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The Effect of the COVID-19 Pandemic on Women's Labor Market Outcomes

Initial Emperical Evidence on the Gender Gap in Employment and Actual Hours Worked in Norway

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Abstract

The aim of this master thesis is to estimate the effect of the COVID-19 pandemic on the gender gap in employment and hours worked in the Norwegian labor market. First, we illuminate attributes of the Nordic model and trends in the gender gap in Norway. Second, we seek to uncover how economic explanations contribute to the gender gap. In our empirical analysis we attempt to find evidence of a "shecession" in employment and hours worked in Norway.

Using data from the Norwegian Labor Force Survey (AKU) we do not find evidence of a "shecession" in employment, possibly indicating that women were not disproportionately displaced compared to men during the pandemic. We propose that this may be due to the attributes of the Nordic model. When studying the pandemic-induced change in actual hours worked, we find that when controlling for industry and occupation combinations women worked more actual hours relative to men after the pandemic. This is likely due to the high concentration of women in vital functions in society, where our findings indicate that there is a positive effect of being a female public worker on actual hours worked during the pandemic. Likely contributing to this is the fact that a large share of women worked part-time in vital functions before the pandemic and had to increase their actual working hours to a larger degree than men on average.

Time constraints due to childcare at home on labor market outcomes have been an important topic during the pandemic. We therefore investigate how the pandemic has affected the labor market outcomes of mothers versus non-mothers. Although we do not find a negative family gap in employment, we detect a pandemic-induced motherhood gap in hours worked, where mothers have a greater reduction in hours compared to non-mothers.

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1 Introduction

The COVID-19 pandemic has shaken the global community causing mass deaths, economic downturn, labor market discrepancies, and supply shortages. ILO (2021b) portrays a dark picture of women's overrepresentation in hard-hit sectors during the pandemic. Due to the characteristics of the pandemic, many typically female-dominated sectors such as tourism, food services, and hospitality have suffered the effect of reduced demand and lockdowns (U.S. Bureau of Labor Statistics, 2021). This has caused mass redundancies and dismissals disproportionally affecting women on a global scale. Data shows that between 2019 and 2020, women's employment suffered a loss of 4.2 percent worldwide, compared to a decline in men's employment by 3 percent (ILO, 2021a), increasing the global gender gap.

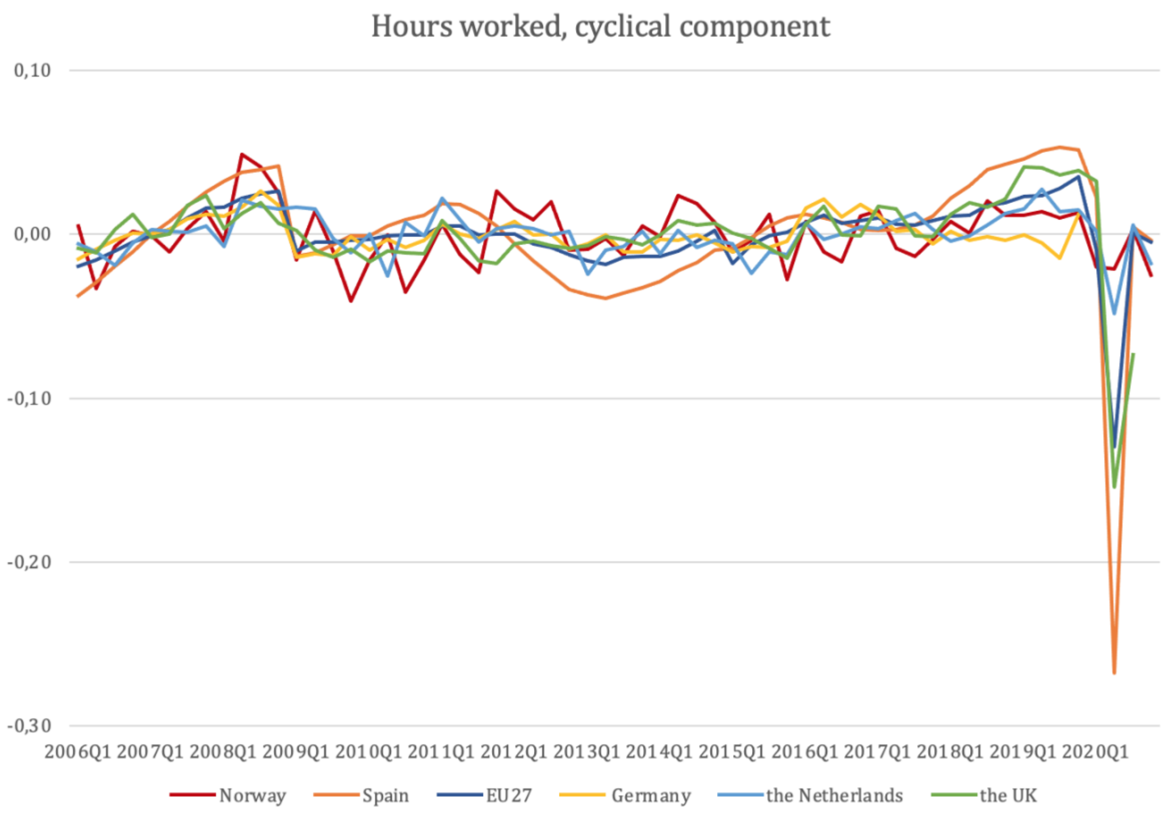
The gender gap is the difference between men and women as reflected in domains such as politics, education, social life, culture, and economic participation and opportunity (World Economic Forum, 2021). While Norway has one of the most gender equal labor markets in the world, we are still far from attaining full parity (International Monetary Fund. European Dept., 2017). Although the female labor participation rate has increased over the last decades, we still observe that part-time work is more common among women than men (Statistics Norway, 2019). Additionally, female full-time equivalent wages currently amount to 87.5 percent of men's earnings (Askvik, 2020). The largest differences in wages are found between professions (Kristoffersen, 2017). There is also a large gender gap in managerial positions: women only account for 37 percent of all leaders in the country (Statistics Norway, 2019), and just 7.5 percent of CEOs in the 200 largest Norwegian companies are women (CORE Senter for likestillingsforskning, 2020).

When researching possible topics for our master thesis we read the working paper *"From Mancession to Shecession: Women's Employment in Regular and Pandemic Recessions"* by Alon, Coskun, Doepke, Koll and Tertilt (2021a). Alon et al. (2021a) use cross-sectional labor market survey data from the US, the UK, Germany, the Netherlands, Spain, and Canada to examine the impact of the COVID-19 pandemic recession on women's versus men's labor market outcomes in terms of employment and actual hours worked. They construct a model in which employment and hours worked are the dependent variables.

The explanatory variables are indicator variables for gender and the pandemic quarters as well as an interaction term between these. Controls for gender specific time trends in labor supply, quarter, age, education, and marital status, and later industry and occupation combination categories are included. The coefficient of interest is the estimate of the interaction term of the gender and pandemic indicator variables, which shows the impact of the pandemic on women relative to men.

All the statistically significant estimates for this coefficient in Alon et al. (2021a) are negative, meaning they find a larger negative pandemic effect on women compared to men. This indicates a “shecession” in the coefficient’s relevant country and labor market outcome. In a “shecession”, women are more exposed to negative labor market outcomes then men during the pandemic both in terms of employment and hours worked. The researchers highlight that this contrasts with their findings of the labor market outcomes of the financial crisis of 2008, which they characterize as a “mancession”.

Figure 1: The cyclical component of total actual hours worked in several European countries



Notes: Figure 1 is made with Eurostat’s “lfsi_ahw_q_h”: Index of total actual hours worked in the main job by sex and age group (2006=100) (2006-2020) – quarterly data” (Eurostat, n.d.). We set the age class to 20-64 *and seasonal adjustment to "Unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data)". We then seasonally adjusted the data and found the cyclical component following (Pindyck & Rubinfeld, 1991).*

Alon et al. (2021a) show that the pandemic recession has been extraordinarily severe. The deviation from long term trends in aggregate hours worked is much larger than in previous downturns for several countries. Finding this interesting, we downloaded data on actual hours worked for Norway, Spain, EU27, Germany, the Netherlands, and the UK from Eurostat. We then seasonally adjusted and found the cyclical component in the data following the method described in Pindyck and Rubinfeld (1991). Figure 1 shows the cyclical component of actual hours worked in EU countries and Norway from Q1 2006 to Q4 2020, in which Q2 to Q4 2020 are affected by the pandemic. We see that the drop in labor supply in Norway was much lower than for other European countries during the pandemic, and we decided to base our thesis on investigating how and if this translated to the gender gap.

As the preliminary results in Alon et al. (2021a) identify signs of a "shecession" in several countries, we want to investigate whether the pandemic caused a "shecession" in Norway. We therefore propose the following research question:

Did the initial two quarters of the COVID-19 pandemic result in a "shecession" in the Norwegian labor market?

Norway adheres to the Nordic model, which describes a set of economic and social welfare systems adopted by the Nordic countries in order to offset negative shocks to the economy and individuals' economic stability (Fløtten & Trygstad, 2020). The Nordic welfare state aims to sustain a high level of employment to finance an extensive public sector, where securing women's participation in the labor force is integrated into both policies and the welfare services. Based on this we specify the first hypothesis:

The pandemic did not cause a "shecession" in employment in the Norwegian labor market due to the attributes of the Nordic model. *(1)*

Research shows that the public sector is countercyclical to economic downturn (Quadrini & Trigari, 2007). Women are overrepresented in the Norwegian public sector and amount to 70,3 percent of all public sector employees (Statistics Norway, 2019). During the pandemic many female-dominated occupations were characterized as essential work, and women had to increase their workload (Melby, Thaulow, Lassemo, & Ose, 2020). These key workers are employed in vital functions that are mainly part of the public sector (Regjeringen, 2021). Considering this we specify the second hypothesis:

The high concentration of female key workers in the public sector prevents a "shecession" in hours worked in the Norwegian labor market. (*2*)

To answer the research question, we utilize the Norwegian Labor Force Survey (AKU), provided through the Norwegian Centre for Research Data (NSD, n.d. a). The quarterly cross-sectional data from the first quarter of 2006 to the third quarter of 2020 allows us to investigate the pandemic's effect on women's employment and actual hours worked during the first two quarters of the pandemic. The empirical analysis is partially based on Alon et al. (2021a). First, we study the effect of the pandemic on female employment and actual hours worked in Norway, and then singling out the effect of being a female public sector employee during the pandemic. The partial replication of the empirical analysis in Alon et al. (2021a) creates results comparable with their international findings, of which we focus on the results from the US. The last part of the analysis investigates the pandemic's effect the motherhood gap in Norway.

The structure of the thesis is as follows: Chapter 2 provides a summary of Norway's economic structure and the Nordic model. Chapter 3 summarizes potential economic explanations for the gender gap. Chapter 4 present a literature review of the gender gap during the COVID-19 pandemic. Chapter 5 presents the Norwegian government's policy responses to the COVID-19 pandemic and the vital functions in society. Chapter 6 describes the data and methodology used in the empirical analysis. Chapter 7 provides the structure of the data analysis. Chapter 8 then presents the results of our empirical analysis. Chapter 9 discusses the findings before presenting. Chapter 10 presents suggestions for further research. Chapter 11 concludes the findings of the thesis.

2 The Nordic Welfare State and implications for the gender gap

2.1 The Nordic model implemented in Norway

The Nordic model describes a set of economic and social welfare systems adopted by the Nordic countries in order to offset negative shocks to the economy and individuals' economic stability (Fløtten & Trygstad, 2020). The Nordic model is based around three basic pillars to ensure social security and economic growth: economic governance, influential labor market organizations, and public welfare systems (Klemsdal, 2009). The systems are distinct in their aim to provide full employment through an organized labor market, and extensive welfare system. The welfare state is financed by general (and progressive) taxes aimed to allocate cash benefits to households and publicly provided social services (Andersen, et al., 2007). In this manner, the model can be interpreted as collective risk sharing within the country (Gylfason, Holmström, Korkman, Vihriälä, & Söderström, 2010). The inherent public spending in the model stimulates private spending and demand, reducing the scope of recessions through the Keynesian multiplicator effect (Cwik, Wieland, Gürkaynak, & Cova, 2011).

Women's employment in the Nordic model is not only desired, but necessary to maintain the lucrative benefits of the welfare state (Melkas & Anker, 1997). Securing women's participation in the labor force is integrated into both policies and welfare services. An example of this is the availability of child day-care and parental leave as it is a major contributor to women's labor force participation in Norway (FN, 2021). The offer of alternative day-care has enabled women to reduce their hours away from paid work and the parental leave for men has increased equality in the household (Næringslivets Hovedorganisasjon, 2018b). In addition, parents receive paid leave from work when their child(ren) are ill, preventing work supply reductions due to childcare (NAV, 2021c).

Norway has an extensive public sector as a result of policies related to the Nordic model. Almost one third of all workers are employed in the public sector (Næringslivets Hovedorganisasjon, 2018a), with the healthcare sector employing 21 percent of the work force (Statistics Norway, 2021c). The large public sector provides education, childcare and social services and has been "women's ally" in securing a high female labor force participation. Especially within the healthcare sector has the female share of employees increased (Melkas & Anker, 1997).

2.2 Trends in the Norwegian gender gap

Norway is one of the leading states in striving for gender parity in the labor market and society in general (World Economic Forum, 2016), with a female labor participation rate of 83.4 percent in 2020 (OECD, 2020a). The Norwegian government has established a ban on discrimination based on gender, pregnancy, maternity leave, and care tasks through Likestillings- og diskrimineringsloven (2018). This law builds on four previous laws: Likestillingsloven (1979), Diskrimineringsloven (2005), Diskriminerings- og tilgjengelighetsloven (2008), and Diskrimineringsloven om seksuell orientering (2013). To mitigate differences between genders in the labor market, mandatory wage transparency and reporting requirements for gender pay has been introduced. In addition to this, Norway has equal pay for equal work as a legal requirement.

Still, several challenges remain before accomplishing complete gender parity. In Norway, over 80 percent of all employed persons work within a field that is female- or male-dominated (Østbakken, Reisel, Schøne, Barth, & Hardoy, 2017). There is a large degree of occupational gender segregation between the public and private sector. The public sector comprises of 70 percent female employees while 63.3 percent of workers in the private sector are men (Statistics Norway, 2019). Men have a higher sector mobility then women (Østbakken, Reisel, Schøne, Barth, & Hardoy, 2017) and there is least occupational- and sector mobility within professionally oriented occupations such as teachers, doctors and nurses (Barth, Røed, Schøne, & Torp, 2004). Additionally, there is a far larger share of male leaders in the labor market (United Nations, 2019), with only 22 percent of top leaders being women (Barne- og likestillingsdepartementet, Nærings- og fiskeridepartementet, 2018).

Another challenge to achieve gender parity is the persistent gender wage discrepancies in Norway. Women are more likely to work in lower paid occupations and industries than men, resulting on average to women's annual earnings being 70 percent that of a man's annual income (Statistics Norway, 2019). Still, we observe that even within the same sector, full-time employed men have higher earnings than full-time employed women (Statistics Norway, 2021a). In addition, women are more likely to work part-time then men (Moland, 2013), in addition to having a greater share of sickness absence from work (Statistics Norway, 2021d).

3 Economic explanations and theories

3.1 The human capital model

The human capital model is one of the most used explanations of the observed gender gap. The model converts human labor into a commodity to be traded, where every individual can offer some form of human capital (Becker, 1985). Human capital is defined as skills and abilities accumulated through training, education, and experience. The theory suggests that an individual's earnings increase with education and experience as these factors cause productivity-enhancement at work (Mincer & Polachek, 1974).

