COVID-19 and Gender Gaps in Employment, Wages, and Work Hours: Lower Inequalities and Higher Motherhood Penalty

Maryna Tverdostup

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Abstract
This paper investigates the dynamics and drivers of gender gaps in employment rates, wages, and work hours during the COVID-19 pandemic, relying on Estonian Labor Force Survey data for 2009–2020. We document that the pandemic has, if anything, reduced gender inequality in all three domains. The evolution of inequalities revealed cyclical pattern mirroring infection rate, with upswings largely driven by parenthood and gender segregation into industries. The results suggest that labor market penalties for women with young children and women employed in affected sectors may last longer than the pandemic, threatening to widen gender inequality in a long run.

Keywords COVID-19 · Employment · Gender inequalities · Gender wage gap · Labor market

JEL Classification J16 · J21 · J31

Introduction
With the escalation of the pandemic, the implications of economic recession for gender equality has attracted substantial research attention. The economic downturn induced by COVID-19 is not just another recession. Unlike a “regular” recession, the pandemic crisis has not only undermined economic activity, but also brought about fundamental changes in work and childcare organization. Disruption of economic activity, teleworking, and the closure of day-care facilities and home-schooling have disproportional effects on the employment, work hours, and wages of men and women, reflecting on preexisting gender inequalities.

* Maryna Tverdostup
tverdostup@wiwi.ac.at

1 Vienna Institute for International Economic Studies (wiwi), University of Tartu, Rahlgasse 3, 1060 Vienna, Austria
This paper provides a comprehensive summary of employment, wage, and work hours resilience during the pandemic across men and women in Estonia. We follow a twofold objective. Firstly, we investigate the dynamics of gender gaps in the employment rates, hourly wage, and work hours over the last decade with a focus on quarterly development in 2020, relying on Estonian Labor Force Survey data. The latter allows us to explore the changes in inequality measures in response to the pandemic cycles—from the first wave on the borderline between the first and second quarters, to a moderate recovery in the second half of the second and throughout the third quarter and to another escalation of the infection rate in the fourth quarter. 1 This study focuses on gender inequalities in three major labor market outcomes, as the pandemic may accelerate or shrink gender inequalities in employment, wages, and work hours to different extents and at different times. 2 

Secondly, this paper draws on the earlier literature on major drivers of gender disparities during the pandemic and conducts an empirical exercise to test which forces determine the dynamics of gender gaps in employment, wages, and work hours and in which direction. There are several channels through which the pandemic recession could exacerbate or shrink gender inequalities, and we focus mainly on: (1) increased childcare demands due to day-care and school closures; (2) the asymmetric effect of the pandemic on different occupations, sectors, and types of firms; and (3) the rise of teleworking. Given earlier evidence on the heterogeneous effects of the pandemic on people with different educational attainments (Blundell et al. 2020; Qian and Fuller 2020), we additionally explore the role of education in shaping gender inequalities during the pandemic.

Our results indicate that in Estonia, our sample country, the pandemic has if anything reduced all three gender inequality measures in 2020. However, the cyclical dynamics of gender inequalities were highly sensitive to the introduction of restrictions aiming to contain the virus. Gender gaps in wages and work hours revealed a U-shaped development, with an increase in the first and last quarters of 2020 as the virus spiked, and a decline in the middle of 2020, coinciding with a period of economic recovery. The employment response to COVID-19 was delayed to the second quarter when male and, to a greater extent, female employment collapsed, and the

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1 Our analysis covers the first wave of the pandemic and associated economic shutdown in March–May 2020, followed by a period of economic revival in June–October 2020 and the second wave of the infections mounting since November 2020. The second wave resulted in another lockdown introduced in March 2021. However, the Labor Force Survey data for this period are not yet available. We acknowledge that the labor market effects of the second economic shut-down may differ from the first one; however, if anything, the effects should be on average comparable, but milder as the second lockdown was foreseen and anticipated, unlike the first one. As a result, advance measures were taken, which may be partly captured in the data from the last quarter of 2020.

2 Flexibility of employment contracts and employment protection matters in this respect. As a short-term response to the pandemic, work hours or wages may be temporarily reduced. In some jobs and industries employment contracts can be easily terminated due to a high share of fix-term or service contracts and unofficial employment (e.g., in construction and agriculture), while in other sectors workers are on average more protected and should experience less job loss. Moreover, the pandemic may affect employment, wage, and work hours unequally across time. Work hours and wage impacts may precede employment distortions, as employers reduce labor costs gradually and lay off employees only if the crisis persists.
gender employment gap widened. The removal of lockdown measures and economic revival narrowed the gender gap in employment in the subsequent quarters.

We document that parenthood was the major driver accelerating gender inequalities in employment, work hours, and, to a lesser degree, wages. The persistently high employment penalty of child-rearing women throughout 2020, even when day-care and schools were re-opened, signals potential long-run employment distortions and slow employment recovery for women, who lost or quit their jobs in 2020. Gender industry segregation appeared most crucial in exacerbating the gender gap in work hours and wages. Surprisingly, occupation segregation favored women, indicating stronger within-occupation resilience of female wages, as compared to male. Moreover, our results give suggestive evidence of a thinning of the “glass ceiling” as the gender wage gap shrunk most drastically in high-level occupations. Telework was relevant only for wage inequality and indicated somewhat higher wage returns for women who worked from home.

