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The Effect Of COVID-19 On Male And Female Labor Supply.

Empirical analysis on gender gap in actual hours worked.

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Abstract

This paper carries out an empirical analysis to answer how the COVID-19 pandemic impacted the labor force in Norway. More specifically how it impacted the female labor force in actual hours worked. This research has been done in many countries and the results tend to have a negative impact on women labor force. I am choosing Norway as my research country because Norway is ranked number three in the worked in gender equality and ranked as the best country to live in for women (Forum, 2021). As a result, the impacts of COVID-19 on the labor supply of women may be smaller than what has been found in other countries with a higher degree of gender inequality.

First, I display a review of earlier research done in this field and discuss how economic theory is used to explain the difference between genders in the labor force. Second, I look into how Norway handled the pandemic. This paper studies the following research question: did COVID-19 have differential impact of labor supply of male employees than female employees?

By using data from the Norwegian Labor Force Survey (AKU), I employ a difference-in-difference design and study the change in hours worked between male and female employees before and after the introduction of the pandemic. I find that the actual working hours for men decreased more than those of women after 2019. Overall, actually working hours decreased after the pandemic. However, men do still work more actual hours than women.There is a disparity in hours worked between men and women, COVID-19 did have a differential impact on labour supply for men and women. Other factors like education and what type of industry you worked in had some say when it came to actual hours worked.

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1 Introduction

Internationally, Norway is known for having a high degree of equality in society. Ranked number three in the world, only behind Iceland and Finland (Forum, 2021). Like other countries, Norway also has a highly gender segregated labor market. In Norway COVID-19 became officially a pandemic in March 2020 (Juul et al., 2022). It is natural to hypothesize that the pandemic had heterogeneous impact across different types of people. This paper focuses on how the labor market impact of the pandemic varied by gender.

Around 85 percent of the Norwegian workforce works in a profession that is either dominated by women or men. About 70 percent of those employed in the public sector are women. Here the proportion of part-time employment is high. Norway has 38 percent female managers, which is higher than in most other countries. Norway has a higher proportion of women members of parliament than the OECD average (40 percent versus 29 percent), but with 40 percent female judges, the proportion is lower than the OECD average of 55 percent (NHO, 2018).

Gender gap is when there is a gap in any area between women and men in terms of their levels of participation, access, rights, remuneration or benefits (Commisssion., 1998). As mentioned before Norway is ranked number three in the world, but is still far away from reaching full equality. This is reflected on the ranking, Norway has an index score of 0.85 in 2022. This index benchmarks gender gaps on economic, political, education, and health-based criteria. A value of 1 shows full gender parity. Iceland is ranked number one and has a score of 0.91 (Forum, 2021).

Such evidence of gender equality begs the question whether COVID-19 would still have a differential impact by gender. Norway is ranked as world's best country for women, ranked number three in the world for gender equality (Forum, 2021). What was the actual effect of COVID-19 on women in Norway. It is well researched on that women were largely negatively impacted of the pandemic compared to men. This necessarily does not mean it applies to the women in Norway. Therefore, I intend to answer the following researched question:

Did COVID-19 have differential impact of labor supply of male employees than female employees?

To approach my research question, I will be using the Norwegian Labor Force Survey (AKU). I will utilize data from 2016, forth quarter to 2020, forth quarter. By using data from few years before COVID-19, I can investigate if there was already forming a pattern before COVID-19 and compare to previous years. The empirical analysis is based on how actual hours worked in Norway is impacted by the pandemic. I have a variable which measures the extensive marginal of employment. As my control variable I have variables that can measure the intensive margin as education level and occupation. My dependent variable also measures the intensive margin of actual hours worked. I have also included demographic variables like age, gender and marital status.

This master's thesis is organized as follows. Chapter 2 is a literature review of how women has been impacted by the COVID-19 pandemic. Chapter 3 describe how Norway reacted to COVID-19. Chapter 4 explains the data and methodology utilized for the empirical analysis. Chapter 5 gives the empirical framework of the data analysis. Chapter 6 illustrates the results of the empirical analysis and discusses the mechanisms behind the results. Chapter 7 gives suggestions for further research in this field and limitations. Lastly, chapter 8 concludes the key findings of the empirical analysis.

2 Literature Review

This section will present a review of the related literature. I will discuss research related to the impacts of COVID-19 on gender equality. Research that discuss the disproportionate impact on women. Review how industries reacted to the pandemic and how maybe other factor could play a role in the inequality. Finally, taking a look into how specially Norway reacted to the pandemic.

The COVID-19 pandemic has affected gender equality worldwide. Highlighting that

the pandemic has aggravated existing gender inequalities, also generated new ones. The pandemic has had a disproportionate impact on women, as they are more likely to work in sectors that have been hit hardest by job losses and economic insecurity, such as hospitality and retail. According to (M. Alon, 2020) the pandemic was involved in creating opportunities for gender equality such as the increased use of flexible work arrangements, including remote work, which can benefit women with caregiving responsibilities. The pandemic has also brought attention to the importance of essential workers, many of whom are women, and the need for better pay and working conditions (M. Alon, 2020).