Individuals allocate time towards work and leisure based on preferences, budget, and efficiency within the household (Becker, 1993, pp. 31-48). Due to traditional division of labor, women anticipate discontinuous work experience when they marry or have children, and thus have lower incentives to invest in human capital accumulation (Blau & Winkler, 2018). This lowers women's earnings relative to men's, contributing to the gender pay gap. An employed woman may avoid jobs that require substantial investment in firm-specific skills as returns to investments are reaped only when remaining with employers over time (Becker, 1962). If women then choose careers that require less on-the-job training, this can create occupational segregation (Blau & Winkler, 2018).

3.2 Occupational segregation

3.2.1 Horizontal occupational segregation

Horizontal occupational segregation is the tendency for women to crowd in specific occupations and industries (Melkas & Anker, 1997). The tendency of the genders to work within different occupations and fields have been found to contribute to gender differences in wages (Hirsch & Macpherson, 1995), as well as hindering job opportunities and development for women (Preston, 1999).

Women tend to be overrepresented in the service sector, in which occupations are generally characterized by their high demand for "soft" skills compared to the demand in traditionally male-dominated sectors for "hard" skills (Grybaite, 2006). These female-dominated sectors broadly involve caring, nurturing, and services. This phenomenon is observed in the Nordic model as described in Section 2.1. To mitigate occupational gender segregation, policies have aimed to redistribute women into male-dominated sectors (Blau, Brummund, & Liu, 2013). This have further leveraged the male-dominated industries by the introduction of productive female employees.

3.2.2 Vertical segregation - The Glass Ceiling

Vertical segregation or "the glass ceiling" refers to a social barrier that prevents qualified women from being elevated to decision-making positions based on sexism or racism (Meulders, Plasman, Rigo, & O'Dorchai, 2010). The theory states that the existence of a glass ceiling increases gender gap as it prevents women from reaching managerial positions. The phenomenon most commonly occurs at the top of the wage distribution (Arulampalam, Booth, & Bryan, 2007). Another aspect of this vertical gender segregation in the labor market due to gender differences is allocating and accepting tasks with low promotability (Babcock, Recalde, Vesterlund, & Weingart, 2017). Examples of non-promotable tasks are non-generating or service-related tasks. Although benefiting the organization, allocating more non-promotable tasks to women may place the task-performing individual at a relative disadvantage. This structural allocation of tasks may contribute to why women are not promoted to decision-making positions.

3.3 The motherhood penalty

The motherhood penalty is the observed phenomenon that mothers experience more disadvantageous labor market outcomes than non-mothers with similar qualifications. Mothers earn less than childless women on average (Waldfogel, 1998). In addition, women who have children early are on average more likely to experience the adverse effects of having children on wages compared to women who delay childbearing (Taniguchi, 1999). Following the neoclassical explanation, the human capital model, the motherhood penalty is a result of disruption of formal education or on-the-job training due to childbearing. Some also propose that women choose lower paying jobs that are reconcilable with childcare (Felfe, 2012) or that employers discriminate against mothers (Budig, Misra, & Boeckmann, 2012). Another aspect that can help explain this are wage structures that disproportionately reward employees that work long or particular hours, such as non-linear wage structures (Goldin, 2015).

4 Literature review of the gender gap during the COVID-19 pandemic

Alon et al. (2020) find that women in numerous countries have suffered disproportionate negative economic consequences of the pandemic-induced economic downturn, calling the phenomenon a "shecession". Although women supply only 39 percent of global employment, women's job displacement accounted for 54 percent of overall job losses during the pandemic (McKinsey, 2020). Alon et al. (2021a) argue that a major contributing factor is the composition of women's employment across industries and occupations. Female-dominated service industries such as retail, hospitality, and tourism were heavily affected by the pandemic and subsequent lockdowns (ILO, 2021b).

Women are more likely to be laid off than their comparable male colleagues. A policy brief based on HMRC data from the UK expressed concern of the gender furlough gap (GOV.UK, 2020). Furloughed workers consisted majorly of women in every region except the West Midlands, and the gender furlough gap was the highest amongst young women. The Norwegian Directorate for Children, Youth and Family Affairs (2020) describes a divided Norwegian labor market in which the same trend can be seen following the initial infection control measures. However, as the pandemic progressed and affected more than immediately affected sectors, men experienced higher gross unemployment then women (Audun Gjerde, 2020).

The closure of schools and daycare centers heavily affected families' childcare needs during working hours. While the national closure started March 12th, the phased opening of kindergartens started on April 20th, and the younger primary (classes 1-4) as well as some upper secondary and tertiary students could attend physical school from April 27th (OECD, 2020b). Additional closures of schools and daycare centers were conditional upon infection rates in different municipalities. During the closures, students attended remote teaching. How this affected division of home production and childcare within the home in Norway is yet to be determined. Alon et al. (2020) found that increased childcare needs had a particularly big impact on working mothers in the US; this in large part because there are many more single mothers than single fathers, as well as more stay-at-home mothers than fathers. In married heterosexual relationships women carried most of the increased childcare burden during the pandemic, and Petts et al. (2020) found that the increased childcare during the pandemic resulted in negative labor market outcomes for women.

According to Alon et al. (2021a), women working remotely have increased hours of childcare and experienced greater productivity reductions compared to men. The flexibility of working remotely combined with the closure of schools and daycare centers has increased the number of hours women spend on home production and childcare (Andrew, et al., 2020). This is reinforced by the fact that more married women had to work from home due to childcare, although married men were in job situations more adaptable for remote work (Alon, Doepke, Olmstead-Rumsey, & Tertilt, 2020). This underlines the existing gender specific division of labor within the home and reinforces traditional gender roles.

Telecommuting may benefit the progression away from traditional gender roles as fathers use more time at home and partake in home production, making this more normative (Carli, 2020). The health sector is also dominated by female employees, and their partners often have to dedicate more time to home production and childcare (Alon, Doepke, Olmstead-Rumsey, & Tertilt, 2020). Men taking more on more childcare responsibilities are a trend observed in several countries as documented by Carlson et al. (2020) in the US, Möhring et al. (2020) in Germany, and Del Boca et al. (2020) in Italy.

5 Vital functions in society and policy responses to the COVID-19 pandemic

5.1 Policy responses to the COVID-19 pandemic

Norway has an extensive social security program with compulsory enrollment in the National Insurance Scheme (NAV, 2021a). Relating to the labor force, the Labor and Welfare Service (NAV) provides unemployment benefits if you are unemployed or temporarily laid-off (dagpenger in Norwegian), sickness benefits if an individual is occupationally disabled due to an illness or injury, parental benefits for ensuring parents' income in connection to childbirth, pensions, and flexible employment schemes tailored to individual needs for qualifications and occupational training. Additionally, NAV provides a guarantee for wages in case of business insolvency (NAV, 2021b).

During the COVID-19 pandemic, the Norwegian Government issued a number of infection control, social security, and financial measures attempting to mitigate and contain the effects of the spreading infection and the economic downturn. The Norwegian society went into lockdown March 12th, 2021, entailing the immediate closure of schools, daycare centers, stores, and gyms. During the four weeks after the initial infection control measures, the number of unemployed individuals more than quadrupled, amounting to 15.5 percent of the work force (Audun Gjerde, 2020). To reduce financial liability related to laid off workers and sick leave for employers, the government issued several job schemes (KPMG, 2020). Although unemployment benefits related to temporarily laid-off workers are provided by NAV, pre-pandemic employers had to pay for the first initial 15-day period of the temporary redundancy. Initial legislation reduced mandatory employer payment from 15 to 2 days to alleviate businesses' financial liability. In September 2020, mandatory employer payment was increased from 2 to 10 days.

On March 20th, 2021, the government launched extensive economic stimulus measures including reduced taxes, payment deferrals and loans to stimulate business and prevent bankruptcy (Gjerde, 2020). Since this, several compensation packages have been granted to different sectors to sustain operation and investment.

The government also commissioned changes in unemployment benefits to ensure economic insurance for laid off and temporarily laid off workers to allow greater access to the schemes during the pandemic. On March 27th, the period that individuals can receive unemployment benefits was extended for individuals nearing the maximum compensation limit. Following this, the government launched a new compensation scheme aimed at temporary laid-off workers, students, apprentices and the self-employed.

5.2 Vital functions in society during the pandemic

In the beginning of the pandemic, the government published a list of vital functions in society. The list is extensive, and we therefore provide a shortened overview summarized in Table 1. The overview is based on "Liste over virksomheter med kritisk samfunnsfunksjon og nøkkelpersoner» (Regjeringen, 2021). The Norwegian government is committed to keeping these functions operative throughout the pandemic, which we propose will hinder a decrease in working hours as noted in hypothesis (2). As we see from Table 1, many of the vital functions in society are provided by the public sector. The largest employer in vital functions is the healthcare sector which has a high percentage of female workers.

Table 1: Summary of vital functions in society

Vital function in Society	Essential work
Defense Department	National Security
Justice Department	Rule of Law Police Border control The Prison and Probation Service
Ministry of Health and Care Services	The health care sector Nuclear safety Food safety Child Welfare Services Crisis center
Ministry of Labor and Social Affairs	Labor and welfare services (NAV)
Rescue Services	Norwegian rescue service Fire Department Civil defense
Digital security	Privacy and GDPR
Environment and Nature	Norwegian Water Resources and Energy Directorate Meteorological Institute Acute Pollution
Critical supply chain	Food supply Fuel supply
Water and drain	Drinking water supply and wastewater management
Financial Services	Norwegian Central Bank Financial Supervisory Authority of Norway Financial institutions
Power Grid	Supply of electrical energy and district heating
Electronic communication	Telecommunication
Transportation	Transportation of goods and people
Satellite-based services	Satellite services

6 Data description and methodology

6.1 Data description

We base our analysis on quantitative data from the Norwegian Labour Force Survey, or Arbeidskraftsundersøkelsen (AKU) in Norwegian, conducted by the national statistics bureau Statistics Norway (2021b). Access to AKU is provided through the Norwegian Centre for Research Data (NSD, n.d. a). The aim of the data is to provide knowledge about the Norwegian labor market and its development over time. As described by Statistics Norway (2021c), the survey data is collected by telephone in quarterly, representative samples. Each sample consists of around 21 000 households. The respondents report on their labor market status for a selected reference week.

Firstly, following Alon et al. (2021a), we run a set of OLS regressions which give results comparable to the findings in the mentioned paper. Alon et al. (2021a) use surveys from a set of countries (the US: the Current Population Survey (CPS), Canada: the Labour Force Survey (LFS), Germany: the German Internet Panel (GIP) and the Mannheim Corona Study (MCS), the Netherlands: the Longitudinal Internet studies for the Social Sciences (LISS), Spain: the Economically Active Population Survey (EAPS), and the UK: the UK Labour Force Survey) to estimate the effect of the COVID-19 pandemic on women's employment and hours worked. We follow their method of constructing a model to find the effect of the pandemic on employment status and hours worked while controlling for labor supply trends, season, age, education, marital status, and later industries and occupations.

We broaden the scope of our analysis beyond that of Alon et al. (2021a) by including observations from every quarter during the period 2006 Q1 to 2020 Q3. We include data since 2006 as this year marks the last time series break, meaning that we have consistent variables from this time forward. However, there are still some variations in reporting during the time-period, and details on how these issues were mitigated are found in the variable description section (Section 6.2).

6.1.1 Sample selection

We have four main samples based on different restrictions of our dataset comprised of AKU-data from the first quarter of 2006 to the third quarter of 2020. Firstly, as we want comparable results to Alon et al. (2021a), we restrict our first sample to include observations from the first quarter of 2019 to the third quarter of 2020, and respondents aged 25 to 55. In addition to making our sample comparable to the samples used in Alon et al. (2021a), there are analytical advantages to these restrictions. When restricting the sample to 2019-2020 we solely include years that are highly comparable with respect to structure, meaning that differences in estimated results are likely due to the pandemic. When restricting the sample to respondents from 25 to 55 years of age we are more likely to measure the pandemic's effect on the most active part of the labor force: we remove students, pensioners, and in general respondents in age groups where there are other reasons than the pandemic to stay out of the labor force.

Table 2: Norwegian sample (1) population characteristics compared to Alon et al. (2021a)

	USA	CAN	DEU	NLD	ESP	GBR	NOR
Labor Supply							
percent employed	78	81	85	82	74	85	87
hours worked last week	30	27	31	25	24	27	25
percent telecommuting	39			59		14	
Percent Female	51	50	51	56	50	51	49
Percent Married	57	50	56	74	52	54	44
Percent Single Mothers (0-17)	7	4	2	3	3	5	2
Percent with Children			41				
pre-kindergarten (0-5)	17	21		13	16	21	11
school age (6-17)	28	26		29	32	30	15
Percent Non-white/Immigrant	25	29	9	23	19	15	
Percent College Graduate	41	37	39	48	43	40	46
Sample Size	919,296	917,951	38,687	50,491	476,973	215,589	77,383

Notes: Table from Alon et al. (2021b)*, Norway added by us. The samples include the population aged 25 to 55 in the time-period 2019 Q1 – 2020 Q3. Child age brackets show the age of the youngest child. The survey data for Norway registers the case of a respondent having no children and there being missing observations of number of children the same, so the percentages of respondents with children are uncertain but display what* *is included in our data. A further discussion of how children are included in the data can be found in section 6.2.2. The data for Norway does not include information on telecommuting, race, or immigrant status. Please see original table in Alon et al. (2021b) for their notes.*

Table 2 shows a comparison between the sample population characteristics given in Table C8 in the appendix of the relevant paper (Alon T. , Coskun, Doepke, Koll, & Tertilt, 2021b) for USA, Canada, Germany, the Netherlands, Spain, and the UK, with a column added by us for the sample population characteristics of our first sample from Norway, sample (1). Table 2 compares the samples' labor supply in terms of both employment and actual hours worked as well as telecommuting from select countries. The table also includes sample population characteristics related to gender, marital status, children, immigration status from select countries and education level. We find that our sample size is quite large when considering the size of the Norwegian population.

In addition to using the sample designed to be comparable to the ones used in Alon et al. (2021a), we run our model with three larger samples. While there are analytical advantages to the sample restrictions in sample (1), we want to expand our analysis to explore the effects of the pandemic on larger parts of the Norwegian population and in a broader time perspective. We also want to check the validity and robustness of the results from our first sample. We therefore employ AKU-data starting from 2006 and include AKU-respondents of all ages. The age of respondents in the AKU spans from 15 to 75, and we can thus see the effects on the pandemic on more volatile groups in the labor force. For example, most part-time workers are either between the ages 15-24 or older than 55 (Arbeids- og sosialdepartementet, 2021). Specifically, in addition to analyzing sample (1): 2019Q1-2020Q3 ages 25-55, we run our regressions on sample (2): 2006Q1-2020Q3 ages 25-55, (3): 2019Q1-2020Q3 all ages, and (4): 2006Q1-2020Q3 all ages. Table 3 describes the sample selection and final sample size for samples (1), (2), (3) and (4). We see that removing respondents under 25 and over 55 removes 45 percent of observations in sample (1) and (2), and that observations with over 60 reported actual working hours in the reference week accounts for between 1 and 2 percent of all samples.

Table 3: Sample selection for samples (1), (2), (3) and (4)

		Number of observations	Removed observations	
(1)	**2019Q1-2020Q3, ages 25-55**			
	All observations from the first quarter of 2006 to the third quarter of 2020	1,190,046		
	Remove observations in which gender is not registered	1,190,046	0	0%
	Remove all observations from before 2019 to be left with observations from 2019 Q1 to 2020 Q3	143,532	1,046,514	88%
	Remove everyone under 25 and over 55	78,730	64,802	45%
	Remove observations with over 60 reported hours every week	**77,383**	1,347	2%
(2)	**2006Q1-2020Q3, ages 25-55**			
	All observations from the first quarter of 2006 to the third quarter of 2020	1,190,046		
	Remove everyone under 25 and over 55	657,020	533,026	45%
	Remove observations with over 60 reported hours every week	**643,560**	13,460	2%
(3)	**2019Q1-2020Q3, all ages (15-75)**	**141,741**		
	All observations from the first quarter of 2006 to the third quarter of 2020	1,190,046		
	Remove all observations from before 2019 to be left with observations from the first quarter of 2019 to the third quarter of 2020	143,532	1,046,514	88%
	Remove observations with over 60 reported hours every week	**141,741**	1,791	1%
(4)	**2006Q1-2020Q3, all ages (15-75)**			
	All observations from the first quarter of 2006 to the third quarter of 2020	1,190,046		
	Remove observations with over 60 reported hours every week	**1,172,191**	17,855	2%

After estimating how the pandemic affected women's employment relative to men's, we want to estimate how being a mother during the pandemic affects our selected labor market outcomes. When estimating the effect of having children on employment and hours worked, we must restrict our samples to only include women due to the design of the AKU variable for number of children, which is explained further in section 6.2.2. Table 4 describes the sample selection and final sample size of each of these samples. We see that the share of women is 50 percent in samples (1), (2), (3), and (4).