Thus, while overall gender inequalities on the labor market appeared, if anything, to have narrowed during the pandemic in our sample country, some trends are alarming. Child-rearing women and women working in the economically most affected sectors appeared particularly vulnerable to pandemic-induced labor market distortions. They may face long-term employment and wage penalties, which may result in permanently amplified gender inequalities, due to high labor market returns to experience (Costa Dias et al. 2020) and the difficulty of re-entering the labor market in post-recession times.

**Background and Related Literature**

One of the highly important questions is how the pandemic will affect gender equality in various domains, including the labor market, family, and society. The potential consequences of COVID-19 on gender equality in a labor market are ambiguous. A strand of emerging literature reports female employment being more affected by COVID-19 than male employment (Alon et al. 2020; Baylis et al. 2020; Cortes and Forsythe 2020; Moen et al. 2020; Fana et al. 2020), with decreased work hours (Collins et al. 2021) and increased pay inequality (Blaskó et al. 2020). A smaller strand of literature suggests that the pandemic hit male and female employment similarly and that the long-term implications of the pandemic-induced recession are ambiguous (Beland et al. 2020; Belot et al. 2021; Blundel et al. 2020).

What we know about the COVID-19 consequences for gender disparities to date are mostly the short-term effects that were documented after the first wave flattened (Beland et al. 2020; Lemieux et al. 2020; Forsythe et al. 2020). While it is an important snapshot of labor market distortions after the first pandemic wave, the gradual economic revival in the second half of 2020 might have moderated the exacerbated inequalities and the subsequent second wave may have different implications than the first one, as it was less unexpected and allowed for gradual and anticipatory labor market adjustments.

Fundamental changes in childcare due to day-care and school closures are the first major driver of gender inequalities in labor market and household production.
Despite telework and home-schooling providing opportunities for the equalization of parents’ contributions to household chores and childcare, a growing strand of literature proves the opposite. Qian and Fuller (2020) document that in Canada, gender gaps in employment widened in February–March 2020 for parents of young children, especially those of elementary-school aged children. Childcare and home-schooling responsibilities were disproportionately allocated among parents, with women taking a leading role (Chung et al. 2021; Fodor et al. 2021; Blundell et al. 2020; Özkazanç-Pan and Pullen 2020; Manzo and Minello 2020). The findings by Collins et al. (2021) provide further empirical evidence that in the USA in dual-earning families, mothers are more likely to reduce work hours in response to the closure of day-care facilities and schools. These findings generally suggest that increased childcare demands demoted female employment and work hours and may leave a potential trace on gender inequality that outlasts day-care and school closures.

The underlying reason for gender inequality in childcare and home-schooling contributions during the pandemic remains an open debate. The crisis may exacerbate gender norms, assuming that women should take on the core caregiving responsibilities, thus reducing their labor force participation to provide childcare and facilitate home-schooling (Collins et al. 2021; Fisher and Ryan 2021; Hjálmsdóttir and Bjarnadóttir 2020). The crisis may reinforce the gender norms in the household division of labor, making female employment more vulnerable and placing employment recovery under threat, as the stringent norms may persist even when the pandemic is over. Unequal participation in childcare may also stem from a labor market in which female employment is more flexible and adjustable to teleworking, while male employment is more rigid and requires physical presence at the workplace (Craig and Churchill 2021). As a result, women may temporarily reduce their worktime to provide childcare or assist home-schooling, yielding a short-term employment distortion, as women will resume their normal worktime upon the day-care and schools’ opening. Furthermore, the gendered division of childcare in the time of the pandemic may be an outcome of disproportional job distortions experienced by men and women. If this is the case, women’s prevailing caregiving role is reinforced by labor market disruptions and may endure even in post-pandemic times, threatening to widen gender employment gaps at the cost of women’s employment in the long run.

The second potential driver of gender inequalities—the asymmetric effect of COVID-19 on jobs and industries—stems from economic distortions, characteristic for a “regular” recession, as well as from the pandemic-specific alterations in employment and wages due to increased health risks and higher demand for particular workers, especially in “essential” industries (these include sectors include, but not limited to, medical and healthcare, telecommunications, information technology systems, defense, food and agriculture, transportation and logistics, energy, water and wastewater, law enforcement, and public works). The latter results in different employment and wage effects across occupations and industries (Beland et al. 2020). While leisure, hospitality, and non-essential retail sectors collapsed, essential trade and “front line” jobs remained relatively unaffected (Forsythe et al. 2020; Cortes and Forsythe 2020). Furthermore, workers in low-paying jobs, particularly in the service industry, were hit the most (Cortes and Forsythe 2020). Substantial
gender segregation in occupations and industries had heterogeneous implications of COVID-19 for the employment and wages of men and women (Wiswall and Zafar 2018; Blau and Kahn 2017). However, the consequences of the pandemic are ambiguous. In line with this, Blundell et al. (2020) find that in Great Britain women are more likely to work in shutdown sectors but also more likely to hold jobs that can be done from home or to be key workers, which makes assessment of the pandemic implications most challenging.

Telework is the third crucial factor reflecting on employment and wages in times of COVID-19. With a lockdown and strict social distancing measures, telework capability appeared to be a crucial job characteristic, which primarily leveled employment and wage decline in certain occupations and industries (Forsythe et al. 2020). The findings of Dingel and Neiman (2020) indicate that workers in jobs, which can be performed from home, earn systematically more in the USA. Adaptability to remote work is largely determined by the features of a job, and these seem asymmetric across men and women, reflecting gender wage and employment inequalities (Bonacini et al. 2021; Blundell et al. 2020; Brynjolfsson et al. 2020). Additionally, Raišienė et al. (2020) document that in Lithuania, women tended to appreciate teleworking more than men at the time of the pandemic.