Some sectors experience unprecedented disruptions, while others have benefited from the crisis. The pandemic had impact on key sectors in the EU, these are: manufacturing, services, tourism, and healthcare. The services sector, which accounts for the majority of employment in the EU, has been hit hard by the pandemic, with lockdowns and social distancing measures leading to reduced demand for services such as hospitality and retail. The adoption of digital technologies has helped some service providers to adapt to the crisis. The tourism industry, which is a significant contributor to the EU's economy, has been particularly affected by the pandemic, with travel restrictions and lockdowns leading to a sharp decline in tourism activity. The healthcare industry has also been impacted by the pandemic, with healthcare workers facing significant challenges in providing care to COVID-19 patients (Maarten DE VET, 2021).

The pandemic had a disproportionate impact on women's employment and labor force participation compared to men. This is also earlier mentioned by (M. Alon, 2020). The divide between men and women was primarily between the more and less-educated rather than between genders. Despite some accounts suggesting that women left the labor force in droves and significantly reduced their work hours, the overall female labor force participation rate remained relatively stable. Balancing caregiving responsibilities with work was a challenge that varied greatly based on factors such as education, occupation, and race. More highly educated individuals had the option to work from home, while those in-service industries

that required in-person interaction experienced substantial employment reductions. The real story of women during the pandemic is that those who were employed and also responsible for educating their children or caring for aging parents experienced significant stress, not because they left the labor force but because they were trying to balance multiple responsibilities (Goldin, 2022).

Analysis from the Norwegian Citizen Panel showed that there was a significant decrease in life satisfaction among the Norwegian population during the pandemic. In March 2020, 83 percentage of the participants reported being satisfied with their lives, while this number decreased to 72 percentage in September 2020.One of the main factors contributing to this decrease in life satisfaction was the impact of the pandemic on work. Many participants reported a decrease in job security, income, and work-life balance, which had a negative impact on their overall well-being. The survey was conducted in March 2020, which was the start of the pandemic in Norway, and again in September 2020. (Bakkeli, 2021)

Women are more likely to work part-time than men in most countries, and this gap has been relatively stable over time. The gender gap in part-time work is partly due to the fact that women are more likely to have caregiving responsibilities for children and elderly relatives. This can make it difficult for them to work full-time, and part-time work can offer more flexibility. However, the gender gap in part-time work is also influenced by workplace policies and cultural norms. The gender gap in part-time work can have negative effects on women's careers, such as lower pay, fewer opportunities for advancement, and reduced access to social benefits like pensions. Addressing the gender gap in part-time work requires a range of policy solutions, such as flexible working arrangements, affordable and accessible childcare, and efforts to change cultural norms around gender roles (ILO, 2018).

2.1 Economic theory

The human capital model is an economic framework that views education and training as investments that individuals make in themselves in order to increase their future earnings

and productivity. The model suggests that individuals can enhance their human capital, which is the stock of knowledge, skills, and abilities they possess, through education and training. (Becker, 1962)

The basic idea behind the human capital model is that education and training improve an individual's productivity and earning potential, which leads to higher wages and better job opportunities over the long term. The model suggests that individuals make rational decisions about how much to invest in their education and training based on their expected future earnings and the cost of education and training. (Becker, 1962)

The human capital theory has its origins in the free competition model, but the theory allows for the fact that individuals are not homogeneous. Therefore, the theory allows wage differences and these differences are explained by the fact that individuals do not have the same degree of human capital. The human capital of an individual consists not only of education, professional experience, seniority and other training, but according to Becker also health condition and other factors that have an effect on the individual's productivity. There are various reasons why human capital affects productivity in work. As previously mentioned, an increase in human capital will have a direct impact on productivity, or the ability to adapt to new tasks. Human capital has value for companies since it increases profits regardless of how it affects productivity. It also helps to explain wage differences, but also why companies choose to invest in their employees. (Becker, 1962)

The accumulation and utilization of human capital has been disrupted by the pandemic. Individuals have been unable to acquire new skills and knowledge due to school closures, remote learning, and restricted access to training programs. The pandemic has accelerated the use of digital technologies and remote work arrangements. The need for people with digital skills and the ability to work well in virtual environments has grown as a result of this shift. People with strong digital skills have been able to work from home and keep their jobs longer, while those without these skills have had trouble adjusting to the new work environment (Marek et al., 2020).

3 Institutional Background

The Norwegian government took extraordinary measures to combat the pandemic on March 12, 2020. All day care centers, schools, universities, and other educational establishments, in addition to gyms, hair salons, restaurants, and movie theaters, were required to close under emergency laws. Travel restrictions were imposed both domestically and internationally, and all organized sports and cultural events were postponed. The population of Norway was urged to remain at home whenever possible, and only when absolutely necessary, contact with health care services was encouraged. The majority of chronic disease patients' appointments were canceled or replaced with video or telephone consultations. (Juul et al., 2022)

The Norwegian government at the start of the pandemic issued a list of crucial functions in society. The list is based on "businesses with critical social function and key persons". The point of this list was to commit to keep the relevant functions running during the pandemic. The list contained: Defense Department, Justice Department, Ministry of Health and Care Services, Ministry of Labor and Social Affairs, Rescue Services, Digital security, Environment and Nature, Critical supply chain, Water and drain, Financial Services, Power Grid, Electronic communication, Transportation and Satellite-based services (offentlige utredninger, 2021).