Table 4: Sample election for samples (5), (6), (7) and (8)

		Number of observations	**Removed observations**	
(5)	**2019Q1-2020Q3, females ages 25-55**			
(1)	2019Q1-2020Q3, ages 25-55	77,383		
	Remove observations in which the respondents are men	**38,504**	38,879	50%
(6)	**2006Q1-2020Q3, females ages 25-55**			
(2)	2006Q1-2020Q3, ages 25-55	643,560		
	Remove observations in which the respondents are men	**325,160**	318,400	50%
(7)	**2019Q1-2020Q3, females all ages**			
(3)	2019Q1-2020Q3, all ages (15-75)	141,741		
	Remove observations in which the respondents are men	**70,233**	71,508	50%
(8)	**2006Q1-2020Q3, females all ages**			
(4)	2006Q1-2020Q3, all ages (15-75)	1,172,191		
	Remove observations in which the respondents are men	**582,344**	589,847	50%

6.2 Variable description

This section provides a detailed description of the variables included in our models. A list of all variables in our main data set is included in the appendix as Table 24 and Table 25. Again, we start by following Alon et al. (2021a) when designing our variables to ensure the best grounds for comparison of our first sample specification.

6.2.1 Dependent variables

We analyze the effect of the pandemic on both employment status and hours worked. To find the effect on employment we use a binary employment indicator that equals 1 when a respondent is employed or self-employed with paid work or temporarily away from paid work, and 0 otherwise. In other words, if a respondent is unemployed or outside of the labor force the binary employment indicator will be 0. This is the same criteria for employment as in Alon et al. (2021b), and in line with Statistics Norway's definition (2021c), in which all persons who performed work for pay or profit for at least one hour in the reference week or were temporarily absent from work are considered employed.

We base our measure of hours worked on the AKU-variable for actual hours worked in both primary and secondary occupations, which gives us the sum of all hours worked in the reference week. Alon et al. (2021a) use the same basis for their outcome variable for hours worked. Workers can adjust their working hours in both their primary and secondary occupation in response to the pandemic, and actual hours worked depict a more accurate description of the labor supply (or demand) in the economy compared to contracted hours which remain quite static. Figure 2 and Figure 3 compares the yearly mean (based on Q1, Q2, and Q3 as Q4 is missing for 2020) of the AKU variables for total contracted hours and total actual hours worked for men and women. We see that contracted hours consistently remain stable and higher than actual hours worked. Contracted hours do not account for different types of leave for example, nor for a temporary reduction in actual working hours in response to infection control measures. The average for both variables are higher between workers aged between 25 and 55 as in sample (3) than for all workers as in sample (4), as expected. We also find that the variable for actual hours worked seemingly responds to recessions, as there is a large dip actual hours worked in 2009 following the financial crisis (note that the fourth quarter of

2008 is not included in the figures). This implies that the change in actual hours worked is largely affected by recession effects, as opposed to solely structural or workforce composition changes. This further strengthens the case for using actual hours worked rather than contracted hours as the basis for our outcome variable for hours worked.

Figure 2: Contracted hours (red) versus actual hours worked (blue) for sample (2) (Q1 2006 - Q2 2020, ages 25-55)

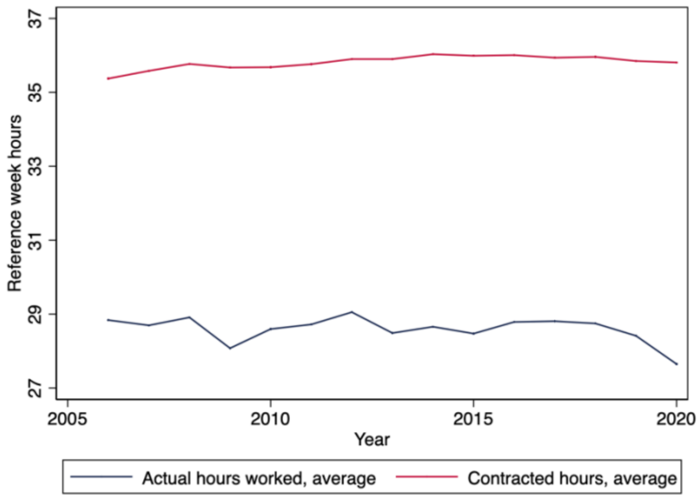
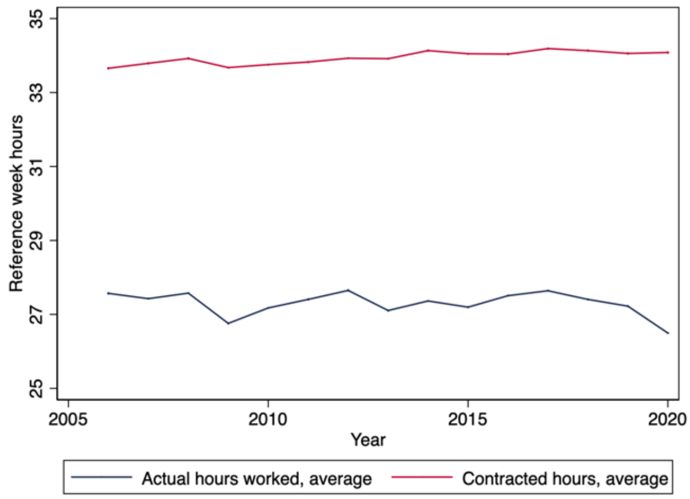


Figure 3: Contracted hours (red) versus actual hours worked (blue) for sample (4) (Q1 2006 – Q2 2020, all ages)



Notes: These figures display the development of the mean of actual hours worked and contracted hours for the first three quarters of the years from 2006 to 2020 (the fourth quarter is not included to balance the means as we have no data for the fourth quarter of 2020). Only observations from employed respondents are included.

To include non-employed respondents in the analysis of the change in working hours, we assign them zero hours worked. Further, this lets our hours variable include both the extensive and intensive margin of labor supply (both whether the individual has been working and how much the individual worked in the reference period (Blundell, Bozio, & Laroque, 2013)). To retain the extensive margin of employment (which includes zero hours worked) while approximating the natural logarithm of hours worked last week, we take the inverse-hyperbolic sine transform of our hours worked-variable in Stata. As described in Bellemare and Wichmann (2020), when taking the inverse hyperbolic sine transformation of a variable, in this case h, we create a new variable h^*such that:

$$h^* = \text{arcsinh}(h) = \ln\left(h + \sqrt{h^2 + 1}\right)$$

The inverse-hyperbolic sine transform allows us to benefit from the attributes of the natural logarithmic transformation that improves the distribution of a variable while including values of zero, which the natural logarithm is undefined for (Bellemare & Wichman, 2020). We are also still able to interpret the coefficients as percentages.

We remove all observations in which the respondent reports having worked over 60 hours in the reference week. Table 3 and Table 4 shows how many observations this removes in each sample of the data. In the largest sample, sample (4), 98 percent of respondents report having worked 60 hours or less in the reference week. The choice of 60 hours as the maximum is quite arbitrary, but this is already 20 hours above the Norwegian Working Environment Act limit for normal working hours per week (Arbeidstilsynet, n.d.). We do not want to eliminate instances in which respondents report having worked overtime, but we consider working more than 60 hours a week relevant only in special cases. We also have observations with up to 240 reported hours worked in the reference week, which most likely are a result of reporting errors.

6.2.2 Explanatory variables

Our main independent variables are the indicator variables for gender and the COVID-19 pandemic. Our gender variable *female* equals 1 when the respondent is female and 0 when the respondent is male. The variable *pandemic* equals 1 in the second and third quarters of 2020 (which are the two latest quarters we have access to and the quarters used in Alon et al. (2021a)), and 0 otherwise. When interacted as we will do in our models, these variables will show the effect of being female during the COVID-19 pandemic on employment and hours worked. The *pandemic* variable is also the variable that is used to find the overall employment and hours decline during the pandemic in our models. The *pandemic* variable is in other words a simple difference-in-difference estimator.

We include several control variables to attempt to isolate the effect of being female during the current pandemic. The first is a control for *gender specific time trends in labor supply.* This is constructed by interacting the categorical variable for year with the indicator variable for female, which should then capture the labor market changes caused by changes over time. How the control for gender specific time trends in labor supply was constructed in Alon et al. (2021a) is not described. As our lowest time dimension is quarter, we cannot experiment with including year-quarter time trends as we would not be able to estimate the effect of the COVID-19 pandemic occurring in the second and third quarter of 2020. However, we still include indicator variables for each *quarter* to account for seasonal variation, using quarter four as the reference category for quarters. For estimating the effect of being a female public sector worker and the motherhood gap we use the categorical variable for year as a time control without controlling for gender specific effects.

We also include category indicators for *age* as control variables, with the categories 25-29, 30-34, 35-44, 45-55, and categories for those under 25 and over 55 when relevant for the sample. We use ages 35-44 as the reference group in all samples. The AKU variable for education level is also used as grounds for a control variable. We translate the education levels in the AKU variable into years of education in our *education* variable. When used in the models this variable shows the effect of years of education on employment and hours worked. We also include controls for *marital status* with one indicator variable for each of the marital status categories of unmarried, married, cohabitant and previously married. We use married as the reference group in all samples.

We leave out two of the control variables used in the models in Alon et al. (2021a): they include race or immigration status, but the AKU does not contain information about the respondents' race, immigration status, place of birth or similar. Because we only know the quarter and not the month each observation is from, we do not control for education workers in the summer months. In sample (1) with data from 2019 Q1 to 2020 Q3 for respondents aged 25 to 55, 7.8 percent of respondents work in education, which corresponds to 6,182 observations in that sample. 1,764 or 29 percent of these observations are from the third quarter of the year which most closely overlaps with the summer months.

Our variable for industry is based on the AKU variable for the industry of the respondents' primary occupation. The industry classification standard changes several times between 2006 and 2020, from SN2002 at the start, to ISIC rev. 3 in the third quarter of 2006, SN2007 and NACE rev. 2 in the first quarter of 2008, changing back and forth between ISIC rev. 3 and ISIC rev. 4 between the first quarter of 2010 and the first quarter of 2019, before returning to SN2007 in the second quarter of 2019. We found that although these classification standards have their differences, they are largely based on the same principles and are thus structured similarly. We were able to unite them under the main industry areas of the most recently used reporting standard, SN2007, as described by Statistics Norway (2008). We achieved this by altering the values of the industry category variable in quarters with different reporting standards to correspond to the comparable SN2007 classification category. To both minimize errors caused by merging and to make the number of industry categories manageable, we chose to use the highest available industry category level available in SN2007. Using these main industry areas leaves us with 21 industry categories along with 1 category for unknown industry, specified in Table 22 in the appendix. We include a subjective classification of which industries are part of the Norwegian public and private sector in the same table. The share of public sector workers in the different samples is given in Table 5, Table 6, Table 7, and Table 8. The industry distribution of the respondents in each of our samples are shown in Table 9, Table 10, Table 11, and Table 12.

Our *occupation* variable is based on the AKU variable for the occupation code of the respondents' primary occupation. The occupation classification standard also changes several times between 2006 and 2020. In our first dataset from the first quarter of 2006, the occupation classification standard ISCO-88 is used. The standard then changes to STYRK-08 in the first quarter of 2011, then back to ISCO-88 in the first quarter of 2014, before returning to STYRK-08 in the first quarter of 2019. We overcome this in the same way as with the industry classification categories; by uniting the different codes in high-level categories. Again, the different standards are built in similar ways, allowing us to unite them into generally overlapping categories. We choose to merge the various occupation classification standards to fit the classification standard STYRK-08 (Statistics Norway, n.d. b). The AKU variable for occupation codes reports occupation codes at the four-digit level, but we replace these four-digit codes with occupation codes at the two-digit level. This lets us avoid problems with different classification categories at lower levels and makes the number of occupation categories manageable. When converting to occupation categories at the two-digit level we are left with 40 occupation categories, including one category for unknown occupation, which are listed in Table 23. Using the two-digit level categories for occupations mean that in reality, there are numerous occupations within each occupation category in our dataset.

We chose STYRK-08 both because this is the most recently used reporting standard in the AKU, and because STYRK-08 has more categories than ISCO-88. We thus avoid having to collapse categories together and convolute the interpretation of occupation codes. The drawback of this, and with merging different standards in general, is loss of some grounds for analysis – in this case by having some occupation codes which do not exist in the classification standard used in several quarters of the AKU. Merging of different classification standards causes reporting inconsistencies and in turn challenges for interpretation of results based on the categories. However, STYRK-08 has been the reporting standard since the first quarter of 2019, so for all observations in sample (1) and (3), the same standard is used.

Alon et al. (2021a) analyze the role of childcare responsibilities for gender gaps by comparing men and women with and without children. Due to the AKU exclusively registering information about children for women (Bø & Håland, 2015), we are unable to conduct similar analyses. However, we use the available data to compare mothers and women without children, using the AKU variable for the respondent's number of children under 16 years old in the reference week. The value of the variable always larger than zero, so we cannot distinguish between a female respondent having no children or a missing value. We assign all respondents without a reported number of children zero children to be able to construct the variable *mother*, which is equal to 1 if a female has one or more children, or 0 otherwise. Table 5, Table 6, Table 7, and Table 8 display summary statistics for the variable *mother*.

6.3 Descriptive statistics

Table 5, Table 6, Table 7, and Table 8 show the descriptive statistics of our main variables of interest for samples (1), (2), (3), and (4). These tables show that we consistently see that relative to men, women have lower employment rates, work less hours, have less contracted working hours, are more likely to work part-time and in the public sector, and have completed more years of education. There are larger differences in employment, actual hours worked, and contracted hours when comparing samples (1) and (2) with the age of respondents restricted to between 25 and 55 than when comparing samples (3) and (4) including respondents of all ages, which spans from 15 to 75 in both samples. We also see that there is a larger share of mothers between 25 and 55 in sample (1) and (2) than in sample (3) and (4) which contains younger and older women. This is expected, especially since only children under the age of 16 are registered in the AKU.

From Table 9, Table 10, Table 11, and Table 12, we find that in samples (3) and (4) which include respondents of all ages, the share of respondents that work in an unknown industry or are unemployed are over twice as large as the share in samples (1) and (2), which excludes respondents under 25 and over 55. This corresponds to the lower shares of employment in samples (3) and (4) compared to samples (1) and (2) reported in respectively Table 7, Table 8 , Table 5, and Table 6. We also see that there are low shares of hospitality workers and that the health care and social care industry is by far the largest employer for women in our data. Classic private sector industries such as manufacturing, construction and trade have the largest shares of male workers, which is consistent with shares from Statistics Norway (2021c). We also find that a comparatively low share of workers across all samples work in accommodation and food service activities. Alon et al. (2021a) show that the share of hospitality workers is 11 percent in Canada, 8 percent in Germany, 9 percent in the Netherlands, 16 percent in Spain, 11 percent in the UK, and 15 percent in the US. This industry is usually dominated by women (ILO, 2021b), but the employment shares are relatively even for men and women in all samples of our data.