Data and Empirical Strategy

We analyze gender inequality in employment, hourly wage, and work hours relying on Estonian Labor Force Survey (hereinafter EE-LFS) data for the years 2013 to 2020. Along with yearly estimates, we look at quarterly dynamics in 2020. The latter relates to the swings in the infection rate, governmental restrictive measures, and upturns in economic activity in 2020, which eventually reflect on labor market outcomes and, potentially, gender inequalities.

The EE-LFS data follow the International Labor Organization (ILO) methodology and are the major source of labor market statistics in Estonia. The data are collected via face-to-face or telephone interviews throughout the year. The reference period is the week preceding the survey.3 The survey covers a representative sample of respondents aged 15–74. Employment data are collected for all respondents. For those currently unemployed or inactive, employment data concern the last occupied job. Since employment and wage data are collected directly from individuals, LFS data also capture unofficial employment, unlike the national registry data, which obtains employment-related information from firms.

Our sample includes both full- and part-time workers. Main dependent variables are being currently employed, net hourly wage, and weekly work hours. Appendix I.A. provides average estimates for all dependent and control variables used in the analysis by gender for the years 2009, 2014, 2019, and 2020.

3 For more details, please, refer to: https://www.stat.ee/en/find-statistics/methodology-and-quality/ems-metadata/40013.
We conduct several empirical exercises to investigate the dynamics and drivers of gender inequalities during the pre- and in-pandemic period. Firstly, we employ a standard nonlinear probit regression to analyze the gender employment gap on a yearly basis for the years 2009–2020 and on a quarterly basis for the year 2020, relying on the following specification:

$$\Pr(e_i = 1| \text{Female}_i, D'_i, LM'_i, R'_i) = \alpha + \beta_1 \cdot \text{Female}_i + \gamma \cdot D'_i + \theta \cdot LM'_i + \theta \cdot R'_i + \epsilon_i,$$

(1)

where $e_i$ is a realization of random variable $E_i$ taking value 1 if respondent $i$ is employed in the reference period and 0 if not; $\text{Female}_i$ is a female indicator variable; thus, coefficient $\beta_1$ captures the residual gender gap in employment; $D'_i$ is a vector of demographic controls, including age, age-squared, marital status, number of children under 18 years, being born in Estonia, Estonian language command and education level; a vector $LM'_i$ incorporates major labor market controls, including occupation (ISCO 1-digit level), sector of economic activity (6 broad categories); $R'_i$ is a vector of region dummies (5 broad regions); vectors $\gamma, \theta$ and $\theta$ capture respective coefficients; $\epsilon_i$ is a residual term.4

Next, we use linear regression analysis to explore gender gaps in wage and work hours. We estimate the following model:

$$\ln X_i = \alpha + \beta_2 \cdot \text{Female}_i + \mu \cdot D'_i + \rho \cdot LM'_i + \tau \cdot R'_i + u_i,$$

(2)

where $X_i \in \{W_i, H_i\}$ with $W_i$ standing for an hourly wage and $H_i$ for weekly work hours of respondent $i$; $\text{Female}_i$ is a female indicator variable; thus, coefficient $\beta_2$ captures the residual gender wage or work hours gap; vectors $D'_i$ and $R'_i$ are identical to equation (1), while vector $LM'_i$ includes occupation (ISCO 1-digit level), industry (14 detailed NACE categories), firm size and foreign ownership, working from home; vectors $\mu, \rho$ and $\tau$ capture respective regression coefficients; $u_i$ is a residual term.

To analyze the factors driving gender inequalities during the pandemic, we employ a standard Oaxaca–Blinder decomposition by Oaxaca (1973):

$$\ln X_m - \ln X_f = \beta_m \left( Y_m - Y_f \right) + Y_f (\beta_m - \beta_f),$$

(3)

where $\ln X_f$ and $\ln X_m$ are means of logarithms of a respondent’s outcome $X_i \in \{W_i, H_i\}$ with $W_i$ standing for an hourly wage and $H_i$ for weekly work hours of females and males, respectively; $Y_f$ and $Y_m$ are vectors of mean values of explanatory variables, including all controls of regression equation (2) for females and males, correspondingly; vectors $\beta_f$ and $\beta_m$ are vectors of corresponding coefficients of explanatory variables for females and males, respectively. The first term on the right-hand side captures the explained fraction of the gender gap, which stems from the different characteristics observed for men and women. The second term indicates an unexplained gender gap, resulting from the difference in yields of men and

4 Due to data limitations, we cannot control for details of industry, firm ownership and size, or for respondents’ propensity to work from home. The latter characteristics are included in the analysis of gender wage and work hours inequalities.
women. To decompose the gender difference in the employment rate, we employ a nonlinear decomposition, which extends the classical Oaxaca–Blinder technique and relies on the weighting method developed by Yun (2005).

**Empirical Results**

**COVID-19 in Estonia: Stylized Facts**

The development of the COVID-19 pandemic in Estonia is largely comparable to other European Union (EU) member states. The dynamics of COVID-19 positive cases in year 2020 is presented in Appendix I.B. As the infections started to rise in March 2020, a state of emergency was imposed on March 11 and lasted until May 18, 2020. A total lockdown and Estonia’s well-operating healthcare system kept the mortality rate low and effectively restrained the virus (Raudla 2021). All restrictions, excluding limited freedom of movement, particularly international, and restricted public events and gatherings were subsequently removed. Jointly with a government rescue package and substantial state, business, and private resources, the economy revived in summer–autumn 2020. However, loose restrictions fueled the second wave of the virus, which started to mount at the end of October 2020. Despite the continuously increasing infection rate, the second lockdown was imposed only on March 12, 2021.