The main concern across Europe has become the new policy of multiple inequalities through anti-discrimination. This is very much manifested in Norway too. The Norwegian law says discrimination on the base of maternity leave, care tasks, pregnancy and genders is prohibited (, LOV-2018-06-20-42(2018). As mentioned before Norway is still working towards a complete gender parity.

4 Data

In this section, we will describe a general overview of the data. Secondly, we will present the sample and how we have processed the data. Thirdly, we will present the data basis in

descriptive tables.

The data material has been collected by NSD (Norsk senter for forskningsdata), I have also obtained the data from NSD. In order to carry out our regression analysis in the thesis, I have used data at the individual level. My analysis is based on the Labor Force Survey (Arbeidskraftundersøkelsen), which states what proportion of the population is employed and unemployed. The data has been collected since 1972. The statistics are published quarterly, normally four weeks after the end of the quarter. The main reason for the Labor Force Survey is to see developments in the labor market, both in terms of employment and unemployment. It also provides good information on different groups of the population's connection to the labor market.

In my analysis, I have decided to use data from the last quarter from 2016 to 2020. I choose this period because I wanted to compare pre and post COVID-19. In addition the information about the individuals has become more comprehensive in recent years (2015 to now). I will use data from the same quarter each year to analyze.

The unmodified data set includes information obtained from approx. 19,000-21,000 individuals between the years 2015-2018. The data is repeated cross sectional data. The number of participants varies over the years and the selection of individuals is random. Some of the individuals have participated more than once, but it is not possible to follow up on the individual itself. In order to obtain a representative sample of individuals, all individuals living in Norway are part of the basis for selection. As long as they are registered with an address in Norway. Between 19,000-21,000 individuals are surveyed every quarter. AKU surveys individuals from those aged 15 to the age of 81 from all counties in Norway. The AKU does not include asylum seekers or individuals who work in the country in the short term, i.e. less than 6 months.

The dataset contains around 83 variables when unmodified. The questions and number of variables vary from year to year. The information obtained covers both the employed, the underemployed and the unemployed. The variables include personal background, occu-

pational code and income, working hours, temporary absence and the process of job search and education. NSD's surveys are used at a national level, both by politicians and Statistics Norway. By using NSD's data, the data comes from the same base system and satisfies a high degree of reliability and quality. Due to the size of the data set, potential sampling bias is also reduced. Sampling bias is a phenomenon where some members of the population are less likely to be part of the sample than others. I have selected a few variables to obtain a more consistent data set that applies to all years, because many of the variables in the data set are not consistent across year

4.1 Variable Description

In this subsection, I describe the variables used in my model. A complete list of all the variable will be listed in the appendix as Table x.

4.2 Dependent variable

I focus on hours worked per week in this analysis, so my dependent variable is "Working hours per week". The AKU variable, which represent the total number of hours worked in the primary occupation during the reference week, serves as the basis for my measurement of hour worked. Employees can change their working hours because of the pandemic and real hours worked portray a more exact portrayal of the labor supply or demand in the economy contrasted with contracted hours which remain very stationary.

Figure 1 is a plot for real working hours per week for each analyzing year. Figure 2 is a plot for agreed/contracted working hours per week for each analyzing year. As we can see, agreed/contracted working hours is much more constant and higher than real working hours. Contracted hours does not tell the full story cause, for instance different types of leave and a temporary reduction in real working hours as a result of infection control measures are not taken into account when calculating contracted hours. There is clear evidence that real working hours seems to be effected by the pandemic, Figure 1 illustrates a large decline in

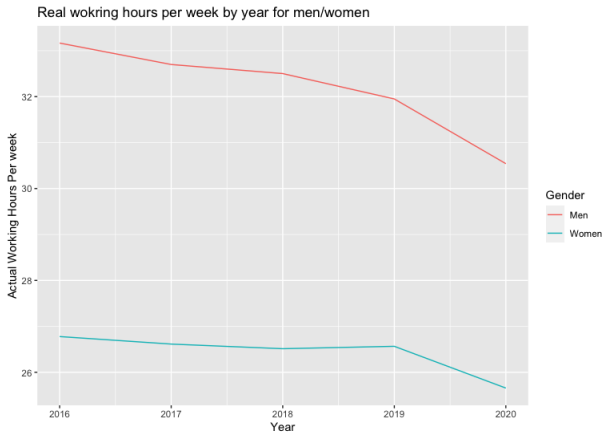

Figure 1: Figure shows the mean actual weekly hours worked separately by men and women from 2016 to 2020.

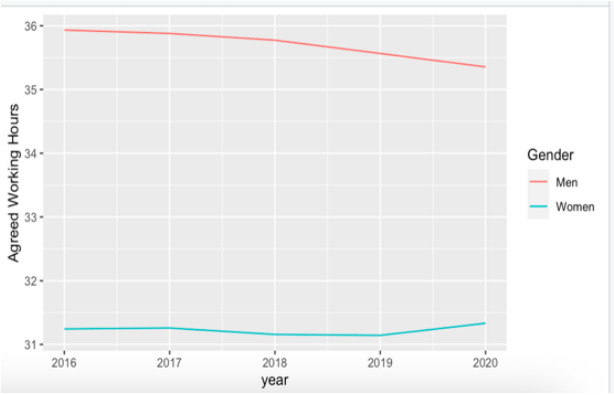

Figure 2: Figure shows the mean agreed weekly hours worked separately by men and women from 2016 to 2020.

working hours. Based on this, I conclude using real working hours and not agreed/contracted working hours.