Table 5: Summary statistics of sample (1), (2019 Q1 to 2020 Q3, ages 25 and 55)

Variable	Mean	Std.dev	Obs.	Min	Max
Female					
Age	40.5650	8.9783	38,504	25	55
Employment status	.8405	.3660	38,504	0	1
Actual hours worked (if employed)	26.0826	16.1725	32,389	0	60
Actual hours worked (total)	21.9314	17.6367	38,504	0	60
Contracted working hours (if employed)	34.1539	8.6489	32,156	0	60
Contracted working hours (total)	28.6851	14.8243	38,271	0	60
Part time worker (if employed)	.2805	.4492	31,601	0	1
Part time worker (total)	.2363	.4248	38,413	0	1
Public sector worker	.5651	.4957	32,291	0	1
Years of education	14.6245	2.5620	38,403	7	21
Mother	.5144	.4997	38,504	0	1
Male					
Age	40.2554	9.0616	38,879	25	55
Employment status	.8856	.3181	38,879	0	1
Actual hours worked (if employed)	30.4170	16.3675	34,446	0	60
Actual hours worked (total)	26.9440	18.1904	38,879	0	60
Contracted working hours (if employed)	37.4554	7.1074	34,025	0	60
Contracted working hours (total)	33.1297	13.7116	38,459	0	60
Part time worker (if employed)	.0938	.2916	34,396	0	1
Part time worker (total)	.0832	.2762	38,779	0	1
Public sector worker	.2113	.4082	34,107	0	1
Years of education	14.0346	2.5985	38,773	7	21

Notes: "Actual hours worked (if employed)" shows summary statistics of actual hours worked in reference week for employed persons. "Actual hours worked (total)" shows summary statistics of actual hours worked after assigning 0 hours worked to all unemployed respondents. The same method is applied to "Contracted working hours (if employed)" and "Contracted working hours (total)". "Part time worker (if employed)" shows summary statistics for a binary variable that indicates if an employed respondent is a part time worker, and "Part time worker (total)" shows summary statistics for a binary variable that indicates how many respondents in the total sample, both employed and unemployed, that are classified as part-time workers.

Table 6: Summary statistics of sample (2), (2006 Q1 to 2020 Q3, ages 25 and 55)

Variable	Mean	Std.dev	Obs.	Min	Max
Female					
Age	40.7809	8.7221	325,160	25	55
Employment	.8380	.3683	325,160	0	1
Actual hours worked (if employed)	26.1858	15.9709	272,865	0	60
Actual hours worked (total)	21.9553	17.5165	325,160	0	60
Contracted working hours (if employed)	33.5957	8.7880	271,244	0	60
Contracted working hours (total)	28.1434	14.7726	323,545	0	60
Part time worker (if employed)	.3251	.4684	272,308	0	1
Part time worker (total)	.2728	.4454	324,502	0	1
Public sector worker	.5544	.4970	271,672	0	1
Years of education	14.1194	2.5824	323,503	7	21
Mother	.5406	.4983	325,160	0	1
Male					
Age	40.5260	8.8044	318,400	25	55
Employment	.8879	.3153	318,400	0	1
Actual hours worked (if employed)	31.7284	16.1936	282,859	0	60
Actual hours worked (total)	28.1775	18.2471	318,400	0	60
Contracted working hours (if employed)	37.9833	6.8993	279,602	0	60
Contracted working hours (total)	33.6888	13.6713	315,146	0	60
Part time worker (if employed)	.0774	.2672	282,519	0	1
Part time worker (total)	.0688	.2531	317,905	0	1
Public sector worker	.2076	.4056	280,076	0	1
Years of education	13.8114	2.5654	317,097	7	21

Notes: "Actual hours worked (if employed)" shows summary statistics of actual hours worked in reference week for employed persons. "Actual hours worked (total)" shows summary statistics of actual hours worked after assigning 0 hours worked to all unemployed respondents. The same method is applied to "Contracted working hours (if employed)" and "Contracted working hours (total)". "Part time worker (if employed)" shows summary statistics for a binary variable that indicates if an employed respondent is a part time worker, and "Part time worker (total)" shows summary statistics for a binary variable that indicates how many respondents in the total sample, both employed and unemployed, that are classified as part-time workers.

Table 7: Summary statistics of sample (3), (2019 Q1 to 2020 Q3, all ages)

Variable	Mean	Std.dev	Obs.	Min	Max
Female					
Age	44.4359	16.6345	70,233	15	75
Employment	.6691	.4705	70,233	0	1
Actual hours worked (if employed)	24.7865	16.1972	47,185	0	60
Actual hours worked (total)	16.5753	17.6491	70,233	0	60
Contracted working hours (if employed)	32.0173	10.7094	46,806	0	60
Contracted working hours (total)	21.3724	17.4346	69,856	0	60
Part time worker (if employed)	.3543	.4783	47,057	0	1
Part time worker (total)	.2381	.4259	70,022	0	1
Public sector worker	.5525	.4972	47,063	0	1
Years of education	13.7714	2.6915	68,947	7	21
Mother	.2873	.4525	70,233	0	1
Male					
Age	44.3043	16.9403	71,508	15	75
Employment	.7096	.4539	71,508	0	1
Actual hours worked (if employed)	29.2238	16.6160	51,009	0	60
Actual hours worked (total)	20.7280	19.2906	71,508	0	60
Contracted working hours (if employed)	35.9573	9.2530	50,426	0	60
Contracted working hours (total)	25.4414	18.1162	70,927	0	60
Part time worker (if employed)	.1523	.3593	50,928	0	1
Part time worker (total)	.1087	.3113	71,339	0	1
Public sector worker	.2054	.4040	50,511	0	1
Years of education	13.4977	2.6230	70,108	7	21

Notes: "Actual hours worked (if employed)" shows summary statistics of actual hours worked in reference week for employed persons. "Actual hours worked (total)" shows summary statistics of actual hours worked after assigning 0 hours worked to all unemployed respondents. The same method is applied to "Contracted working hours (if employed)" and "Contracted working hours (total)". "Part time worker (if employed)" shows summary statistics for a binary variable that indicates if an employed respondent is a part time worker, and "Part time worker (total)" shows summary statistics for a binary variable that indicates how many respondents in the total sample, both employed and unemployed, that are classified as part-time workers.

Table 8: Summary statistics of sample (4), (2006 Q1 to 2020 Q3, all ages)

Variable	Mean	Std.dev	Obs.	Min	Max
Female					
Age	43.9813	16.3063	582,344	15	75
Employment	.6760	.4679	582,344	0	1
Actual hours worked (if employed)	30.3036	16.5551	420,605	0	60
Actual hours worked (total)	16.8028	17.5613	582,344	0	60
Contracted working hours (if employed)	36.2763	9.3724	415,839	0	60
Contracted working hours (total)	21.2308	17.1639	579,835	0	60
Part time worker (if employed)	.3972	.4893	393,873	0	1
Part time worker (total)	.2693	.4436	581,011	0	1
Public sector worker	.5368	.4986	393,286	0	1
Years of education	13.3781	2.6199	569,490	7	21
Mother	.3097	.4623	582,344	0	1
Male					
Age	43.8865	16.7376	589,847	15	75
Employment	.7094	.4540	589,847	0	1
Actual hours worked (if employed)	24.8417	16.0055	395,005	0	60
Actual hours worked (total)	21.4996	19.5959	589,847	0	60
Contracted working hours (if employed)	31.4395	10.7354	392,478	0	60
Contracted working hours (total)	25.6706	18.2916	585,109	0	60
Part time worker (if employed)	.1430	.3501	420,604	0	1
Part time worker (total)	.1021	.3029	588,848	0	1
Public sector worker	.2089	.4065	417,110	0	1
Years of education	13.2632	2.6088	576,877	7	21

Notes: "Actual hours worked (if employed)" shows summary statistics of actual hours worked in reference week for employed persons. "Actual hours worked (total)" shows summary statistics of actual hours worked after assigning 0 hours worked to all unemployed respondents. The same method is applied to "Contracted working hours (if employed)" and "Contracted working hours (total)". "Part time worker (if employed)" shows summary statistics for a binary variable that indicates if an employed respondent is a part time worker, and "Part time worker (total)" shows summary statistics for a binary variable that indicates how many respondents in the total sample, both employed and unemployed, that are classified as part-time workers.

Table 9: Summary statistics for industry categories, sample (1)

	(1) 2019Q1-2020Q3, ages 25-55			
	Female		**Male**	
	Mean	Std.dev	Mean	Std.dev
A – Agriculture, forestry, and fishing	.0069	.0832	.0193	.1378
B – Mining and quarrying	.0084	.0913	.0343	.1821
C – Manufacturing	.0328	.1781	.1013	.3018
D – Electricity, gas, steam, and air supply	.0030	.0550	.0082	.0906
E – Water supply	.0020	.0452	.0068	.0825
F – Construction	.0141	.1179	.1259	.3317
G – Wholesale and retail trade	.0901	.2864	.1155	.3197
H – Transportation and storage	.0159	.1251	.0577	.2332
I – Accommodation and food service activities	**.0256**	**.1580**	**.0211**	**.1437**
J – Information, communication	.0252	.1568	.0534	.2248
K – Financial and insurance activities	.0149	.1213	.0182	.1338
L – Real estate activities	.0057	.0757	.0107	.1030
M – Professional, scientific, and technical activities	.0492	.2163	.0593	.2362
N – Administrative activities	.0340	.1814	.0467	.2110
O – Public administration and defense	.0595	.2367	.0556	.2292
P – Education	.1110	.3141	.0477	.2132
Q – Health care and social work	**.3013**	**.4588**	**.0750**	**.2635**
R – Arts, entertainment, and recreation	.0163	.1267	.0178	.1324
S – Other service activities	.0250	.1561	.0101	.1004
T – Activities of household as employers; activities of households for own account	.0000	.0050	.0001	.0071
U – Activities of extraterritorial organizations and bodies	.0001	.0124	.0001	.0134
V – Unknown or unemployed	.1581	.3648	.1142	.3180
Observations	38,504		38,879	

Notes: The mean is to be interpreted as the percentage of respondents that are reported to work in the relevant industry. Some of the industry classification category names are shortened. See Table 22 for the full list of industry classification categories with their full names. Industries we find particularly interesting are highlighted in bold.

Table 10: Summary statistics for industry categories, sample (2)

	(2) 2006Q1-2020Q3, ages 25-55			
	Female		**Male**	
	Mean	Std.dev	Mean	Std.dev
A – Agriculture, forestry, and fishing	.0078	.0884	.0233	.1510
B – Mining and quarrying	.0115	.1066	.0352	.1843
C – Manufacturing	.0391	.1940	.1238	.3294
D – Electricity, gas, steam, and air supply	.0027	.0523	.0075	.0865
E – Water supply	.0043	.0658	.0178	.1325
F – Construction	.0113	.1057	.1101	.3130
G – Wholesale and retail trade	.0880	.2833	.1172	.3217
H – Transportation and storage	.0280	.1651	.0745	.2626
I – Accommodation and food service activities	**.0226**	**.1488**	**.0163**	**.1268**
J – Information, communication	.0176	.1315	.0410	.1984
K – Financial and insurance activities	.0162	.1265	.0175	.1312
L – Real estate activities	.0043	.0660	.0070	.0838
M – Professional, scientific, and technical activities	.0401	.1962	.0499	.2178
N – Administrative activities	.0496	.2173	.0579	.2221
O – Public administration and defense	.0551	.2283	.0520	.2091
P – Education	.0967	.2956	.0392	.1941
Q – Health care and social work	**.3069**	**.4612**	**.0734**	**.2609**
R – Arts, entertainment, and recreation	.0127	.1123	.0123	.1105
S – Other service activities	.0227	.1491	.0102	.1007
T – Activities of household as employers; activities of households for own account	.0004	.0216	.0003	.0184
U – Activities of extraterritorial organizations and bodies	.0001	.0117	.0001	.0106
V – Unknown or unemployed	.1611	.3676	.1123	.3158
Observations	325,160		318,400	

Notes: The mean is to be interpreted as the percentage of respondents that are reported to work in the relevant industry. Some of the industry classification category names are shortened. See Table 22 for the full list of industry classification categories with their full names. Industries we find particularly interesting are highlighted in bold.

Table 11: Summary statistics for industry categories, sample (3)

	(3) 2019Q1-2020Q3, all ages			
	Female		**Male**	
	Mean	Std.dev	Mean	Std.dev
A – Agriculture, forestry, and fishing	.0069	.0832	.0209	.1430
B – Mining and quarrying	.0062	.0790	.0244	.1543
C – Manufacturing	.0261	.1596	.0819	.2742
D – Electricity, gas, steam, and air supply	.0021	.0463	.0068	.0822
E – Water supply	.0018	.0434	.0048	.0696
F – Construction	.0108	.1036	.1019	.3025
G – Wholesale and retail trade	.0831	.2760	.0978	.2971
H – Transportation and storage	.0131	.1138	.0480	.2139
I – Accommodation and food service activities	**.0255**	**.1577**	**.0178**	**.1325**
J – Information, communication	.0165	.1274	.0365	.1876
K – Financial and insurance activities	.0121	.1096	.0131	.1137
L – Real estate activities	.0046	.0681	.0088	.0935
M – Professional, scientific, and technical activities	.0334	.1798	.0462	.2099
N – Administrative activities	.0264	.1605	.0366	.1880
O – Public administration and defense	.0482	.2143	.0445	.2064
P – Education	.0832	.2762	.0392	.1943
Q – Health care and social work	**.2369**	**.4251**	**.0563**	**.2305**
R – Arts, entertainment, and recreation	.0156	.1240	.0162	.1264
S – Other service activities	.0187	.1356	.0105	.1019
T – Activities of household as employers; activities of households for own account	.0001	.0092	.0001	.0083
U – Activities of extraterritorial organizations and bodies	.0001	.0099	.0001	.0098
V – Unknown or unemployed	.3275	.4693	.2866	.4522
Observations	70,233		71,508	

Notes: The mean is to be interpreted as the percentage of respondents that are reported to work in the relevant industry. Some of the industry classification category names are shortened. See Table 22 for the full list of industry classification categories with their full names. Industries we find particularly interesting are highlighted in bold.

Table 12: Summary statistics for industry categories, sample (4)

	(4) 2006Q1-2020Q3, all ages			
	Female		**Male**	
	Mean	Std.dev	Mean	Std.dev
A – Agriculture, forestry, and fishing	.0078	.0881	.0237	.1523
B – Mining and quarrying	.0081	.0898	.0251	.1566
C – Manufacturing	.0302	.1713	.0956	.2941
D – Electricity, gas, steam, and air supply	.0019	.0439	.0061	.0780
E – Water supply	.0034	.0585	.0139	.1174
F – Construction	.0089	.0940	.0879	.2832
G – Wholesale and retail trade	.0851	.2790	.0993	.2991
H – Transportation and storage	.0234	.1513	.0593	.2363
I – Accommodation and food service activities	**.0237**	**.1522**	**.0148**	**.1207**
J – Information, communication	.0124	.1110	.0290	.1679
K – Financial and insurance activities	.0122	.1098	.0128	.1127
L – Real estate activities	.0036	.1668	.0061	.0783
M – Professional, scientific, and technical activities	.0369	.1887	.0387	.1928
N – Administrative activities	.0369	.1887	.0452	.2078
O – Public administration and defense	.0426	.2021	.0435	.2040
P – Education	.0742	.2622	.0324	.1770
Q – Health care and social work	**.2421**	**.4283**	**.0578**	**.2335**
R – Arts, entertainment, and recreation	.0122	.1099	.0112	.1055
S – Other service activities	.0190	.1368	.0099	.0990
T – Activities of household as employers; activities of households for own account	.0007	.0268	.0003	.0196
U – Activities of extraterritorial organizations and bodies	.0001	.0108	.0001	.0087
V – Unknown or unemployed	.3218	.4671	.2862	.4520
Observations	582,344		589,847	

Notes: The mean is to be interpreted as the percentage of respondents that are reported to work in the relevant industry. Some of the industry classification category names are shortened. See Table 22 for the full list of industry classification categories with their full names. Industries we find particularly interesting are highlighted in bold.