Estonia’s COVID-19 response was quite comparable to Nordic, Balkan, and other Baltic states, with a stringency index ranging below the EU average right from the start of the pandemic. As a result, Estonia experienced a rather moderate overall economic downturn. However, the local labor market was heavily disrupted, similarly to the majority of EU member states. The overall unemployment rate almost doubled compared to 2019, reaching 6.8% in 2020, and remained just slightly below the EU average of 7.1%. Male employment was hit harder than female and reached 7.0% as compared to 6.6% among females. The first drop in employment was documented during the state of emergency and shortly afterward and the second started at the end of October, coinciding with the escalation of the second pandemic wave. Accommodation and food service activities, manufacturing and wholesale and retail trade were among the most affected sectors. All types of employment relations were affected similarly, with a proportional decrease in permanent and temporary

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5 For more details, please refer to: https://ourworldindata.org/grapher/covid-stringency-index?time=2021-03-28.
6 For more details, please refer to: https://ec.europa.eu/eurostat/databrowser/view/tec00115/default/table?lang=en.
7 For more details, please refer to: https://ec.europa.eu/eurostat/databrowser/view/une_rt_a/default/table?lang=en.
employment relations. Similarly to the overall EU trends, youth and the less educated experienced the sharpest employment decline throughout 2020.

Labor Market Dynamics

Figure 1 presents the dynamics of employment rate, weekly work hours, hourly wage, and working from home for men and women over the sample period.

In line with earlier studies, we document a substantial average employment loss in 2020; however, men experienced a greater absolute decline (72.5% in 2019 vs. 70.3% in 2020) than women (64.6% in 2019 vs. 63.2% in 2020), as documented on panel (1). This evidence contradicts earlier findings on greater employment distortions faced by women in the pandemic (Baylis et al. 2020). However, the dynamics of the employment rate throughout 2020 differ drastically for men and women with women being more affected at the onset of the pandemic. As a result of the economic shutdown in March–May, the

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8 For more details, please refer to: https://www.stat.ee/en/find-statistics/covid-19-impact-estonia/short-term-labour-market-statistics.
9 For more details, please refer to: https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_M__custom_953858/default/table?lang=en,
https://ec.europa.eu/eurostat/databrowser/view/tps00066/default/table?lang=en.
The share of employed females slipped to 61.2% in the second quarter with a subsequent increase to 64.2% in the fourth quarter. The male employment rate remained relatively stable with a mild gradual decline from 71.2% in the first quarter to 70% at the end of the year, quite the opposite of a U-shaped female employment rate trend.

Surprisingly, average work hours exhibit an insignificant average decline in 2020 for both men and women (panel (ii) of Fig. 1). For the latter, average work hours dropped in the first quarter (to 36.2 h in the first quarter 2020 as compared to 36.7 h in 2019) with a subsequent increase in the third and fourth quarters. Thus, the effect of the economic lockdown, day-care, and school closures on female work hours was rather short-term and females resumed normal worktime once restrictions were lifted. The average hourly wage kept growing in 2020 at a slightly slower pace for men (panel (iii) of Fig. 1). Both male and female wages
exhibited a mild dip in the second, first, and second quarters correspondingly, but recovered in subsequent quarters.

These results indicate an overall short-term labor market effect of restrictions imposed to contain the virus. A notably quick recovery of female employment in the third and fourth quarters and work hours in the second and third quarters as well as a minor effect on wages suggests that female labor market outcomes were at least as resilient as those of males.

One reason for this is the disproportional propensity to work from home between men and women. Earlier studies refer to teleworking as one of the key factors safeguarding employment during the pandemic (Belzunegui-Eraso and Erro-Garcés 2020). We show the shares of females and males working at least sometimes from home on panel (iv) of Fig. 1. Two stark observations can be made. Firstly, women systematically worked from home more than men in 2020 overall (25.9% compared to 22.7%). Secondly, the spikes in teleworking coinciding with the first lockdown and the escalation of the second wave of the infection (fourth quarter) are much higher for women (31.6% vs. 24.7% in the second quarter and 28.1% vs. 23.3% in the fourth quarter). Several recent studies report a higher propensity to telework in times of COVID-19 for women (Blundell et al. 2020; Brynjolfsson et al. 2020). Our results provide further support to these findings and indicate that the teleworking capability of female jobs may be one of the key factors which deterred the exacerbation of gender inequalities. We provide further disaggregation of the propensity to work from home by gender and occupation in Appendix I.C and gender and economic sector in Appendix I.D.

Total Gender Gaps in Employment, Hourly Wage, and Work Hours

We start by analyzing how the rate of gender inequality in employment, hourly wage, and work hours varied over last years and how it changed during the pandemic (Fig. 2). The raw gap stems from a univariate model controlling for gender only. The unexplained gap is a gender difference in the employment rate, which remains when controlling for a set of characteristics considered in the regression Eq. (1), whereas unexplained gaps in wage and work hours stem from Eq. (2). The first stark observation is a reduction of gender gaps, both raw and unexplained, in all three labor market outcomes in year 2020, compared to 2019. One needs to acknowledge that confidence intervals of gap estimates are relatively wide; hence, the evidence on yearly changes needs to be addressed cautiously, bearing in mind that we can only conclude on economically significant differences across years.