There were individuals that reported they worked 240 hours per week, this has to be a result of reporting errors. To prevent reposting errors, I removed all observations that reported they worked more than 60 hours. There were 1371 individuals that worked more than 60 hours, by removing them i removed 2 percent of the data.

4.3 Explanatory variables

The gender indicator variable is my primary independent variable. My gender variable equals 1 when the individual is male and 0 if the individual is female. There are 35737 males involved in the survey and 33 444 females involved. The distribution between the genders is close to 50/50 throughout the survey, which means that the representativeness of the sample is strengthened.

Control variables has also been included. The first control variable is year. (have to write more about year) the year variable is designed to apprehend the changes in the labor market over time (2016-2020). The variable is constructed for each year

Age as control variable has been incorporated in the analysis. Age has been separated

into 3 different categories: young adults (15-25), middle-aged (26-62) and Elders (63-75). There are 4 578 individuals between the age of 63 to 75. 54 949 individuals between the age of 26 to 62. There are 9 654 young adults involved in the analysis.

The variable education is divided in such a way that individuals with a high level of education have been given the value 1 and a low level of education has been given the value 0. I have defined high education as university level and low education as anything below university level. 41.9 percentage of the observation fall under the category high level of education.

The marital status variable has changed over the years, as we have several categories from recent years. I have categorized this variable into a dummy variable, in that the value 1 is; is single. I included those who are divorced into the value single. The value 0 is being in a relationship or married. 24.80 percentage of the observation is either single or divorced.

Child(ren) under 16, this variable is designed so that if an individual has 1 or more children it corresponds as 1. Not having children corresponds as 0. (have to write more here)

There is also a control variable for industry. The AKU follows the standard for occupational classification ISCO-88. I made 4 different dummy variables for each industry I choose. Hotel and restaurant, construction, teachers (school) and oli and gas, these are the four industries.

4.4 Summary Statistics

The summary statistics for the variables included in the analysis are presented in the descriptive table above. The informational index comprises of 69,181 perceptions, with a mean of 28.490 working hours and a standard deviation of 16.067. The majority of the data fall between 16 and 38 hours (25th and 75th percentiles), with the minimum and maximum values of 0 and 60, respectively.

The year variable spans from year 2016 to 2020. The fact that the `gender_m` variable

Descriptives Table

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Real_working_hours	69,181	28.490	16.067	0.000	16.000	38.000	60.000
year	69,181	2,018.030	1.404	2,016.000	2,017.000	2,019.000	2,020.000
gender_m	69,181	0.517	0.500	0.000	0.000	1.000	1.000
Elder	69,181	0.066	0.249	0.000	0.000	0.000	1.000
Middle_Aged	69,181	0.794	0.404	0.000	1.000	1.000	1.000
Young_Aged	69,181	0.140	0.347	0.000	0.000	0.000	1.000
High_education	69,180	0.419	0.493	0.000	0.000	1.000	1.000
Full_time	69,181	0.745	0.436	0.000	0.000	1.000	1.000
Child_under_16	69,181	0.177	0.382	0.000	0.000	0.000	1.000
Hotel_and_restaurant	69,181	0.008	0.090	0.000	0.000	0.000	1.000
Construction	69,181	0.018	0.133	0.000	0.000	0.000	1.000
teachers	69,181	0.005	0.067	0.000	0.000	0.000	1.000
Health_and_social_services	69,181	0.088	0.283	0.000	0.000	0.000	1.000
extraction_of_oil_and_gas	69,181	0.001	0.035	0.000	0.000	0.000	1.000
Single	69,179	0.248	0.432	0.000	0.000	0.000	1.000
Post2019	69,181	0.203	0.402	0.000	0.000	0.000	1.000

Figure 3: Table displays summary statistics of the variables employed in the empirical analysis

has a mean value of 0.517 indicates that men account for slightly more than half of the observations. Only a small proportion of the sample is over the age of 65, as evidenced by the `Elder` variable's mean value of 6.6 percentage. The majority of the sample is between the ages of 35 and 64, as evidenced by the mean value of 79.40 percent for the `Middle_Aged` variable. The `Young_Aged` variable has a mean of 14.00 percent , showing that only a small proportion of the sample is younger than 35

The mean value of the `High_education` variable is approximately 42 percentage of the sample holds a degree from a higher education institution. The majority of the sample works full-time, as evidenced by the mean value of 74.50 percent for the `Full_time` variable. The `Child_under_16` variable has a mean value of 17.70 percent, indicating that children under the age of 16 are present in a small portion of the sample. The proportion of people who

work in various industries and their marital status are the remaining variables. In general, the table gives a useful summary of the most important aspects of the data set. This can help with further analysis and interpretation of the results.