7 Empirical design

7.1 The impact of the pandemic on employment and hours worked – the basic gender gap

We base the starting point of our empirical analysis on Alon et al. (2021a). Our primary regression equation is specified as follows:

$$y_{it} = \beta_0 + \beta_1 F_i + \beta_2 D_t + \beta_3 F_i \times D_t + \beta_4 \boldsymbol{X}_{it} + \varepsilon_{it} \tag{1}$$

In regression equation (1), the outcome variable represented by y_{it} is either a binary employment indicator for whether an individual i is employed at time t, or the inverse-hyperbolic sine transform of hours worked in the reference week. F_i indicates if the respondent is female, and D_t is a dummy variable for the COVID-19 pandemic, corresponding to the second and third quarter of 2020. The vector $\boldsymbol{X}_{it}$ consists of control variables including gender specific time trends, years of education, and indicator variables for age categories and marital status categories. Unlike Alon et al. (2021a), we cannot include control variables for race and education workers in the summer months. The coefficient of interest β_3 multiplied with 100 yields the percentage difference of the effect of the pandemic on women versus men, and thus the gender gap.

7.2 Industry and occupation

We attempt to characterize the sources of gender differences by including industry and occupation variables to the regression, leading to the following specification:

$$y_{it} = \gamma_0 + \gamma_1 F_i + \gamma_2 D_t + \gamma_3 F_i \times D_t + \gamma_4 \boldsymbol{Job}_{it} + \gamma_5 \boldsymbol{Job}_{it} \times D_t + \gamma_6 \boldsymbol{X}_{it} + \varepsilon_{it} \tag{2}$$

In regression equation (2), the vector $\boldsymbol{Job}_{it}$ is a combination of occupation and industry categories, with an indicator variable for every occupation-industry (793 variables in total). These variables describe the job an individual has at time t, and is interacted with the COVID-19 pandemic indicator D_{it}. γ_3 captures the impact of the pandemic recession on workers within different industry and occupation categories. The coefficient of interest is γ_3, and $\gamma_3 * 100$ captures the observed pandemic specific effects on the net gender gap of any combination of industry and occupation. This specification implies that if gender differences occur fully because more women than men work in jobs that are highly exposed to the negative shocks of the pandemic, we expect a negative estimate of β_3 in regression equation (1) and a zero estimate of γ_3 in regression equation (2).

7.3 The post-pandemic impact of motherhood

We depart from the empirical design of Alon et al. (2021a) to isolate the effect of motherhood on women's labor force participation and labor supply during the pandemic. We constrict the regression to only compare mothers to women without children in order to find the basic motherhood gap. The regression equation is specified as follows:

$$y_{it} = \alpha_0 + \alpha_1 M_i + \alpha_2 D_t + \alpha_3 M_i \times D_t + \alpha_4 \boldsymbol{X}_{it} + \varepsilon_{it} \qquad (3)$$

In regression equation (3), we follow the design and interpretation of regression equation (1). The regressions differ as the dummy variable M_i, *mother*, replaces the female dummy variable for *female*, F_i. We use the same controls as in regression equation (1) and (2), however we remove the gender specific time trends from the vector $\boldsymbol{X}_{it}$ and replace them with a simple yearly time trend. We are left with regression equation (3) which measures the effect of being a mother during the pandemic compared to being a woman without children. To account for industry and occupation specific effects we specify the regression equation as follows:

$$y_{it} = \theta_0 + \theta_1 M_i + \theta_2 D_t + \theta_3 M_i \times D_t + \theta_4 Job_{it} + \theta_5 Job_{it} \times D_t + \theta_6 X_{it} + \varepsilon_{it} \qquad (4)$$

The interpretation and variable description of regression equation (4) corresponds to regression equation (2), but the indicator variable for *female*, F_i, is replaced with the indicator variable M_i for *mother*. The coefficient of interest is θ_3, the coefficient for the interaction term for the indicator variables *female* and *pandemic*. θ_3 isolates the effect of being a mother during the pandemic, controlled for industry and occupation categories.

8 Results

This chapter presents the main findings of our empirical analysis. Firstly, we present the effect of the COVID-19 pandemic on the outcome variables *employment* and *hours worked* in Norway. We then perform robustness checks on these results, as well as an investigation into the labor market outcomes for public sector workers compared to private sector workers. Following the initial presentation of our findings, we compare our results with the international results from Alon et al. (2021a). We then run a regression of how motherhood affects employment and hours worked during the pandemic.

8.1 The gender gap in employment

Table 13 summarizes the regression results for the pandemic-induced percentage change in employment, and the consequent gender gap in employment with and without industry and occupation controls. The first line in Table 13 represents the overall employment decline for both genders caused by the pandemic, found by regressing *employment* on *pandemic* alone. β_3 is the estimate of the basic gender gap as specified in regression equation (1) described in Section 7.1. γ_3 is the estimate of the gender gap when controlling for industry and occupation as specified in regression equation (2) described in Section 7.2. If the gender gap occurred solely because there are more women than men in a specific sector, this coefficient would be equal to zero. The estimate of the coefficient γ_3 therefore displays the gender gap that is unaccounted for after industry and occupation controls. The coefficients are reported in percentage points and the p-values are displayed in parentheses, following Alon et al. (2021a). Please see Table 26 and Table 27 for reporting of (robust) standard errors and full regression results for the overall change in employment and regression equation (1).

The interpretation of the overall employment decline is the percentage change in overall employment for both genders induced by the pandemic. The overall employment decline for both genders in Table 13 is highly significant in all samples, varying from -0.95 percent to -1.51 percent. This indicates that the pandemic has resulted in a significant decline in employment for both men and women. The results for samples (2) and (4) with the broader time-period predict the decrease in overall employment quite accurately when compared with the overall employment decrease of 1.1 percent from 2019 to 2020 reported by Statistics Norway (2021c).

Table 13: The pandemic-induced change in employment and in the gender gap in employment

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
Change in Employment	-1.51	-1.06	-0.95	-1.04
	(0.00)	(0.00)	(0.00)	(0.00)
R^2	0.0004	0.0000	0.0001	0.0000
Basic gender gap (β_3)	-0.85	-0.86	-0.33	-0.33
	(0.26)	(0.26)	(0.65)	(0.64)
R^2	0.0686	0.0623	0.2090	0.2063
w/ industry & occupation controls (γ_3)	-0.16	-0.17	-0.04	-0.01
	(0.25)	(0.21)	(0.75)	(0.92)
R^2	0.9786	0.9826	0.9817	0.9817
Observations	76,371	634,233	137,404	1,132,625

Notes: Regression coefficients from different samples of Norwegian labor force survey data. *Coefficients are reported in percentage points. P-values are reported in parentheses below estimates, following Alon et al. (2021). No controls are used when estimating the overall employment decline. Controls for gender specific time trends, age, education, marital status, and quarter are included when estimating the basic gender gap, as specified in regression equation (1). We then add industry and occupation controls as specified in regression equation (2).*

The interpretation of the coefficients β_3 and γ_3 is the percentage difference in the relative employment between men and women during the pandemic. The basic gender gap (β_3) in all the samples in Table 13 are negative, indicating to a small degree that women are more likely to be unemployed then men during the pandemic. However, we cannot draw any confirmative conclusions based on these results as the findings are not statistically significant. Industry and occupation combinations seem to account for a large part of the variation in the gender gap (γ_3), causing a reduction in the gender gap. However, also the estimations of γ_3 are statistically insignificant, implying that there is not a systematic difference between the genders in terms of employment during the pandemic. This is opposite the findings of Alon et. al (2021a), as we will discuss further in Section 8.4.

8.1.1 Robustness checks for the gender gap on employment

To ensure the robustness of our results, we run a set of regressions with variations on our main regression models and check how they influence our results. The results of these regression equations are displayed in Table 14. We experiment with running regression (1) described in Section 7.1 without the vector of control variables $\boldsymbol{X}_{it}$, which gives us regression equation (1.1):

$$y_{it} = \zeta_0 + \zeta_1 F_i + \zeta_2 D_t + \zeta_3 F_i \times D_t + \varepsilon_{it} \qquad 1.1$$

We then run regression equation (1) with all controls in $\boldsymbol{X}_{it}$ as described in Section 7.1 except the gender specific time trends, which leaves us with regression equation (1.2) in which $\boldsymbol{Y}_{it}$ includes a variable controlling for years of education and indicator variables for quarters, age categories, and marital status categories:

$$y_{it} = \partial_0 + \partial_1 F_i + \partial_2 D_t + \partial_3 F_i \times D_t + \partial_4 \boldsymbol{Y}_{it} + \varepsilon_{it} \qquad 1.2$$

Next, we run a simpler version of regression equation (2) as described in Section 7.1 with the aim of investigating the effect of including industries on the results for employment. Instead of including different combinations of industries and occupations and the pandemic-induced effect on these different combinations as in (2), regression specification (2.1) includes just a vector for indicator variables for the different industry categories, and thus solely as simple control variables:

$$y_{it} = \phi_0 + \phi_1 F_i + \phi_2 D_t + \phi_3 F_i \times D_t + \phi_4 \boldsymbol{Industry}_{it} + \phi_5 \boldsymbol{X}_{it} + \varepsilon_{it} \qquad 2.1$$

Next, we run a version of regression equation (2) where $\boldsymbol{Job}_{it}$, the vector for all the possible industry and occupation combinations, is replaced with $\boldsymbol{Industry}_{it}$, a vector of indicator variables for the different industry categories (without combining them with occupation categories):

$$y_{it} = \varphi_0 + \varphi_1 F_i + \varphi_2 D_t + \varphi_3 F_i \times D_t + \varphi_4 \boldsymbol{Industry}_{it} + \varphi_5 \boldsymbol{Industry}_{it} \times D_t + \varphi_6 \boldsymbol{X}_{it} + \varepsilon_{it} \qquad 2.2$$

Table 14: Robustness checks for the gender gap in employment

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
w/o controls (ζ_3)	0.31	0.73	0.17	-0.62
	(0.58)	(0.13)	(0.75)	(0.19)
R^2	0.0047	0.0053	0.0020	0.0013
w/o time controls (∂_3)	-0.12	-0.27	-0.13	-0.91
	(0.82)	(0.55)	(0.80)	(0.03)
R^2	0.0685	0.0614	0.1512	0.2056
w/ industry controls, w/o industry	-0.11	-0.11	0.02	0.01
and pandemic interacted (ϕ_3)	(0.38)	(0.39)	(0.89)	(0.92)
R^2	0.9743	0.9814	0.9748	0.9773
w/ industry controls and industry	-0.29	-0.24	-0.13	-0.10
and pandemic interacted (φ_3)	(0.05)	(0.10)	(0.36)	(0.45)
R^2	0.9744	0.9814	0.9749	0.9773
Observations	76,371	634,233	137,404	1,132,625

Notes: Coefficients are reported in percentage points. P-values are reported in parentheses below estimates.

Although there are no statistically significant estimates for neither ζ_3 in Table 14, nor β_3 in Table 13, we find it interesting enough to note that the estimates of ζ_3 have the opposite sign of the estimates of β_3 in samples (1), (2), and (3). A possible driver of this change might be that vector $\boldsymbol{X}_{it}$ includes factors that make women more likely to be employed even during the pandemic, such as women having more years of education than men. The estimates of ∂_3 are higher and have higher p-values than the estimates of β_3 in all samples except sample (4) in Table 14, in which we find a statistically significant estimate for the gender gap. Sample (4) in Table 14 does not account for gender specific time trends in labor supply, which is interesting as this sample includes all observations from 2006 Q1 to 2020 Q3. Our interpretation of this is that during the two quarters affected by the pandemic (2020 Q2-Q3) women are 0.91 percent less employed than men, disregarding changes in women's labor supply over time. While it is interesting to note that this result marks a significant difference in the post-pandemic and pre-pandemic data on the gender gap in employment, the absence of time trends in this comparison of data spanning more than a decade makes this result carry less weight.

In contrast to regression equation (2.1), regression equation (2.2) controls for the effect of the pandemic on each individual industry. The difference between the estimates for ϕ_3 and φ_3 is thus the effect of adding the interaction term of industry categories and the *pandemic* variable in (2.2). We see that controlling for industry-specific effects of the pandemic produces consistently larger estimates of the gender gap, and a significant estimate of φ_3 in sample (1) in Table 14. This implies that the negative employment impact of the pandemic on each of our different industry categories has disproportionately affected the women in these industries. In sample (1) in Table 14, this is shown to have resulted in a negative gender gap of 0.29 percent.

When including industry and occupation controls as in regression equation (2) in Section 7.1, although statistically insignificant, we see that the estimates of γ_3 in Table 13 are consistently smaller than the estimates of φ_3 in Table 14. This suggests that there is a smaller gender gap within occupations within different industries compared to the estimations of the gender gap within industries in regression equation (2.2). However, this interpretation is based on results that are not statistically significant and is merely an attempt to describe the possible differences between the different model specifications.

We note that the coefficient of determination, R^2, for the results of regression equation (2), (2.1) and (2.2) are exceedingly high, as shown in Table 13 and Table 14. It is unlikely that the independent variables can account for a such high amount of the variation in the outcome variable. One explanation for the high values for R^2 is that controlling for industries, which all the relevant regression specifications have in common, captures too much of the variation in the *employment* indicator variable, and so the model is overfit. Differences between R^2 and adjusted R^2 are negligible in all our model estimations. After performing Breusch-Pagan tests that identified heteroscedasticity being present throughout our initial models, we decided to consistently use robust standard errors in our regressions.

8.2 The gender gap in hours worked

Error! Reference source not found. summarizes the regression results for the pandemic-induced percentage change in actual hours worked, and the consequent gender gap in hours worked with and without industry and occupation controls. The interpretation of Table 15 and the inherent models is the same as for Table 13 as described in Section 8.1, but the outcome variable *employment* is replaced by *hours worked*.

Table 15: The pandemic-induced change in hours and in the gender gap in hours

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
Change in overall hours worked	-26.95	-24.66	-19.93	-19.66
	(0.00)	(0.00)	(0.00)	(0.00)
R^2	0.0040	0.0006	0.0019	0.0003
Basic gender gap (β_3)	1.37	1.38	3.89	3.87
	(0.75)	(0.75)	(0.24)	(0.24)
R^2	0.0570	0.0563	0.1512	0.1523
w/ industry & occupation controls (γ_3)	7.78	7.41	5.45	5.41
	(0.04)	(0.05)	(0.03)	(0.03)
R^2	0.3901	0.3949	0.5655	0.5698
Observations	76,371	634,233	137,404	1,132,625

Notes: Regression coefficients from different samples of Norwegian labor force survey data. Coefficients are reported in percentage points. P-values are reported in parentheses below estimates, following Alon et al. (2021). The hours index uses the inverse hyperbolic sine transformation of actual hours worked in the relevant reference week. No controls are used when estimating the overall employment decline. Controls for gender specific time trends, age, education, marital status, and quarter are included when estimating the basic gender gap, as specified in regression equation (1). We then add industry and occupation controls as specified in regression equation (2).

Firstly, we observe that the results for all samples in Table 15 predict estimates of the change in overall hours worked that are statistically significant. The interpretation of this is that the pandemic induced a decline in hours worked for both genders, varying from

-26.95 percent in sample (1) to -19.66 percent in sample (4). However, when estimating the basic gender gap (β_3), the coefficient changes sign, becoming positive. This implies that women have worked more hours relative to men during the pandemic. None of the estimates for β_3 are significant. However, samples (7) and (8) with observations from all ages return a higher positive gender gap on hours worked and a lower p-value than samples (5) and (6). As none of the estimations of the basic gender gap are statistically significant, we can only make note that all the estimations of β_3 are positive and women might have experienced a relative increase in working hours compared to men as a result of the pandemic.