Following a relatively steady level of 8 pp to 9 pp in 2015–2019, the unexplained employment gap declined to 7.2 pp in 2020 (panel (i) of Fig. 2). Panel (i) of Fig. 1 illustrates that the male employment rate dropped more substantially in 2020, largely explaining a decline in the raw gender gap in 2020.

Notably, employment disparity reveals unexplained gender gaps systematically higher than explained ones for most of the years, indicating that characteristics possessed by females associate with a higher employment propensity than the actual propensity observed in our sample. This empirical observation signals the potential
underemployment of women. Notably, the raw gap substantially exceeds the residual gap in the third quarter of 2020 marking the largest positive difference in the sample period and suggesting that an increase in female employment in the third quarter reduced gender inequality. The overall hourly wage gap reached 18.4 pp in raw and 17.4 pp in unexplained terms in 2020, as compared to correspondingly 19.9 pp and 17.8 pp in 2019. Despite earlier forecasts, the pandemic did not accelerate gender disparity in wages and has, if anything, marginally reduced it in 2020 overall. However, one needs to account for potential effect of selection into employment on gender wage gap (Dolado et al. 2020). Changing employment gap may reflect on the wage gap if, for instance, male workers of specific education or occupation level are affected. Given a strong disproportional effect of COVID-19 on different types of workers, occupations, and industries, a spillover effect of employment drop caused by the pandemic on wages is likely and needs to be accounted for. The raw gender disparity in work hours shrank in 2020 overall, with an unexplained gap dropping to 3.9 pp in 2020, compared to 4.3 pp gap in 2019. A positive dynamic in work hours gap is largely attributed to female work hours being on average less affected by the pandemic than male work hours (panel (ii) Fig. 1).

The quarterly dynamics differs across three domains, with gender gap in employment exhibiting an inverse U-shaped trend over the four quarters of 2020 and gender gaps in wages and work hours having a distinct U-shaped development. The highest employment gap was recorded in the second quarter, which mirrors a one-off drop in female employment (panel (i) of Fig. 1). This indicates that a short-term employment distortion, driven by the lockdown in March–May, was stronger among females. This short-term decline in employment was widely documented in the studies published in mid-2020 (among others, Beland et al. 2020; Lemieux et al. 2020). However, our estimates show that the female employment rate recovered in subsequent quarters, as economic activity intensified, and schools were re-opened.

The wage gap increased in the first quarter, when the first wave of infection hit. An increase was followed by a gradual decline to 16.1 pp in raw and 13.4 pp in unexplained gaps in the third quarter of 2020. The dynamics of the raw gap in the second and third quarters are largely explained by males experiencing a stronger decline and a slower recovery of wage levels (panel (iii) of Fig. 1). An increase in the gender wage gap as the pandemic unfolded is consistent with earlier evidence reporting a widening of gender inequalities and documenting labor market disadvantages related to COVID-19 as being stronger among females (Baylis et al. 2020; Cortes and Forsythe 2020). However, a decline of both raw and unexplained gaps in the third quarter to the lowest level in our sample period indicates that the revival of economic activity and the removal of restrictions favored female wages, which is also reflected in the overall dynamics of male and female hourly wages on panel (iii) of Fig. 1.

The quarterly dynamics of raw gender gap in work hours mirrors gaps in wages, as it jumped to 9.7 pp in the first quarter, reaching the highest level in our sample period. However, controlling for sociodemographic, education, and employment profiles reduced the gender gap by more than one half and made it statistically insignificant. The raw gap declined in the two subsequent quarters to 7.1 pp, which coincides with the infection rate dynamics (see Appendix I.B).
Since quarterly dynamics can be affected by seasonal effects, we conduct a robustness check and estimate gender gaps in three domains on quarterly basis for years 2018 to 2020 to identify whether evolution observed in 2020 is a recurring trend (Appendix II.A). The results suggest that the quarterly dynamics of three gender gaps in 2020 is not a subject to persistent trend. The only similarity is observed for gender wage gap over four quarters of 2018 and 2020—both revealing a U-shaped dynamic. However, the magnitude of drop in the second and third quarters of 2018, relative to the first and fourth quarters, is notably smaller than in 2020, with the latter year characterized by a drastic decline in wage gap in the third quarter. This evidence provides sufficient arguments to conclude that quarterly evolution of gender disparities in 2020 are subjects to not only seasonal effects, but, to certain extend, evolution of the pandemic.

**Decomposition of the Gender Gaps in Employment, Hourly Wage, and Work Hours**

Next, we analyze contributions of individual groups of factors to the gender employment, hourly wage, and work hours gaps variation using the Oaxaca–Blinder technique, following Eq. (3). The results are presented in Figs. 3 and 4, respectively.
Fig. 4 Selected contributions to the gender wage gap. Note: The point estimates are reported with 95% confidence intervals relying on robust standard errors. The estimates are based on EE-LFS data and account for population weights in the respective year or quarter. Decomposition is performed using the Oaxaca–Blinder technique specified in Eq. (3) and additionally extracts contributions of demographics and region, which are negligible.
We document no systematic changes in contribution of parenthood, gender segregations into sectors, as well as into jobs with higher telework possibilities to explaining gender gaps in employment, wage, and work hours in 2020, as compared to 2019 [see panels (i), (vii) of Figs. 3 and 4, as well as panel (xi) of Fig. 4]. As for the other factors, we document changing contributions to explained and unexplained gaps in light of the pandemic. Below, we discuss most prominent changes in contribution of individual groups of factors to explaining gender gaps in three labor market outcomes in 2020.