The variable Post2019 indicates that 79.7 percentage of the observations in the dataset were taken in 2019 or earlier, while approximately 20.3 percentage of the observations were taken after 2019. This variable is helpful as an intermediary for evaluating the effect of the Coronavirus pandemic on the labor market, as it considers the separation of pre-pandemic and pandemic-time information. With this information, I can compare trends before and after the pandemic and examine how working hours

5 Empirical Framework

In this seciton, I outine the regression specifications used to examine the impact of COVID-19 on labour supply for female workers relative to male workers

5.1 Standard Differences-in-Differences

$$HoursWorked_{it} = \beta_0 + \beta_1 Post2019_t + \beta_2 Male_i + \beta_3 Male_i \times Post2019_t + \epsilon_{it} \quad (1)$$

Ordinary Least Squares will be used as the method to solve the regression. Y is real hours worked per week, which is the dependent variable. $Post2019$ is a binary variable indicating whether the observation is after 2019 or not. $Male$ is a binary variable indicating whether the observation is male or female. $Post2019 : Male$ is the interaction term among $Post2019$ and $Male$ in the regression analysis. The main parameter of interest is β_3. It can be interpreted as the change in male labour supply relative to the female labour supply after the introduction of the pandemic

5.2 Two-way fixed effects model

$$HoursWorked_{it} = \beta_0 + \beta_1 Male_i \times Post2019_t + \beta_2 Child_i + \beta_3 Single_i +$$
$$\beta_4 Education_i + \beta_5 MiddelAged_i + \beta_6 Elder_i + \beta_7 Male\_year\_trend + factor(year)_t + \epsilon_{it} \quad (2)$$

Equation 2 is a two way fixed model. The dependent variable is still Real working hours. The variable $factor(year)$ is included as a categorical variable with four levels: 2017, 2018, 2019, and 2020. The annual variation in Real working hours in relation to the reference category, which is year 2016, is shown as the coefficient estimate. The variable Child under 16 is a binary variable indicating whether the individual has a child under the age of 16 living in the same household. The variable *Single* is a binary variable indicating whether the individual is single or not. The variable High education is a binary variable indicating whether the individual has a high level of education. The variable Middle Aged is a binary variable indicating whether the individual is middle-aged, the same goes for the variable *Elder*. The overall trend in the relationship between gender and Real working hours between 2017 and 2020 is represented by the variable gender year trend (interaction of male indicator with a linear yearly trend).If the coefficient of gender year trend is negative and statistically significant, it would imply that women are working more hours than men over time, reducing the gender gap. Alternately, assuming the coefficient is positive and statistically significant, it would imply that the gender gap increases over time.

5.3 Event study design

$$\begin{aligned} HoursWorked_{it} = \beta_0 &+ \beta_1 \text{Male:2016} + \beta_2 \text{Male:2017} + \beta_3 \text{Male:2018} + \\ &+ \beta_4 \text{Male:2020} + \beta_5 \text{Male}_i + \beta_6 \text{Education}_i \\ &+ \beta_7 \text{MiddelAged}_i + \beta_8 \text{Single}_i + \beta_9 \text{Child}_i + \text{factor(year)}_t + \epsilon_{it} \end{aligned} \quad (3)$$

The event study design enables us to check whether the trends in labor supply across men and women were the same prior to COVID-19. We can do so by testing whether B1 = B2

