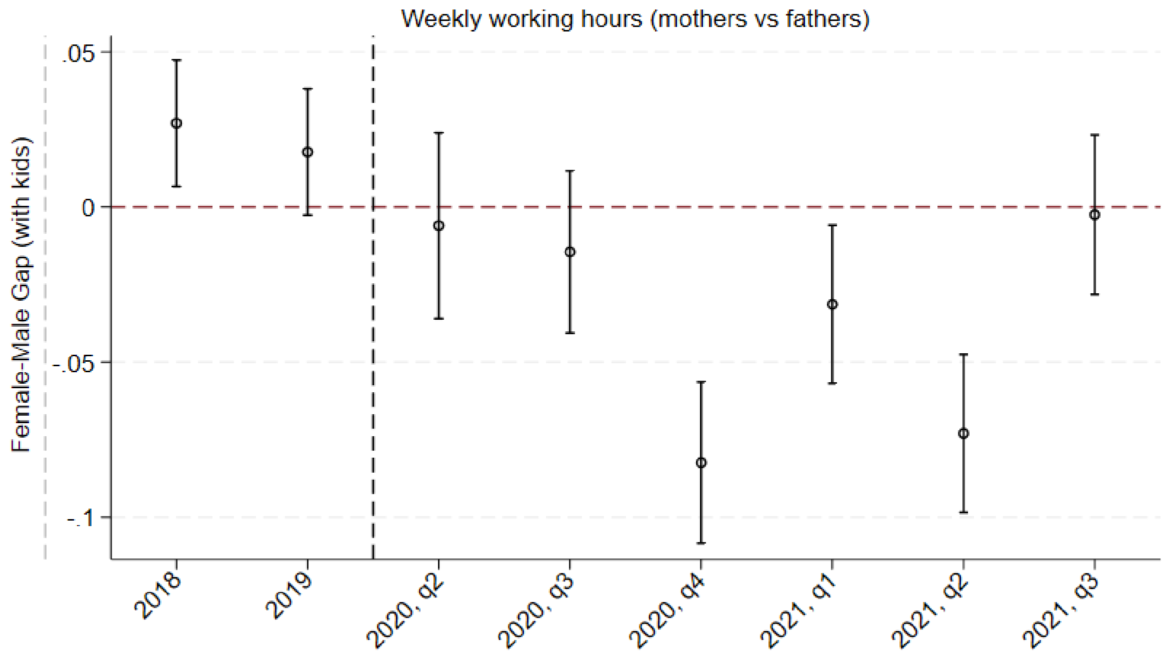

Figure A.2: Event study, employment of mothers vs fathers

Figure A.3: Event study, women and men without kids

Figure A.4: Log of employed persons over the quarters of year

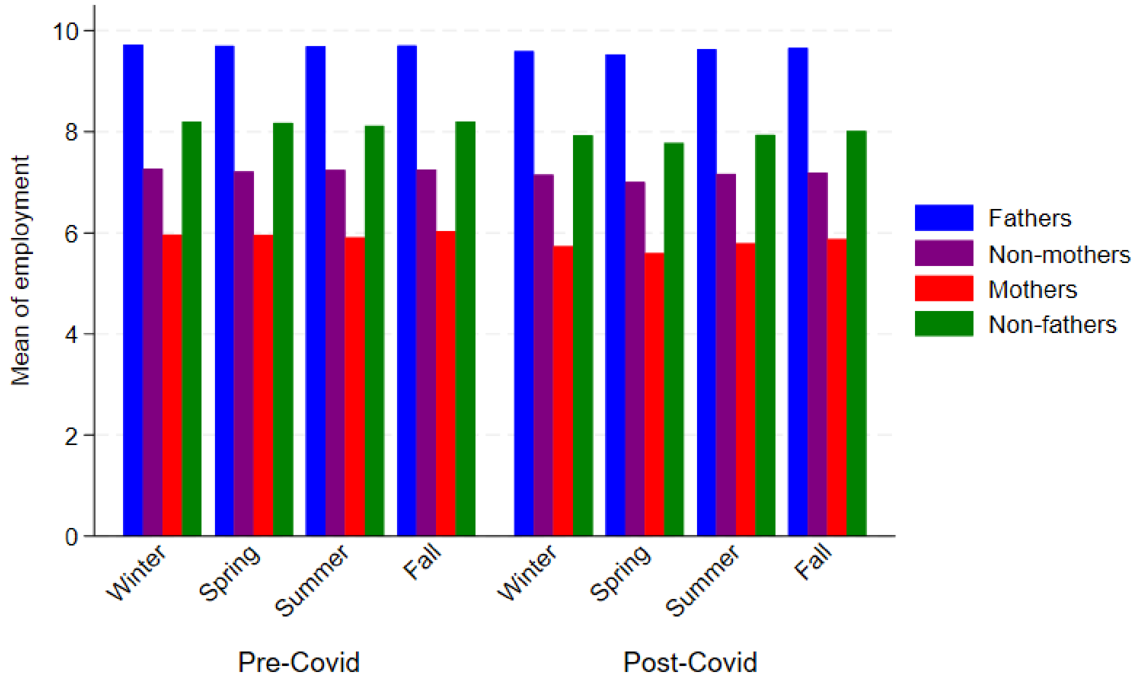

Figure A.5: Dose response of mothers' employment to number of kids

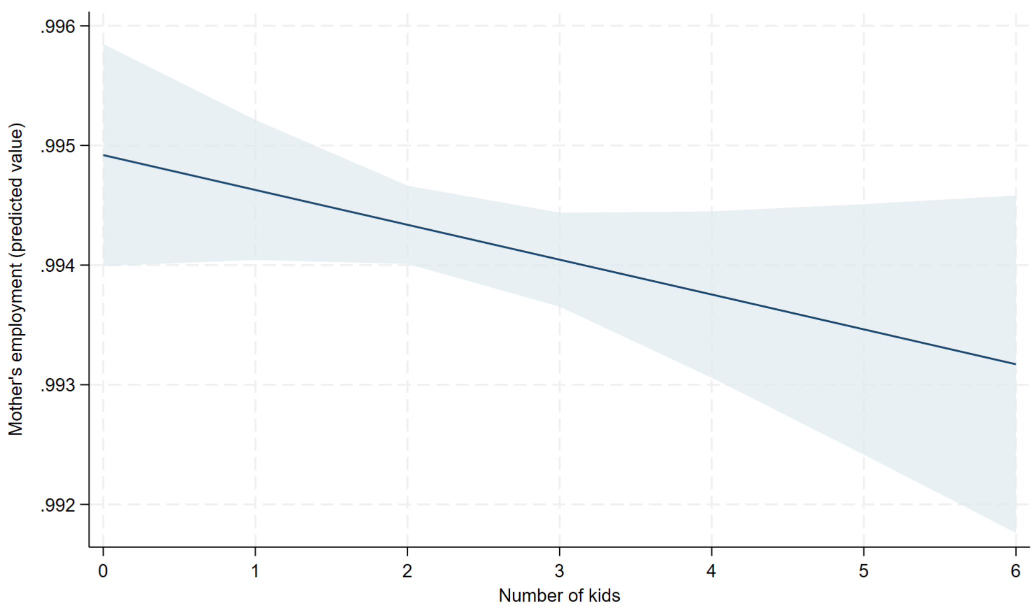

Figure A.6: Dose response of mothers' employment to kids' age differences