Parenthood

Our results suggest that child-rearing women are systematically less likely to be employed than child-rearing men, provided they have comparable demographic, education, and employment characteristics (panel (ii) of Fig. 3). A disproportionately higher employment penalty of child-rearing women is particularly high in the second, third, and fourth quarters of 2020. It implies that women with minor children were even less likely to be employed in the middle and end of 2020 than they were before the pandemic, as compared to men with children. The dynamics of the unexplained parenthood contribution in the second through fourth quarters of 2020 reveals employment withdrawals of mothers as a major force driving a sharp decline in female employment in the second quarter (panel (i) of Fig. 1). Day-care facilities and school closures fueled gender disparity in the employment rate, as females assumed greater responsibility in home-schooling and childcare.

However, a contribution of parenthood to the unexplained gender gap in wage and work hours declined in 2020, compared to 2019 (panel (ii) of Fig. 4). Women with children under 18 years of age were working significantly less hours and earned lower wage, then men with children throughout 2020, however, to lesser extent than in 2019. Notably, unexplained contribution of parenthood to gender employment gap increases (panel (ii) Fig. 4). This result suggests that the growing childcare and home-schooling demands of the pandemic reduced female employment propensity, as mothers likely tend to quit jobs at higher rate than fathers, however, did not increase females’ propensity to switch to part-time job or reduce work hours in any other way.

This result complements the earlier findings of Collins et al. (2021), Fisher and Ryan (2021), and Hjálmsdóttir and Bjarnadóttir (2020) and adds that parenthood has been the major factor exacerbating gender employment gap in 2020. The findings provide further support to the earlier evidence on disproportionally stronger employment distortions among mothers with young children (Chung et al. 2021; Fodor et al. 2021; Qian and Fuller 2020).

Education Level

Whereas the role of education in gender employment gap did not alter during 2020, its role in explaining gender work hours and wage gaps changed notably, compared to 2019. An increase of an explained education contribution to wage gap in 2020 compared to 2019 signals changing composition of wage-earners and job loss
among low-educated men, which may stem from hourly wage cuts for employees in low-level jobs. This result is in line with earlier evidence on systematically stronger employment and wage distortions among people with a low level of education (Baylis et al. 2020). We add evidence of potentially stronger wage distortions among low-educated men. An increasing negative contribution of education to explaining gender gap in work hours in 2020 suggests that educated women could be suffering work hours decline caused by the pandemic, whereas employment propensity and hourly wage rate remained relatively unaffected. Furthermore, this result goes in line with earlier findings of Meriküll and Mõtsmees (2017), documenting women to have higher willingness to accept lower wage upon starting employment, while men have relatively higher demands. With women having, on average, lower reservation wages and higher willingness to compromise pay rate below the desired one, employment distortions in form of wage declines and transition to part-time job may be more tolerable for women, increasing their chances to stay on the labor market at the times of the crisis caused by the pandemic.

**Occupation**

While we document no systematic changes in gender selection into occupations which sustained higher employment, wage rate, or work hours during 2020, contribution of occupation to unexplained gaps in employment and work hours has changes non-negligibly. A declining contribution of occupation to unexplained gap in 2020, compared to 2019, signals that women were less likely to terminate employment relations or undergo work hours decline than men, provided they are working on the same occupational level (panel (vi) of Figs. 3 and 4) in 2020 as a whole. This finding indicates stronger within-occupation and within-industry resilience of female employment and work hours during the pandemic. A detailed look at gender employment gaps across occupations (Appendix III.A) reveals that, if anything, the pandemic has marginally decreased the raw gender gap in employment among professionals (ISCO 2) and both raw and unexplained gaps for technicians and associate professionals (ISCO 3). No significant effect of the pandemic was reported for other occupations.

However, the unexplained contribution to work hours gap was strikingly high in the second quarter of 2020 (panel (vi) of Fig. 4), suggesting that women experienced more severe declines in work hours than men in the same occupation, as the pandemic unfolded. Subsequently insignificant unexplained contributions indicate the temporary nature of disproportional worktime yields for both men and women. This trend is likely driven by elementary jobs (ISCO 9), which are the only ones with a persistently significant gender gap in work hours, which spiked in the first quarter and gradually declined back to pre-crisis level in the subsequent quarters (Appendix III.G.).

The unexplained contribution of occupation on gender wage gap did not change notably, as compared to 2019 and remained consistently and significantly negative during 2020 (panel (vi) of Fig. 4). This empirical observation is likely related to the narrowing of the gender wage gap in top-level occupations, i.e., among managers (ISCO 1) and professionals (ISCO 2), as documented in Appendix III.D, suggesting
a thinning of the “glass ceiling” (Cohen and Huffman 2007; Christofides et al. 2013; Albrecht et al. 2003). Appendix III.C presents gender wage gap estimates in quantiles over year 2013–2020, following unconditional quantile regression approach by Firpo et al. (2009). The results indeed point toward notable reduction of unexplained gender wage gap in the top quantile of wage distribution, namely a drop from 35.8 pp in 2019 to 26.7 pp in 2020. Yet, a sizable decline is also documented in the middle of wage distribution (from 22.7 pp in 2019 to 16.2 pp in 2020 in 40th quantile). We document no expansion of gender inequality in 2020 relative to 2019 in all parts of the wage distribution. Hence, an overall reduction of gender wage disparity is driven by declining gaps over entire wage distribution, yet with different magnitude across quantiles.