When including industry and occupation controls, the estimations for the gender gap γ_3 all become statistically significant at the 5 percent level and display a positive gender gap in favor of women. These results indicate that women have worked between 5.41 and 7.78 percent more relative to men in the pandemic-affected second and third quarter of 2020. The nature of γ_3 infers that these differences occur within industry and occupation combinations, or in other words jobs. See Section 9.2 for a discussion of what this entails.

8.2.1 Robustness checks for the gender gap in hours worked

Again, we run a set of regressions with variations on our main regression models to ensure the robustness of our results. We run regression equations (1.1), (1.2), (2.1), and (2.2), as described in Section 8.1.1, but replace the outcome variable with *hours worked*.

As in Section 8.1.1, we find that adding the controls in vector $\boldsymbol{X}_{it}$ lowers the estimates of θ_3 in Table 16 to the (statistically insignificant) estimates of β_3 in Table 15. As previously explained, this could be caused by vector $\boldsymbol{X}_{it}$ including factors that make women more likely to be employed even during the pandemic, such as women having more years of education than men. Nevertheless, we find estimates of coefficient ζ_3 in samples (2) and (4) in Table 16 that are statistically significant at the 5 percent level, and a coefficient ζ_3 that is statistically significant at the 10 percent level in sample (3). All estimates of ζ_3 in samples (2), (3) and (4) in Table 16 have values indicating a positive gender gap, meaning that women work more hours relative to men in the first two quarters of the pandemic (without accounting for confounding variables). The estimates for ∂_3 in (3) and (4) in

Table 16 are apparently quite consistent over time, given the similarities to the corresponding estimates of β_3 in Table 15. We find particularly high initial estimates of the gender gap in hours worked represented by ζ_3 and ∂_3 in sample (2) in Table 16, but this greater effect is lost when controlling for gender specific time trends in labor supply as in the estimation for β_3 in Table 15.

Table 16: Robustness checks for the gender gap in hours worked

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
w/o controls (ζ_3)	4.04	10.31	4.32	4.32
	(0.20)	(0.00)	(0.08)	(0.04)
R^2	0.0133	0.0139	0,0075	0.0063
w/o time controls (∂_3)	2.63	6.70	3.47	3.55
	(0.39)	(0.01)	(0.14)	(0.07)
R^2	0.0564	0.0557	0.1163	0.1517
w/ industry controls, w/o industry	3.80	3.81	5.03	4.90
and pandemic interacted (ϕ_3)	(0.28)	(0.28)	(0.04)	(0.04)
R^2	0.3715	0.2887	0.5491	0.5631
w/ industry controls and industry	5.89	4.55	4.91	4.03
and pandemic interacted (φ_3)	(0.11)	(0.21)	(0.04)	(0.10)
R^2	0.3726	0.3890	0.5501	0.5633
Observations	76,371	634,233	137,620	1,132,625

Notes: Coefficients are reported in log points. P-values are reported in parentheses below estimates. The hours index uses the inverse hyperbolic sine transformation of actual hours worked in the relevant reference week.

The inclusion of the interaction term between industry and pandemic in regression equation (2.2), slightly reduces the statistically significant estimates of ϕ_3 in Table 16 from regression equation (2.1) on samples (3) and (4), possibly implying that the industry-specific effects of the pandemic more negatively affected the number of hours worked in female-dominated industries. However, we see the opposite effect when including industry and occupation categories (Jobs) as controls as in regression equation (2), yielding the results for γ_3 in Table 15. This indicates that the gender gap within industry and occupation combinations is larger than within industry categories alone

– the opposite effect of the one indicated through the variations of the estimations of the pandemic's effect on employment in Section 8.1.1.

As mentioned in Section 8.1.1, after performing Breusch-Pagan tests that identified heteroscedasticity being present throughout our initial models, we decided to consistently use robust standard errors in our regressions. Differences between R^2 and adjusted R^2 are negligible in all our model estimations, and we find the values for R^2 to be reasonable in models with *hours worked* as the outcome variable.

8.3 The pandemic-induced effect on hours worked in the public sector

After considering the effect of including industry and occupation combination categories as controls, we want to investigate the relative effect of being a public sector worker compared to a private sector worker on hours worked. To do this we modify regression equation (1) (as described in Section 7.1) where we replace the indicator variable *female* with the indicator variable for being employed in the public sector, the construction of which is described in Section 6.2.2. This specification is as follows:

$$y_{it} = \rho_0 + \rho_1 public_{it} + \rho_2 D_t + \rho_3 public_{it} \times D_t + \rho_4 \boldsymbol{X}_{it} + \varepsilon_{it} \tag{1.3}$$

The full regression results for regression equation (1.3) are shown in Table 30. Following this we want to investigate our hypothesis (2) further by including the *public sector* variable in a triple interaction term with *female* and *pandemic* as described in regression equation (1.4):

$$\begin{aligned} y_{it} = \varrho_0 + \varrho_1 public_{it} + \varrho_2 F_i + \varrho_3 D_t + \varrho_4 public_{it} \times F_i + \varrho_5 F_i \times D_t \\ + \varrho_6 public_{it} \times D_t + \varrho_7 public_{it} \times F_i \times D_t + \varrho_8 \boldsymbol{X}_{it} + \varepsilon_{it} \end{aligned} \tag{1.4}$$

The full regression results for regression equation (1.4) are shown in Table 31. Table 17 displays the overall change in *hours worked* in the public sector relative to the private sector after the pandemic, as well as the relative change in hours worked when considering female public sector workers. The first line presents the estimated post-pandemic overall change in hours for public sector workers (ρ_3) relative to the post-pandemic overall change in hours in the private sector. This coefficient ρ_3 is found by interacting the indicator variable for the public sector and the indicator variable for the pandemic. We observe that relative to private sector workers, public sector workers have increased their actual hours worked after the inset of the pandemic with a statistically significant findings for sample (4).

ϱ_7 measures the relative pandemic-induced change in hours worked for female public sector workers. In Table 17 we find that female public sector workers increase their actual working hours after the pandemic more than all other employees (either gender). The estimates for sample (2) and (4) are statistically significant on a 1 percent level and (1) and (3) on a 5 percent level. When comparing ϱ_7 and ρ_3, there seems to be a greater and more conclusive effect of being a female public worker than just being a public worker on actual hours worked during the pandemic.

Table 17: The pandemic-induced change in hours for public sector workers

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
Overall relative change in hours	0.72	4.02	3.37	5.87
for public sector workers (ρ_3)	(0.81)	(0.13)	(0.18)	(0.00)
R^2	0.0383	0.0403	0.0373	0.0380
Observations	66,050	549,083	96,365	800,506
Overall relative change in hours	15.20	15.46	12.57	14.84
for female public sector workers (ϱ_7)	(0.02)	(0.00)	(0.02)	(0.00)
R^2	0.0425	0.0465	0.0417	0.0440
Observations	66,050	549,083	96,365	800,506

Notes: Coefficients are reported in percentage points and represent the coefficient for the variable pandemic. *P-values are reported in parentheses below estimates. Controls for time trends, age, education, marital status, and quarter are included. Only employed respondents working in an industry classified as either private or public in Table 22 are included in these models.*

8.4 Comparison of our findings with the results of Alon et al. (2021a)

In this section we compare the results of the regression on Norwegian labor market to the international results in Alon et al. (2021a). We have chosen to focus the comparison of our results to those of the US as the US does not have an extensive welfare state as we do in Norway, as described in Section 2.1.

8.4.1 A comparison of the gender gap in employment with the US

Table 18 summarizes the regression results for the pandemic-induced percentage change in employment and the consequent gender gap in employment from Alon et al. (2021a) compared to our own findings. The first column shows the results from our regression on Norwegian data and the following columns are the estimates of Alon et al. (2021a) for the US, Canada, Germany, the Netherlands, Spain, and Great Britain for comparison. The samples used in the regressions are restricted to respondents aged 25-55 with the time-period for the observations between 2019 Q1 and 2020 Q3 for comparable results. The *pandemic* indicator variable corresponds to Q2 and Q3 in 2020 for all countries.

The interpretation of Table 18 and its inherent regressions is the same as described for Table 13 in Section 8.1. In general, we see that the overall employment decline is relatively low compared to the decline in employment in other countries, especially when solely considering statistically significant estimates. As our estimates of β_3 and γ_3 for employment in Table 18 are not statistically significant, it is difficult to meaningfully compare these with the estimates of the other countries in general. Statistically significant estimates for the basic gender gap β_3 is only found in the US and Spain, and the negative estimates indicate a "shecession" in employment for these countries. Statistically significant, negative estimates for γ_3 are found in the US and Canada.

We will try to compare the trends in our results from Norway with those from the US. The first observable difference between how the pandemic has affected employment in the US and Norway is the overall employment decline, where both coefficients are highly significant. The regressions in Table 18 etimates a decline in overall employment in Norway of 1.51 percent compared to a striking 6.34 percent decline in the US. When considering the number of unemployed individuals in the US compared to Norway in absolute terms, the estimation becomes even more severe.

Table 18: The pandemic-induced change in employment and in the gender gap in employment – Norwegian and international results compared

	NOR	USA	CAN	DEU	NLD	ESP	GBR
Change in overall employment	-1.51	-6.34	-5.52	-0.28	0.67	-6.96	-0.13
	(0.00)	(0.00)	(0.00)	(0.55)	(0.13)	(0.00)	(0.00)
Basic gender gap (β_3)	-0.85	-1.91	-0.44	-1.34	1.51	-1.36	0.15
	(0.26)	(0.00)	(0.13)	(0.13)	(0.21)	(0.02)	(0.81)
w/ industry & occupation controls (γ_3)	-0.16	-1.09	-0.46	-1.32	1.11	0.03	-0.34
	(0.25)	(0.00)	(0.02)	(0.16)	(0.28)	(0.43)	(0.52)

Notes: Regression coefficients from Norway compared to international results from Table 8 in Alon et al. (2021a). *Coefficients are reported in log points. P-values are reported in parentheses below estimates. The hours index uses the inverse hyperbolic sine transformation of actual hours worked in the relevant reference week. The sample includes data between 2019 Q1 and 2020 Q3 on civilians of ages 25 to 55 who are employed, unemployed or outside of the labor force. No controls are used when estimating the overall hours decline. Controls for gender specific time trends, age, education, marital status, and quarter are otherwise included for estimates for Norway. Alon et al.* (2021a) *have run individual country regressions based on similar data and with similar controls – our method is based on theirs. Alon et al.* (2021a) *do not report number of observations or R-squared in this table so neither do we. For further notes and details on the data used for the other countries, please see their paper and their Appendix C.*

The coefficient of the basic gender gap β_3 for Norway in Table 18 is estimated to be -0.85 percent, indicating that women are more likely to be unemployed then men. However, the findings are not significant, and we cannot make conclusions based on these findings. In the US, the coefficient β_3 is highly significant and estimated at -1.91 percent. The interpretation of this is that women's employment in the US is more negatively affected by the pandemic than in Norway. This can likely be attributed the fact that pandemic-related job losses were concentrated in female-dominated sectors such as leisure, hospitality, and retail (U.S. Bureau of Labor Statistics, 2021).

Even when controlling for industry and occupation we cannot confirm a "shecession" in employment in Norway, as γ_3 remains insignificant. This means that the results for Norway in Table 18 do not estimate a gender gap in employment even when accounting for industry and occupational differences. This is contrary to the results for the US, where the estimation of the gender gap even controlling for industry and occupation, γ_3, is highly significant. This implies that differences across industry and occupation combinations accounts for almost 50 percent of the differences in the gender gap in employment in the US, implying that many women work in pandemic-exposed jobs. The estimation of the gender gap in US therefore suggests a "shecession" in employment resulting from the pandemic.

8.4.2 A comparison of the gender gap in hours worked with the US

Table 19 summarizes the regression results for the pandemic-induced percentage change in hours worked and the consequent gender gap in hours worked both from Alon et al. (2021a) and our own findings. The interpretation of Table 19 and its inherent regressions is the same as described for Table 18 in Section 8.4.1. However, the outcome variable in the regressions in Table 19 is *hours worked* instead of *employment*. Alon et al. (2021a) find evidence for a "shecession" in hours in the US, Canada and Germany.

Two striking observations are that Norway has the lowest statistically significant estimate for overall reduction in hours worked and a statistically significant positive estimation of the gender gap with industry and occupation controls (γ_3). In both Norway and the US, we observe highly significant declines in hours worked for both genders, as illustrated by the first line in Table 19, with respectively 27 percent and 36 percent. This decline is attributed to both increased unemployment (we assign zero working hours to all unemployed respondents as described in Section 6.2.1), leaves of absence due to illness, holidays, vacations, and other factors such as childcare and telecommuting that we cannot account for with the AKU data sets.

In the US, a significant gender gap in hours worked appears when observing the estimate of β_3. The basic gender gap in hours worked is highly significant and shows a decline of 7.8 percent. The estimate of β_3 with Norwegian data is positive and stands in contrast with the US estimate, however the coefficient is not significant. What is interesting is the effect on the estimate of the gender gap when controlling for industry and occupation combinations (γ_3): the coefficient of the gender gap in Norway changes sign. The interpretation of the coefficient is that even within industry-occupation combinations, women work 7.8 percent more hours relative to men during the pandemic. When regressing hours worked on being female during the pandemic, we do not find evidence of a “shecession” in Norway. This contrasts the estimates of γ_3 in the US, where industry and occupation only account for 33 percent of the variation in the gender gap. The remaining 5.3 percent of the gender gap is unexplained. Contributing factors to this might be gender discrimination or childcare responsibilities.

Table 19: The pandemic-induced change in hours and in the gender gap in hours – Norwegian and international results compared

	NOR	USA	CAN	DEU	NLD	ESP	GBR
Change in overall hours worked	-26.95	-36.17	-43.77	-52.18	6.91	-43.99	-42.20
	(0.00)	(0.00)	(0.00)	(0.55)	(0.14)	(0.00)	(0.00)
Basic gender gap (β_3)	1.37	-7.76	-6.50	-26.39	-6.63	-3.85	4.97
	(0.75)	(0.00)	(0.00)	(0.01)	(0.46)	(0.16)	(0.12)
w/ industry & occupation controls (γ_3)	7.78	-5.20	-7.21	-22.38	-11.21	-2.14	0.53
	(0.04)	(0.00)	(0.00)	(0.03)	(0.22)	(0.21)	(0.87)

Notes: Regression coefficients from Norway compared to international results from Table 8 in Alon et al. (2021a)*. Coefficients are reported in log points. P-values are reported in parentheses below estimates. The hours index uses the inverse hyperbolic sine transformation of actual hours worked in the relevant reference week. The sample includes data between 2019 Q1 and 2020 Q3 on civilians of ages 25 to 55 who are employed, unemployed or outside of the labor force. No controls are used when estimating the overall hours decline. Controls for gender specific time trends, age, education, marital status, and quarter are otherwise included for estimates for Norway. Alon, Doepke, Olmstead-Rumsey, & Tertilt (2021) have run individual country regressions based on similar data and with similar controls – our method is based on theirs. Alon et al. (2021) do not report number of observations or R-squared in this table so neither do we. For further notes and details on the data used for the other countries, please see their paper and their Appendix C.*

To summarize the comparison of our findings with that of the US in Alon et al. (2021a), contrary to the findings of Alon et al. (2021a), we did not find evidence of a “shecession” in employment or hours worked with our Norwegian data.

8.5 The pandemic-induced impact on motherhood

8.5.1 The post-pandemic impact of motherhood on employment

The coefficient α_3 in Table 20 represents the estimate of the basic motherhood gap between mothers and non-mothers. The coefficient represents the percentage difference of the pandemic's effect on employment for mothers versus non-mothers.