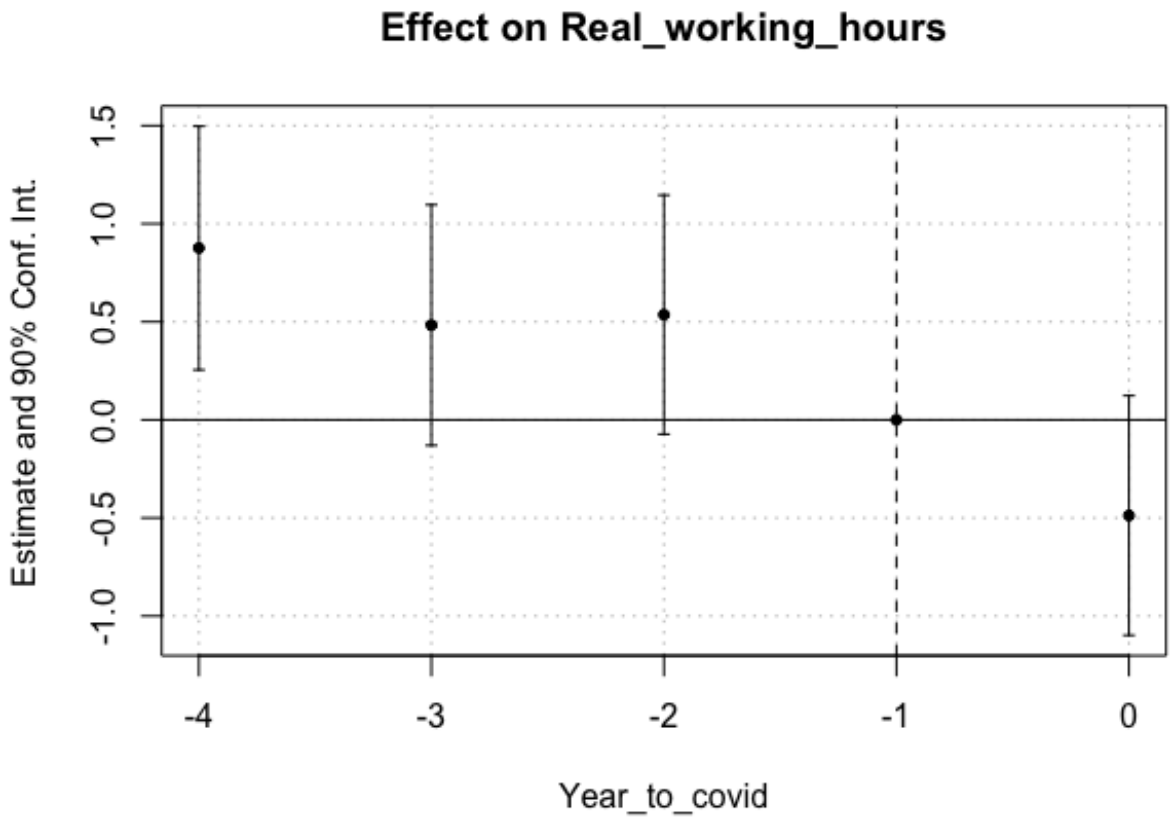

Figure 4: The event-study plot illustrates the impact of the COVID-19 pandemic on real working hours. The x-axis represents time, with negative values indicating the period before the pandemic and zero representing the onset of the pandemic. The y-axis displays the estimated coefficients, representing the changes in real working hours associated with each time interval.

= B3 = 0. Failing to reject this hypothesis would provide evidence to support the parallel trends assumption. In this regression model (3), the variable $Male : year2016$ represents the interaction effect between Male and year 2016, $Male : year2017$ represents the interaction effect between male and year 2017, and so on. The coefficients of these interaction terms indicate the effect of male on real working hours in each year relative to the reference category, which is the effect of gender in the year 2019 (a year before COVID-19).

An event study focuses on determining how a particular event affected a desired outcome. The COVID-19 pandemic is the specific event in this case, and the outcome of interest is actual working hours. We can estimate the average change in real working hours that occurred

in 2020 in comparison to the other years in the analysis by including the "factor(year)2020" variable in the regression. In event studies, this method is frequently used to separate the impact of a specific event from other factors that could be influencing the desired outcome.

We can examine how the COVID-19 pandemic affected the average level of real working hours and whether the effect varied across demographic groups or other factors by estimating the impact of the pandemic on real working hours using regression analysis.

5.4 Event study with industry sector controls

$$\begin{aligned} HoursWorked_{it} = \beta_0 &+ \beta_1 \text{Male:2016} + \beta_2 \text{Male:2017} + \beta_3 \text{Male:2018} \\ &+ \beta_4 \text{Male:2020} + \beta_5 \text{Male}_i + \beta_6 \text{Education}_i \\ &+ \beta_7 \text{MiddelAged}_i + \beta_8 \text{Single}_i + \beta_9 \text{Child}_i + \beta_{10} \text{Hotel\&Restaurant}_i \\ &+ \beta_{11} \text{Construction}_i + \beta_{12} \text{Teachers}_i + \beta_{13} \text{Health\&social}_i + \\ &+ \beta_{14} \text{Oil\&Gas}_i + \text{factor(year)}_t + \epsilon_{it} \end{aligned} \tag{4}$$

Model 4 is similar to model 3, but with the addition of industry sector variables to the model. The industry sector variables in this model are: Hotel and restaurant, Construction, Teachers, Health and Social Services, and Extraction of Oil and Gas.

The Hotel and Restaurant, Construction, Teachers, Health and Social Services, and Oil and Gas Extraction industry variables in this regression can assist the model in capturing the impact of specific industries on working hours. By including these variables, the regression is able to account for differences in working hours between industries, which could be brought about by differences in wages, benefits, and working conditions.

The model can better isolate the effect of other variables on working hours, such as gender and education, by including these industry variables in the regression. It can also control for the potential confounding effects of differences in working hours between industries.