**Economic Sector**

We document a changing role of gender segregation into sectors in explaining gender disparities in all three labor market outcomes during 2020. An increased negative contribution to unexplained fraction of employment gap signal stronger resilience of female employment in the sectors, which incurred layoffs, implying that females were less likely to terminate employment relationships then men, provided they are working in the same economic sector (panel (viii) of Fig. 4). Cross-sectoral variations in employment gaps (Appendix III.B) reveal that gender gaps declined in all sectors except construction during the pandemic, with the most pronounced reductions in financial, real-estate and business activities, particularly in the first quarter, as well as in industry, including energy.10

Gender industry segregation appears to be the major factor explaining the gender wage and work hours gaps throughout the pandemic. While the overall explained contribution of industry was lower for both wage and work hours in 2020 compared to 2019, a drastic increase in the role of segregation by industry during in 2020 largely explains the substantial decline in the unexplained gender wage gap (panel (viii) of Fig. 4). This result suggests that men are more likely to be employed in economic sectors which sustained higher wage rates and incurred less work time cuts in the form of, for instance, transition to part-time job, throughout 2020. A sharp drop in female work hours observed in the first quarter (panel (ii) of Fig. 1) in the overall sample is likely linked to females being employed in sectors which experienced the sharpest drop in work hours as the pandemic unfolded.

An outstandingly high negative contribution to unexplained wage gap in the second quarter signals that, in the same industry, female wages underwent less of a wage decline as compared to male wages as the first wave of the pandemic hit. This trend may be largely driven by a sharp decline in wage disparity in the financial and insurance services sector (Appendix III.E). The one-off nature indicates that a substantial negative contribution was driven by female wage resilience in the first pandemic wave, rather than a faster wage recovery as the first wave flattened, although these two are impossible to empirically distinguish with the quarterly

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10 Due to the data limitations, we look at aggregated sectors only.
Importantly, the gender wage gap increased in those sectors most affected by the pandemic and declined in the least affected industries in our sample country (Appendix III.E).

Appendix III.H disaggregates the gap in gender work hours by industry, finding that the gender gap in work hours rose in manufacturing and other service activities due to mounting inequality in the third and fourth quarters, as well as in real estate activities, due to steadily high inequality in work hours in the first two quarters of the year. The latter may have largely driven the spike in the role of industry segregation (panel (vii) of Fig. 5). Notably, industry segregation is even more important in explaining the gender gap in work hours, as compared to the wage gap. The latter implies even greater differences in cross-industry work hours, with female employees dominating in the most affected sectors.

Firm characteristics

Documented increased contribution of firm ownership and size to the unexplained gap in wages in 2020, as compared to 2019 (panel (x) of Fig. 4), particularly in second and third quarters, signals that men’s wages recovered faster as the first wave of the pandemic flattened, as compared to female wages in firms of the same size and ownership type. Appendix III.F disaggregates the gender wage gap by firm ownership, recording a substantial difference in wage gap dynamics across Estonian- and foreign-owned firms and a reduction of gender wage gap, both raw and residual, in foreign-owned companies in 2020, as compared to 2019.

We document that gender segregation in firms of different sizes and ownership types did not reflect on the gender gap in work hours throughout 2020 (panel (ix) of Fig. 4). However, we find unexplained contributions of firm characteristics orthogonal to the gender wage gap (panel (x) of Fig. 4). Women tend to work longer hours provided they are employed in a firm of the same size and ownership type as men. Appendix III.I depicts a drastic difference in the magnitude and dynamics of the gap in gender work hours between Estonian- and foreign-owned firms. While for foreign-owned firms the gap in work hours gradually became insignificant over the four quarters and declined in 2020 overall, gender inequality in work hours in home-owned firms exacerbated in the first and fourth quarters of 2020 but overall remained unaffected in 2020.

Telework

As expected, telework had a nonnegligible effect on wages throughout 2020. The role of telework is somewhat like education—women are more likely to work from home (panel (iv) of Fig. 1) and telework was positively associated with wages

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11 The first wave of the pandemic and the lockdown measures cover the end of the first quarter and the beginning of the second quarter of 2020. Economic recovery followed in the second quarter. Thus, we cannot clearly distinguish between the effect of the lockdown and the effect of the post-lockdown recovery when analyzing our results for the second quarter of 2020.
Fig. 5 Selected contributions to the gender work hours gap. Note: The point estimates are reported with 95% confidence intervals relying on robust standard errors. The estimates are based on EE-LFS data and account for population weights in the respective year or quarter. Decomposition is performed using the Oaxaca–Blinder technique specified in Eq. (3) and additionally extracts contributions of demographics and region, which are negligible.
during the pandemic (panel (xi) of Fig. 4). A sharp drop in telework contribution to the unexplained gender work hours gap (see panel (xii) of Fig. 4) signals smoothing disproportional effect of telework male and female work hours. Given that telework capacity of a job has been documented as a core factor safeguarding employment and wages when social distancing is encouraged (Bonacini et al. 2021; Dingel and Neiman 2020), we can expect that teleworking women avoided work hours decline. Thus, our results suggest that this was one of the important factors explaining gender wage and work hours inequality in 2020.

Conclusions

This paper tests empirically whether the COVID-19 pandemic accelerated gender inequalities in the labor market. We use Estonian Labor Force Survey data to investigate the evolution of gender gaps in employment, hourly wages, and work hours over the years 2013 through 2020 and across the four quarters of 2020, focusing on fluctuations in inequality measures as the infection rate swung and restrictions were imposed. We employ the Oaxaca–Blinder decomposition to distinguish whether changes stem from parenthood, education level, occupation, industry, telework, or firm characteristics (size and foreign ownership).