Table 20: The pandemic-induced motherhood gap in employment

Sample	(5)	(6)	(7)	(8)
	2019Q1-2020Q3, females ages 25-55	2006Q1-2020Q3, females ages 25-55	2019Q1-2020Q3, females all ages	2006Q1-2020Q3, females all ages
Basic motherhood gap (α_3)	1.17	0.96	0.11	0.50
	(0.14)	(0.16)	(0.87)	(0.40)
R^2	0.0780	0.0625	0.2144	0.2030
w/ industry & occupation controls (θ_3)	0.16	0.15	0.02	-0.02
	(0.28)	(0.30)	(0.89)	(0.88)
R^2	0.9818	0.9847	0.9858	0.9873
Observations	38,019	320,626	68,146	563,152

Notes: Regression coefficients from different samples of Norwegian labor force survey data. Coefficients are reported in percentage points. P-values are reported in parentheses below estimates. Controls for time trends, age, education, marital status, and quarter are included.

We see that the estimates of α_3 in all samples are positive, however the findings are statistically insignificant. θ_3 is the estimated coefficient of the motherhood gap when controlling for industry and occupation combinations. Controlling for industry and occupation combinations reduce the estimates of the motherhood gap in all samples, and sample (4) in Table 16 changes sign becoming slightly negative. However, the estimates of θ_3 are also statistically insignificant. Also notable is the high R^2 in the model with industry and occupation controls, indicating that the model is overfit. Based on our data and models, we do not find evidence for a motherhood gap in employment in Norway.

8.5.2 The post-pandemic impact of motherhood on hours worked

The interpretation of the models in Table 21 are the same as in Table 20 but the outcome variable *employment* is replaced with *hours worked.* The estimates for the basic motherhood gap (α_3) are all negative and statistically significant on at least a 10 percent level in sample (6), and on a 1 percent level in samples (7) and (8). We observe that samples (7) and (8) with all ages have a larger negative motherhood gap than sample (6) ages 25-55, as well as a explains a greater amount of the variation in the data set (R^2).

Table 21: The pandemic-induced motherhood gap in hours worked

Sample	(5)	(6)	(7)	(8)
	2019Q1-2020Q3, females ages 25-55	2006Q1-2020Q3, females ages 25-55	2019Q1-2020Q3, females all ages	2006Q1-2020Q3, females all ages
Basic motherhood gap (α_3)	-0.27	-6.11	-9.32	-10.10
	(0.95)	(0.10)	(0.01)	(0.00)
R^2	0.0625	0.0528	0.1529	0.1432
w/ industry & occupation controls (θ_3)	-2.32	-7.77	-5.18	-8.55
	(0.53)	(0.01)	(0.09)	(0.00)
R^2	0.4092	0.4018	0.5637	0.5570
Observations	38,019	320,626	68,146	563,152

Notes: Regression coefficients from different samples of Norwegian labor force survey data. Coefficients are reported in percentage points. P-values are reported in parentheses below estimates. Controls for time trends, age, education, marital status, and quarter are included.

The estimations of the coefficient θ_3 in Table 21 also display statistically significant negative estimations of the motherhood gap with industry and occupation controls on actual hours worked. Sample (7) show statistically significant findings on a 10 percent level, and samples (6) and (8) are statistically significant on a 1 percent level. In sample (6), the motherhood gap in hours worked increases when controlling for industry and occupation combinations. In samples (7) and (8) the motherhood gap decreases when introducing industry and occupation controls. This might indicate that young mothers work in jobs that are more exposed to the negative labor force consequences of the pandemic, which would result in a larger reduction of hours worked as seen in (7) and (8) in Table 21.

9 Discussion of empirical strategy and findings

In this chapter we aim to answer our research question of "*Did the initial two quarters of the COVID-19 pandemic result in a "shecession" in the Norwegian labor market?"* considering our empirical findings in Section 8, the related literature, and economic explanations. Our two hypothesizes are (1) *"the pandemic did not cause a "shecession" in employment in the Norwegian labor market due to the attributes of the Nordic model"* and (2) "*the high concentration of female key workers in the public sector prevents a "shecession" in hours worked in the Norwegian labor market.".*

9.1 The overall decline in employment and actual hours worked

From our findings we observe that the pandemic caused a large decline in both overall employment and hours worked in Norway. This was expected given the nature of the pandemic where lockdowns and other infection control measures reduced access to businesses, schools, and day care centers. However, when comparing the outcomes for Norway to the outcomes of the US, we observe a stark contrast in the scope of the overall decline in employment. A large share of this difference is likely due to differences in labor market compositions but also the extent of apt job retention schemes. Although the US government provided job retention schemes including the Coronavirus Aid, Relief, and Economic Security (CARES) Act financing the existing Short-Time Compensation (STC) programs, these schemes were very limited with highly specific eligibility criteria, resulting in few applications for job retention schemes (OECD, 2020c).

In line with the Nordic model, the Norwegian government has provided extensive unemployment benefits and compensation packages during the pandemic. This has allowed individuals to keep their jobs (even if they work zero hours) and maintains the population's purchasing power. The financial support acts as a Keynesian multiplier as the government spending hinders negative ripple effects into sectors that weren't initially hit by the pandemic recession. This mitigates indirect unemployment effects of the pandemic recession and might explain the low overall employment decline in Norway compared to other countries.

9.2 The COVID-19 pandemic's effect on women's employment

Following this we wanted to check whether the effect of the pandemic disproportionally affected women's labor market outcomes in employment and hours worked relative to men, causing a "shecession" in these dimensions in the Norwegian labor market. Our findings imply that there are no significant differences between genders in employment status, and hence we have no basis to confirm nor deny the hypothesis that the pandemic has not caused a "shecession" in employment in Norway.

The statistically insignificant findings on the pandemic's effect on employment in Norway might be due to the attributes of the Nordic model, as proposed in hypothesis (1). The extensive public sector has a high degree of occupational segregation (Melkas & Anker, 1997) with a concentration of women in key worker occupations during the pandemic, especially in the healthcare sector. In comparison, many US women became unemployed and displaced from their jobs in pandemic-affected sectors causing a "shecession" in employment (Alon T. , Coskun, Doepke, Koll, & Tertilt, 2021a). Additionally, Norway has a relatively small hospitality sector compared with the US, which Alon et al. (2021a) claim is a partial explanation for the "shecession" in employment they find evidence for.

Because of our statistically insignificant estimates of the gender gap in employment we cannot make conclusions on how the pandemic will affect women's employment based on economic theory. Contrary to the theory on horizontal occupational segregation (Preston, 1999), we cannot confirm that the gender segregation in the Norwegian labor market has negative outcomes on the gender gap in employment. This can likely not be credited to occupational segregation in itself, but rather the classification of vital occupations in society during the pandemic that coincidentally aligned with female dominated occupations. Although not initially proposed, this is in line with the underlying assumptions for hypothesis (2).

9.3 The COVID-19 pandemic's effect on women's actual hours worked

Next, we investigate the implications of the pandemic on hours worked. Although there are no statistically significant estimates of the basic gender gap in hours worked, the trend in our datasets suggest that women have experienced an increase in actual hours worked compared to men after the pandemic. This is in contrast with the findings of Alon et al. (2021a) where the US had a large negative basic gender gap in hours worked. The positive estimate of the gender gap (γ_3) in hours worked might imply that a larger number of women in the Norwegian labor force are employed in occupations that are relatively protected from the decline in actual working hours caused by the pandemic. This is consistent with findings that jobs within the public sector is countercyclical to economic downturn (Quadrini & Trigari, 2007) and hypothesis (2), and is evidence against the existence of a "shecession" in Norway.

Our findings imply that there is more likeness between men and women in the younger and older age brackets within industry and occupation combinations in hours worked. This could be explained by several theories. In the youngest age bracket (15-24), on-the-job experience between genders could be more comparable than in the ages 25-55, and hence result in a lower gender gap accordring to the human capital model (Mincer & Polachek, 1974). Additionaly, women in the ages between 25 and 55 might be more submitted to the burden of childcare and the motherhood penalty (Waldfogel, 1998), and hence cause the greater gender gap in this age group.

The unaccounted-for positive gender gap in hours worked is a surprising phenomenon at first glance. The most likely explanation for our findings is the large share of female part-time workers within the category of essential occupations. As mentioned, 21 percent of the labor force is employed within the health care sector, and 80 percent of health care workers are female (Statistics Norway, 2021e). The sector has a high percentage of part-time employees – 72 percent of women fall within this category compared to 56.2 percent of men (KS, 2021). The $\boldsymbol{Job}_{it}$ vector of control variables is based on the underlying trends in the datasets. As a large share of female part-time workers in the public sector had to increase their working hours during the pandemic, and this could to some degree explain the gender gap in hours worked.

While we have been unable to construct models that give consistent or statistically significant results using the variable for part-time and full-time work, we have found evidence for the pandemic's relative effect on public sector workers. We see a slight trend of the pandemic increasing working hours in the public sector relative to the private sector, but a definite trend of female public sector workers (many of whom are part-time workers) relatively increasing their working hours after the pandemic. According to the human capital model, this increase in women's on-the-job experience will reduce the gender gap (Mincer & Polachek, 1974), but the possible existence of glass ceilings for women in the public sector may eliminate the positive long-term gender gap effects of this (Meulders, Plasman, Rigo, & O'Dorchai, 2010).

9.4 The post-pandemic motherhood gap

9.4.1 Mothers' employment post COVID-19 pandemic

We find no statistically significant motherhood gap in employment. This indicates that mothers might not have been disproportionally displaced from their jobs during the pandemic, and mothers do not suffer a motherhood penalty in employment during the pandemic. There are likely numerous policies ensuring these findings. Norway has extensive anti-discrimination laws, where mothers can pursue legal measures if she has been wrongfully dismissed due to childcare. Additionally, Norway provides a generous parental leave as well as paid leave due to sick children, without having to seize employment relationships. Parental flexibility during the pandemic also ensures that parents may reduce their hours worked without this affecting employment status. Next, we discuss how mother's actual hours worked were affected by the pandemic.

9.4.2 Mothers' hours worked post COVID-19 pandemic

We find that some of the variation in the motherhood gap is explained by controlling for industry and occupation. There may be several explanations for the remaining unaccounted-for motherhood gap. A likely explanation as noted in the literature (Petts, Carlson, & Pepin, 2020) is the increase in the need for at-home childcare during the closure of schools and daycare centers. Some of this effect is likely mitigated in Norway as key workers were given the option of kindergarten and/or elementary school provided by the welfare state during the pandemic (KS, 2021). However, when evaluating the findings, we cannot miss that there might be systematic differences between mothers and non-mothers. Non-mothers might prefer work and therefore choose to devote more hours in the labor market then women that choose to become mothers.

10 Future research

Future research could analyze the gender wage gap. Individual wage reports and information on received cash benefits during the pandemic would shed more light on how the pandemic affected individuals in different occupations and industries. Panel data would enable research into the individual-specific effects of the pandemic.

At the time of writing this thesis, the pandemic is still a reality, and we therefore cannot conclude on the long-term effect on the gender gap in hours worked. The pandemic caused an extraordinary situation where many key workers in vital functions had to perform on maximum capacity. Therefore, we cannot confirm that women in these key occupations will not reduce their relative workload to pre-pandemic levels after the initial pandemic effect to meet their own preferences (Blau & Winkler, 2018), and hence increase the gender gap long term (Mincer & Polachek, 1974). Future research should investigate the long-term implications of this on the gender gap using extended data.

In our thesis we find evidence of a motherhood gap in hours worked, however we are not able to fully trace the source for the gap with our data. Additionally, the AKU does not ask men if they have children. In Norway, a potential skewed distribution of housework between women and men in the household has yet to be researched. However, the closure of daycare centers and online teaching have created a greater need for childcare amongst parents in general. The consequences for equality in household units are important for long-term decrease in the gender gap.

11 Conclusion

In this thesis, we have studied the effect of the COVID-19 pandemic on women's labor market outcomes represented through employment status and actual hours worked in Norway using data from the Norwegian Labor Force Survey. Basing the empirical analysis on Alon et al. (2021a) makes for results comparable to their findings, where we focus on comparing our findings with those from the US. We approach the task using different samples, uncover the extent of industry and occupation specific effects, and check how being a (female) public sector employee affects hours worked during the pandemic. We complete the analysis by identifying a motherhood gap during the pandemic.

We find that the pandemic has caused decline in both overall employment and hours worked in Norway. However, we do not find evidence of women being disproportionally displaced compared to men, and thus no evidence of a "shecession" in employment in Norway. This stands in contrast with the findings of Alon et al. (2021a), and especially their findings from the US. The differences may be explained by the Nordic model's focus on female employment, anti-discrimination laws, and welfare benefits such as childcare for parents in vital functions in society, and job retention schemes allowing the reduction of hours to zero, as reasoned in hypothesis (1). Additionally, the high degree of occupational segregation in Norwegian society has women centered in occupations that are vital functions during the pandemic, while the US has a large share of women employed in hard-hit sectors.

We also find evidence of the pandemic causing a relative increase in actual hours worked for women when controlling for industry and occupation categories. We therefore do not find a "shecession" in hours worked. This might be explained by women's employment share in the public sector and vital functions during the pandemic, combined with the effect of increasing hours in their usual part-time jobs relative to men, as claimed in hypothesis (2). However, being a mother during the pandemic increased the likelihood of reducing actual hours in paid work relative to non-mothers. Related literature sheds light onto the subject indicating that the motherhood gap might be due to mothers increasing home production as well as a skewed distribution of unpaid work within the family unit during the pandemic.

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13 Appendix

A1 Industry and occupation categories

Table 22: Industry categories following the SN2007/SIC2007 classification standard (Statistics Norway, n.d. a)

SN2007/SIC2007 classification		Industry number	Code	Sector
A	Agriculture, forestry, and fishing	1	01–03	Private
B	Mining and quarrying	2	05–09	Private
C	Manufacturing	3	10–33	Private
D	Electricity, gas, steam, and air conditioning supply	4	35	Both
E	Water supply; sewerage, waste management and remediation activities	5	36–39	Public
F	Construction	6	41-43	Private
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	7	45–47	Private
H	Transportation and storage	8	49–53	Private
I	Accommodation and food service activities	9	55–56	Private
J	Information and communication	10	58–63	Private
K	Financial and insurance activities	11	64–66	Private
L	Real estate activities	12	68	Private
M	Professional, scientific, and technical activities	13	69–75	Private
N	Administrative and support service activities	14	77–82	Private
O	Public administration and defense; compulsory social security	15	84	Public
P	Education	16	85	Public
Q	Human health and social work activities	17	86–88	Public
R	Arts, entertainment, and recreation	18	90–93	Private
S	Other service activities	19	94–96	Private
T	Activities of household as employers; undifferentiated goods- and services-producing activities of households for own account	20	97	None
U	Activities of extraterritorial organizations and bodies	21	99	None

Table 23: Occupation categories following the STYRK-08 classification standard (Statistics Norway, n.d. b)

Code		STYRK-08 classification
1		***Managers***
	11	Chief executives, senior officials, and legislators
	12	Administrative and commercial managers
	13	Production and specialized service managers
	14	Hospitality, retail, and other service managers
2		***Professionals***
	21	Science and teaching professionals
	22	Health professionals
	23	Teaching professionals
	24	Business and administration professionals
	25	Information and communications technology professionals
	26	Legal, social, and cultural professionals
3		***Technicians and associate professionals***
	31	Science and engineering associate professionals
	32	Health associate professionals
	33	Business and administration associate professionals
	34	Legal, social, cultural, and related associate professionals
	35	Information and communications technicians
4		***Clerical support workers***
	41	General and keyboard clerks
	42	Customer services clerks
	43	Numerical and material recording clerks
	44	Other clerical support workers
5		***Service and sales workers***
	51	Personal service workers
	52	Sales workers
	53	Personal care workers
	54	Protective services workers
6		***Skilled agricultural, forestry, fishery, and hunting workers***
	61	Market-oriented skilled agricultural workers
	62	Market-oriented skilled forestry, fishery, and hunting workers
7		***Craft and related trades workers***
	71	Building and related trades workers, excluding electricians
	72	Metal, machinery, and related trades workers

	73	Handicraft and printing workers
	74	Electrical and electronics trades workers
	75	Food processing, woodworking, garment and other craft and related trades workers
8		***Plant and machine operators and assemblers***
	81	Stationary plant and machine operators
	82	Assemblers
	83	Drivers and mobile plant operators
9		***Elementary occupations***
	91	Cleaners and helpers
	92	Agricultural, forestry, and fishery laborers
	93	Laborers in mining, construction, manufacturing, and transport
	94	Food preparation assistants
	95	Street and related service workers
	96	Refuse workers and other elementary workers

A2 Variables

Table 24: Background variables

AKU name	AKU code	Description
aar	*V002*	Calendar year
kvartal	*V004*	Quarter in year
alder_aar	*V007*	Respondent's age by end of year
kjonn	*V008*	Gender; male or female
spm120	*V009*	Marital status
sstat	*V010*	Status in labor force
hnar	*V013*	Industry category of primary occupation
y_kode1	*V015*	Occupation category for primary occupation
stimpruz	*V023*	Sum of contracted hours in primary and secondary occupation in the reference week, corrected for unanswered
heldelt	*V027*	Employed fulltime, long part-time, or short part-time
sfakarbz	*V030*	Sum of actual hours worked in primary and secondary occupation in the reference week, corrected for unanswered
antbarn_uke	*V082*	Number of children under 16 in the reference week (exclusively asked to women)
aldbarn	*V083*	Age of youngest child
utd_bu	*V084*	Education level

Notes: This table includes the variables we included in our dataset and is not an extensive list of variables in the AKU. For a full list of variables included in the AKU and further details on the variables listed here, please see (NSD, n.d. b).