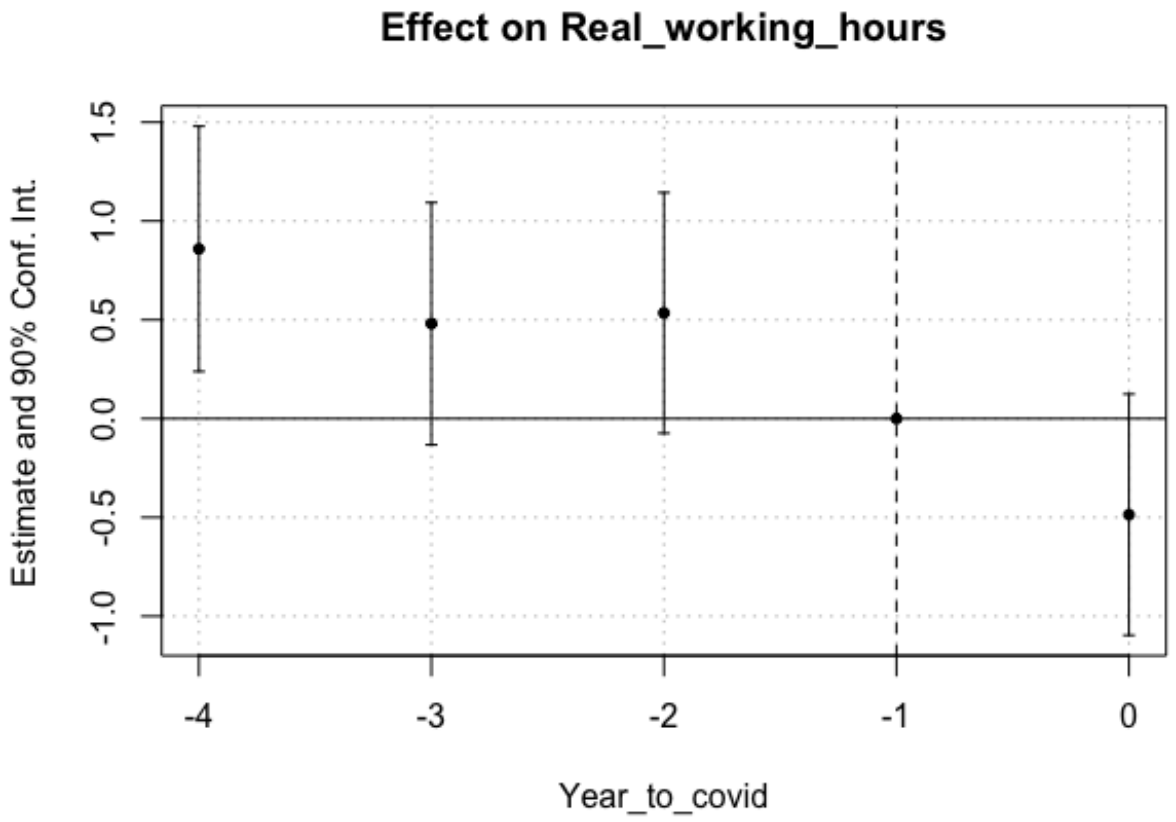

Figure 5: This plot is very similar to Figure 4 but it also includes industries to the plot.

6 Results

The main results of the empirical analysis will be presented in this chapter. Firstly, we will take a look into the impact of gender and the post pandemic period on real working hours. We will then move on to how demographical factors can explain the impact on real working hours. Thirdly, we are going to examine if gender differences in the effect of the pandemic on working hours. We will take a deeper look into working hours by adding working industries into the analysis. Lastly, the mechanisms of the results will be explained.

6.1 Impact of Gender and Post-2019 Period on Real Working Hours

The purpose of the differences in differences model 1 is to investigate the correlation between the independent variables $Post2019$, $Male$, and the interaction term between $Post2019$ and $Male$. The dependent variable is Real working hours. The constant term is additionally included for the model, addressing the expected value of Real working hours when all control variables are 0.

The $Post2019$ variable's coefficient is negative (-0.939) and statistically significant ($p < 0.01$), indicating that real working hours differ significantly between the pre-2019 and post-2019 periods. After controlling for other variables in the model, real working hours have decreased by an average of 0.939 hours between pre and post 2019 time period. After controlling for the model's other variables, the $Male$ variable's coefficient is positive (4.958) and statistically significant ($p < 0.01$), indicating the difference between male and female hours worked. The coefficient value suggests that male workers work 4.958 hours more than female workers. Interaction term among $Post2019$ and $Male$ is negative (-1.005) and statistically significant at 1 percent, demonstrating that the effect of the post-2019 period on genuine working hours varies by sexes. More specifically, men's real working hours suffer more than women's (-0.005) during the time period after 2019. The F-statistic of the model is statistically significant ($p < 0.01$), indicating that the overall regression model is a good fit for the data.

In conclusion, the regression results suggest that there is a significant difference in real working hours between the pre-2019 and post-2019 periods, with a stronger negative impact on male workers. The results also suggest that gender is an important factor to consider when examining the impact of changes in working conditions or policies on real working hours. However, the model explains only a small proportion of the total variation in real working hours, indicating that there may be other factors that influence this outcome.

6.2 The Effects of Demographic Factors and Year on Real Working Hours

The correlation between real working hours and a number of control variables, such as gender, age, education level, marital status, and the year the data were collected, is analyzed in the two way fixed model 2.

factor(year)2017, **factor(year)2018**, **factor(year)2019**, and **factor(year)2020**: For the years 2017, 2018, 2019, and 2020, respectively, these are dummy variables. 2016 serves as the category of reference. The change in real working hours compared to 2016 is shown by the coefficients. Since none of the coefficients in this regression are statistically significant, there is no significant variation in actual working hours across these years. According to the findings, there is a negative correlation between the year and actual working hours, with working hours decreasing for each year from 2017 to 2019. However, compared to previous years, working hours are significantly lower in 2020. The coefficient of year 2020 is significant at (P¡0.01) meaning hours in 2020 were significantly lower compared to 2016.