Unlike the forecasts and earlier evidence, we find no exacerbation of the overall gender gaps in employment, hourly wages, or work hours in 2020 in our sample country. When analyzed in total population, all gender gaps revealed only a temporary increase in response to the infection rate fluctuations and restrictive measures imposed by the government. There was a temporary increase in the employment gap in the second quarter, but it smoothed out in subsequent quarters. Gender gaps in wages and work hours revealed slightly different dynamics over the year. Both picked up in the first quarter, with a decline during the following two quarters and a subsequent increase in the last quarter of 2020.

The evolution of gender inequalities mirrors the infection rate. The first kink coincides with the pandemic onset and the first lockdown, which implied the closure of non-essential retail, day-care facilities and schools, social distancing, and mandatory teleworking. As the infection rate declined and restrictions were largely removed in the second half of May 2020, female work hours and wage gaps narrowed to the pre-crisis level. The third quarter of 2020 marked the highest speed of economic recovery, which is also reflected in all three analyzed gender inequality measures. However, in the fourth quarter the infection rate topped the levels recorded in spring 2020. Despite the stringent restrictions that were imposed only in March 2021, the gender gap in work hours and wages rose at the end of 2020. This evidence is a noteworthy signal of a potential exacerbation of gender inequalities during the second lockdown in March–May 2021.

Our results suggest that a temporary upswing in employment gap was largely driven by parenthood. We document that employment propensity of child-rearing women reduced relatively more than that of child-rearing men throughout 2020. Thus, mothers were more likely to terminate employment in response to day-care and school closures than fathers, given all other comparable characteristics.
Substantial gender segregation in industries exacerbated gender inequality particularly in terms of work hours. The reduction of work hours in male-dominated sectors was likely lower than in female-dominated sectors, particularly in the first quarter of 2020 as the pandemic unfolded. Industry gender segregation overall fueled the gender wage gap in 2020; however, in the least affected sectors—financial and insurance services and healthcare—female wages were more resilient.

Downward fluctuations in the gender wage gap are mainly driven by education, occupation, and telework. Women’s stronger educational profile paid off particularly at the start of the pandemic, when the first wave escalated, whereas low-educated men experienced stronger wage distortions throughout 2020. We document persistently higher employment propensity and wage returns to females, provided the structure of female occupations. A documented decline in the gender wage gap in top-level jobs indicates a potential thinning of the “glass ceiling” and decomposition analysis suggests stronger resilience of female wages in high-level occupations during the pandemic. Telework appeared relevant only for the gender wage gap, as we document a higher propensity to work from home among women and, as a result, stronger wage resilience among teleworking women. A narrowing of the gender gap in work hours was mainly driven by firm ownership and size, with women experiencing milder declines in work hours, provided they work in the firm of same ownership type and size as men, particularly during spikes in the infection rate.

The upside of our findings is the rather cyclical nature of employment distortions and that fact that there is no evidence of exacerbated gender inequalities across the total population. This points toward short-term distortions, which should not leave a long-lasting trace on average gender inequalities in the labor market. This result holds for all gender inequality measures considered in this paper.

However, the persistently high employment penalty of child-rearing women is alarming. This finding implies that once employment is terminated, re-entering the labor market may be difficult and may take longer due to high returns to work experience and overall labor market disturbances considering the post-pandemic economic recession. The increasing gender disparity in work hours and wages at the end of 2020 is another alarming finding, which signals two potential mechanisms. The first one is a labor market factor. Employers might have perceived a potential second lockdown due to the mounting infection rate and, based on their experience from the first wave, may have taken advance measures and adjusted labor costs. A reduction in work hours and wages, as a precautionary step taken by employers to sustain their businesses, might have been disproportional across men and women with women being more affected.

The second factor may stem from the family. Like employers, employees might have anticipated the second lockdown and particularly the closure of day-care and schools, which re-opened the question of home-schooling and childcare. Similarly to the first wave of the pandemic, mothers were likely to take the major responsibility in facilitating home-schooling of older children and caring for the smaller ones. Perceiving this, women might have deliberately reduced their worktime in advance, increasing the residual gap in work hours. An increase in the residual gender gap in wages can be explained by informal arrangements between child-rearing mothers and their employers. Negotiated wage reductions as compensation for lower job
commitment is particularly relevant for unofficial employment, which is largely captured by the LFS data. The latter explanation is particularly valid in times of the pandemic, as employment flexibility increased dramatically in response to persistent uncertainties and looming financial stability issues.

Whichever mechanism underlines an increase in gender work hours and wage gaps at the end of 2020, the major takeaway is that there may be another spike in gender inequality in the first half of 2021. Our evidence on the dynamics of gender gaps in 2020 suggests that female employment, wages, and work hours were resilient in the face of the pandemic-induced crisis, and they may remain so throughout the second wave.

However, the above-mentioned conclusions rely on average statistics. While average inequalities may narrow or remain unaffected, certain demographic or labor market groups may experience a long-run expansion of gender inequalities at the cost of female employment, wages, or worktime. This is particularly relevant for child-rearing women, women employed in male-dominated industries and industries most affected by the pandemic, as well as low-level occupations. However, to draw conclusions on the long-term implications of the pandemic for overall gender inequality and to identify the most vulnerable groups, a longer post-pandemic sample period and better data granularity are needed. Furthermore, one has to acknowledge that our findings are country-specific, similarly to the majority of recent empirical studies on the labor market implication of the COVID-19 pandemic. To draw general conclusions, a meta-analysis relying on the emerging literature is needed. These questions remain open for future study.

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