Table 25: Regression variables

Variable name	**Description**
employment	Indicator variable for employment status, based on *sstat*
asinh_hoursworked	The inverse-hyperbolic sine transform of actual hours worked in the reference week, based on *sfakarbz*
female	Indicator variable for female, based on *kjonn*
pandemic	Indicator variable for the occurrence of the pandemic, based on *aar* and *kvartal*
year	Calendar year, based on *aar.* Interacted with *female* to control for gender specific time trends in labor supply
Q1, Q2, Q3, Q4	Indicator variables for quarter, based on *kvartal*. Reference group: *Q4*
age_under_25, age_25_29, age_30_34, age_35_44, age_45_55, age_over_55	Indicator variables for age categories, based on *alder_aar*. Reference group: *age_35_44*
educ	Years of education
unmarried, married, cohabitant, prev_married, unknown_marstat	Indicator variables for marital status categories, based on *spm120*. Reference group: *married*
industry	Categorical variable for industry categories, based on *hnar*
public	Indicator variable for the public sector, based on *hnar*
occupation	Categorical variable for occupation categories, based on *y_kode1*
mother	Indicator variable for being a mother, based on *antbarn_uke*

Notes: Please see Section 6.2 for further details on the variables listed here.

A3 Main regression results for the pandemic-induced effects on employment

Table 26: Regression results for overall change in employment

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
pandemic	-0.0151***	-0.0106***	-0.0095***	-0.0104***
	(0.0027)	(0.0024)	(0.0027)	(0.0023)
constant	.8676***	.8631***	0.6923***	0.6932***
	(0 .0014)	(0.0004)	(0.0014)	(0.0004)
Observations	77,383	643,560	141,741	1,172,191
R^2	0.0004	0.0000	0.0001	0.0000

*Notes: Robust standard errors are reported in parentheses below estimates. Stars indicate p-values in the following categories: ***p<0.01 **p<0.05 *p<0.1.*

Table 27: Regression results for regression equation (1) for employment

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
female (β_1)	-0.0658***	-0.0774***	-0.0508***	-0.0548***
	(0 .0030)	(0.0030)	(0.0028)	(0.0028)
pandemic (β_2)	-0.0127 **	-0.0103**	-0.0131**	-0.0114**
	(0.0062)	(0.0051)	(0.0060)	(0.0050)
female#pandemic (β_3)	-0.0085	-0.0086	-0.0032	-0.0033
	(0.0076)	(0.0076)	(0.0071)	(0.0071)
year#female				
Q1	-0.0027	-0.0029***	-0.0018	0.0013
	(0.0043)	(0.0011)	(0.0040)	(0.0011)
Q2	0.0036	0.0001	0.0050	0.0063***

	(0.0040)	(0.0011)	(0.0038)	(0.0010)
Q3	0.0005	-0.0013	0.0006	0.0022**
	(0.0040)	(0.0011)	(0.0037)	(0.0010)
age_under_25			-0.2108***	-0.2012***
			(0.0048)	(0.0016)
age_25_29	-0.0247***	-0.0418***	-0.0298***	-0.0429***
	(0.0041)	(0.0014)	(0.0041)	(0.0014)
age_30_34	-0.0023	-0.0177***	-0.0063*	-0.0213***
	(0.0035)	(0.0012)	(0.0035)	(0.0012)
age_45_55	0.0042	-0.0021***	0.0091***	0.0046***
	(0.0027)	(0.0009)	(0.0027)	(0.0009)
age_over_55			-0.3449***	-0.3503***
			(0.0033)	(0.0011)
educ	0.0267***	0.0247***	0.0314***	0.0322***
	(0.0005)	(0.0001)	(0.0004)	(0.0001)
unmarried	-0.0769***	-0.0830***	-0.0645***	-0.0831***
	(0 .0036)	(0.0013)	(0.0033)	(0.0012)
cohabitant	0.0292***	0.0243***	0.0569***	.0477***
	(0.0026)	(0.0009)	(0.0027)	(0.0009)
prev_married	-0.0748***	-0.0684***	-0.0830***	-0.0881***
	(0.0059)	(0.0019)	(0.0044)	(0.0014)
constant	0.5418***	0.5948***	0.4550***	0.4705***
	(0.0085)	(0.0032)	(0.0077)	(0 .0031)
Observations	76,371	634,233	137,404	1,132,625
R^2	0.0686	0.0623	0.2090	0.2063

*Notes: Robust standard errors are reported in parentheses below estimates. Stars indicate p-values in the following categories: ***p<0.01 **p<0.05 *p<0.1. The estimates for the gender specific time controls in* year#female *are left out for brevity.*

Due to the number of variables (~800) used in estimating regression equation (2) for (γ_3), the regression results for this model are not included.

A4 Main regression results for the pandemic-induced effects on hours worked

Table 28: Regression results for overall change in hours worked

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
pandemic	-0.2695***	-0.2466***	-0.1993***	-0.1966***
	(0.0156)	(0.0136)	(0.0121)	(0 .0104)
constant	3.019***	2.9963***	2.3624***	2.3597***
	(0.0080)	(0.0024)	(0.0064)	(0 .0019)
Observations	77,383	643,560	141,741	1,172,191
R^2	0.0040	0.0006	0.0019	0.0003

*Notes: Robust standard errors are reported in parentheses below estimates. Stars indicate p-values in the following categories: ***p<0.01 **p<0.05 *p<0.1.*

Table 29: Regression results for regression equation (1) for hours worked

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
female (β_1)	-0.4602***	-0.5899***	-0.3606***	-0.4392***
	(0.0177)	(0.0170)	(0.0135)	(0.0133)
pandemic (β_2)	0.0844**	-.0085	0.0392	-0.0318
	(0.0365)	(0.0305)	(0.0285)	(0.0239)
female#pandemic (β_3)	0.0137	0.0138	0.0389	0.0387
	(0.0434)	(0.0434)	(0.0331)	(0.0331)
year#female				
Q1	0.1552***	0.0541***	0.1223***	0.0562***
	(0.0237)	(0.0064)	(0.0186)	(0.0050)
Q2	-0.0198	0.0137**	-0.0069	0.0311***

	(0.0231)	(0.0064)	(0.0177)	(0.0050)
Q3	-0.4977***	-0.5467***	-0.3673***	-0.3944***
	(0.0241)	(0.0069)	(0.0181)	(0.0052)
age_under_25			-0.9226***	-0.9202***
			(0.0221)	(0.0075)
age_25_29	-0.1762***	-0.2643***	-0.1897***	-0.2621***
	(0.0228)	(0.0080)	(0.0224)	(0.0079)
age_30_34	-0.1371***	-0.2096***	-0.1495***	-0.2208***
	(0.0215)	(0.0074)	(0.0214)	(0.0075)
age_45_55	0.1155***	0.0609***	0.1329***	0.0839***
	(0.0162)	(0.0054)	(0.0162)	(0.0054)
age_over_55			-1.1943***	-1.2703***
			(0.0163)	(0.0055)
educ	0.1109***	0.0972***	0.1229***	0.1217***
	(0.0026)	(0.0009)	(0.0020)	(0.0007)
unmarried	-0.1739***	-0.1983***	-0.1505***	-0.2212***
	(0.0191)	(0.0068)	(0.0163)	(0.0058)
cohabitant	0.0536**	0.0518***	0.1638***	0.1470***
	(0.0169)	(0.0059)	(0.0148)	(0.0053)
prev_married	-0.2505***	-0.2169***	-0.2904***	-0.2866***
	(0.0303)	(0.0099)	(0.0190)	(0.0065)
constant	1.8068***	2.2107***	1.507***	0.4705***
	(0.0454)	(0.0184)	(0.0367)	(0 .0031)
Observations	76,371	634,233	137,404	1,132,625
R^2	0.0570	0.0563	0.1512	0.1523

*Notes: Robust standard errors are reported in parentheses below estimates. Stars indicate p-values in the following categories: ***p<0.01 **p<0.05 *p<0.1. The estimates for the gender specific time controls in* year#female *are left out for brevity.*

Due to the number of variables (~800) used in estimating regression equation (2) for (γ_3), the regression results for this model are not included.

A5 Regression results for the role of public sector workers

Table 30: Regression results for regression equation (1.3)

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
publicsector (ρ_1)	-0.2167***	-0.2397***	-0.1965***	-0.2129***
	(0.0152)	(0.0046)	(0.0127)	(0.0038)
pandemic (ρ_2)	0.1648***	0.0372	0.1373***	0.0187
	(0.0296)	(0.0232)	(0.0244)	(0.0191)
publicsector#pandemic (ρ_3)	0.0072	0.0402	.0337	0.0587***
	(0.0303)	(0.0267)	(0.0252)	(0.0222)
i.year				
Q1	0.1864***	0.0696***	0.1796***	0.0688***
	(0.0206)	(0.0056)	(0.0171)	(0.0047)
Q2	-0.0362*	0.0132**	-0.0314*	0.0124***
	(0.0210)	(0.0057)	(0.0174)	(0.0047)
Q3	-0.5742***	-0.6258***	-0.5217***	-0.5681***
	(0.0229)	(0.0067)	(0.0188)	(0.0055)
age_under_25			-0.3797***	-0.3893***
			(0.0226)	(0.0074)
age_25_29	-0.1230***	-0.1550***	-0.1141***	-0.1440***
	(0.0215)	(0.0075)	(0.0213)	(0.0075)
age_30_34	-0.1528***	-0.1781***	-0.1528***	-0.1780***
	(0.0207)	(0.0071)	(0.0207)	(0.0071)
age_45_55	0.1201***	0.0866***	0.1253***	0.0910***
	(0.0151)	(0.0050)	(0.0151)	(0.0049)
age_over_55			-0.0484**	-0.0895***
			(0.0165)	(0.0055)
educ	0.0271***	0.0196***	0.0318***	0.0259***
	(0.0025)	(0.0008)	(0.0021)	(0.0007)
unmarried	0.1301***	0.1411***	0.0979***	0.0996***
	(0.0177)	(0.0062)	(0.0157)	(0.0055)

cohabitant	-0.0413**	-0.0236***	-0.0202	-0.0035
	(0.0161)	(0.0056)	(0.0144)	(0.0050)
prev_married	-0.0056	0.0076	-0.0584*	-0.0270***
	(0.0280)	(0.0089)	(0.0214)	(0.0071)
constant	3.2361	3.4432***	3.1475***	3.3343***
	(0.0420)	(0.0151)	(0.0359)	(0.0129)
Observations	66,050	549,083	96,365	800,506
R^2	0.0383	0.0403	0.0373	0.0380

*Notes: Robust standard errors are reported in parentheses below estimates. Stars indicate p-values in the following categories: ***p<0.01 **p<0.05 *p<0.1. The estimates for time controls in* year *are left out for brevity.*

Table 31: Regression results for regression equation (1.4)

Sample	(1)	(2)	(3)	(4)
	2019Q1-2020Q3, ages 25-55	2006Q1-2020Q3, ages 25-55	2019Q1-2020Q3, all ages	2006Q1-2020Q3, all ages
publicsector (ϱ_1)	-0.1133***	-0.1123***	-0.1193***	-0.1100***
	(0.0244)	(0.0074)	(0.0205)	(0.0061)
female (ϱ_2)	-0.2196***	-0.2607***	-0.2457***	-0.2682***
	(0.0192)	(0.0057)	(0.0157)	(0.0046)
pandemic (ϱ_3)	0.1802***	0.0369	0.1445***	0.0173
	(0.0323)	(0.0259)	(0.0267)	(0.0213)
publicsector#female (ϱ_4)	-0.0337	-0.0430***	0.0199	-0.0059
	(0.0322)	(0.0096)	(0.0268)	(0.0080)
publicsector#pandemic (ϱ_5)	-0.0882*	-0.0737*	-0.0495	-0.0451
	(0.0496)	(0.0439)	(0.0418)	(0.0370)
female#pandemic (ϱ_6)	-0.0416	0.0055	-0.0204	0.0019
	(0.0393)	(0.0348)	(0.0320)	(0.0284)
publicsector#female#pandemic (ϱ_7)	0.1520**	0.1546***	0.1257**	0.1484***
	(0.0656)	(0.0580)	(0.0547)	(0.0484)
i.year				

Q1	0.1869***	0.0720***	0.1801***	0.0710***
	(0.0205)	(0.0056)	(0.0171)	(0.0047)
Q2	-0.0361*	0.0142**	-0.0311*	0.0134**
	(0.0209)	(0.0056)	(0.0173)	(0.0047)
Q3	-0.5737***	-0.6241***	-0.5215***	-0.5663***
	(0.0229)	(0.0066)	(0.0188)	(0.0054)
age_under_25			-0.3530***	-0.3631***
			(0.0225)	(0.0074)
age_25_29	-0.1138***	-0.1473***	-0.1057***	-0.1369***
	(0.0215)	(0.0075)	(0.0212)	(0.0074)
age_30_34	-0.1531***	-0.1767***	-0.1528***	-0.1763***
	(0.0206)	(0.0071)	(0.0206)	(0.0070)
age_45_55	0.1194***	0.0840***	0.1239***	0.0876***
	(0.0151)	(0.0050)	(0.0150)	(0.0049)
age_over_55			-0.0583***	-0.1076***
			(0.0165)	(0.0055)
educ	0.0298***	0.0197***	0.0330***	0.0246***
	(0.0025)	(0.0008)	(0.0021)	(0.0007)
unmarried	0.1158***	0.1196***	0.0870***	0.0804***
	(0.0177)	(0.0061)	(0.0157)	(0.0055)
cohabitant	-0.0462***	-0.0292***	-0.0235	-0.0075
	(0.0161)	(0.0055)	(0.0143)	(0.0050)
prev_married	0.0082	0.0292***	-0.0378*	0.0022
	(0.0280)	(0.0089)	(0.0215)	(0.0071)
constant	3.2749***	3.5355	3.2158	3.4475***
	(0.0422)	(0.0152)	(0.0361)	(0.0130)
Observations	66,050	549,083	96,365	800,506
R^2	0.0425	0.0465	0.0417	0.0440

*Notes: Robust standard errors are reported in parentheses below estimates. Stars indicate p-values in the following categories: ***p<0.01 **p<0.05 *p<0.1. The estimates for time controls in* year *are left out for brevity.*