Male: The coefficient is positive. This indicates that on average males works more hours than females.Child under 16: This is a dummy variable that indicates whether the employee has a child younger than 16 years old. According to the coefficient of -2.312, workers who have a child under the age of 16 work on average 2.312 fewer hours than workers who do not have children under the age of 16. *Single*: This is a dummy variable that indicates if the worker is single. The coefficient of -0.732 indicates that single workers work an average of 0.732 fewer hours than non-single workers. The coefficient for High education is valued to be 2.331. Which indicates that, on average, workers with a high level of education work 2.331 more hours than workers with a lower level of education. The coefficient of 6.931 indicates that middle-aged workers typically put in 6.931 more hours than non-middle-aged workers. This is relative to the variable Young Aged. The coefficient of 0.480 is not statistically significant, which means that there is no significant difference in working hours between elderly workers and non-elderly workers. This finding is also in relation to the variable

Young aged.

Gender year trend: This variable represents an interaction term between male and a linear trend over the years. The coefficient of -0.256 indicates that, on average, the trend in real working hours for males is decreasing by 0.256 hours per year more than it is for females. This coefficient is also statistically significant at 5, which means that the effect of the variable on the outcome is likely to be real.

Gender:Post2019 is another variable which represents an interaction term between male and the post 2019 period. The coefficient of -0.321 is not statistically significant, which means that there is no significant difference in the effect of being male on real working hours between the pre-2019 and post-2019 periods, after considering the other variables in the model.In terms of interpreting this lack of significance for females, it suggests that the effect of being female on real working hours is relatively consistent between the pre-2019 and post-2019 periods, as the non-significant interaction term implies that the difference in real working hours between males and females did not significantly change during these periods.

6.3 Gender Differences in the Effects of COVID-19 on Working Hours

Table 3 is an event study. It does include a variable for the year 2020, which could be considered an event, especially given the context of the COVID-19 pandemic. Like the other regressions this event study also confirms that, when compared to 2019, the reference year, working hours were significantly reduced. We see that the coefficient is -1.102, and is statistically significant at the 0.01 level. Moreover, the event study also backs the finding in section 5.2.

There are four $Male : year$ interaction terms: $male : year2016$, $male : year2017$, $male : year2018$, and $male : year2020$. Each of these terms captures the effect of being male in the specific year on Real working hours. The year 2016 term is statistically significant at the 5 percent level with a p-value of 0.017, indicating that there is evidence to suggest that

the impact of 2016 on working hours is different for men and women. Rest of them are not, specially for 2020. Therefore, there is no evidence to suggest that the year 2020 had a different impact on working hours for men and women.

6.4 Relationship between Working Hours and Demographic and Industries

The purpose of the event study 4 is to investigate the factors that affect actual working hours with a focus on selected industries. Compared to the reference category, the regression results indicate that employment in various industries is associated with varying average weekly working hours. With a coefficient of -3.661, employees in the hotel and restaurant industry work an average of fewer hours per week, while those in the construction industry put in more hours with a coefficient of 2.831. With a coefficient of -1.945, teachers work fewer hours, and workers in the health and social services industry work fewer hours with a coefficient of -0.772. In the industry oil and gas has coefficient of 3.059, indicating that workers in this industry work appropriately 3 hours more than the reference category. Based on these coefficients, it appears that industry has a significant impact on average working hours, with some industries being linked to longer or shorter working hours than others.

This regression also confirms that on average, real working hours decreased by 1.105 hours in 2020. According to this finding, the COVID-19 pandemic may have had a significant impact on employee work hours. The regression also confirms like the others that the interaction term gender and year, is only significant for 2016 at 5 percentage. For year 2020 is not even significant for 10 percentage. Consequently, there is no indication that year 2020 had a different impact on working hours for men and women.

6.5 Mechanisms

The global economy has been significantly impacted by the COVID-19 pandemic, including employment and actual working hours. Numerous businesses were forced to close their doors or reduce their operations as a result of the pandemic. As a result, there were fewer jobs available and less demand for labor. The number of hours worked decreased as a result of the lower demand for labor, particularly in industries that were particularly hard hit by the pandemic (Maarten DE VET, 2021). This is the main reason why there is a significantly difference between the period pre and post 2019. Norway went into a lockdown in March 2020 (Juul et al., 2022). This is the second quarter, and my analysis is from the fourth quarter. So, deep into 2020. The effect of COVID-19 can really be seen in the analysis. The Norwegian Economy has now adapted to the new guidelines, and the data from the fourth quarter gives more a real story of what actually happened. The research conducted by Bakkeli is for Norway in the same time period. From the start of the year to end of the year life satisfaction among the population of Norway went down by 11 percent (Bakkeli, 2021). The main reason for this according to Bakkeli is work. From our analysis we learn that both men's and women's actual working hours decreased. Our empirical analysis backs the research conducted by Bakkeli.

The disparity in hours worked between men and women may be attributable to a variety of factors. We learn from the analysis that men's real working hours suffer more than women's during the time period after 2019. Men do still work more actual hours, but the decline has been greater for men in the time period after 2019. This can be explained by that men likely work in industries that were directly impacted by the pandemic, resulting in a sharper decline in actual hours worked. It is know that women typically work in sectors like the health department. This sector was classed by the government as critical social function (offentlige utredninger, 2021). This is understandable as it was a pandemic. Women's actual hours still decreased, this can be explained by that women typically work in sector like the services sector. This sector accounts for the majority of employment in

EU. A potential explanation for the decrease in men's actual working hours is that many of the male dominated industries were able to adapt to the pandemic. Working remote from home were one of the solution. When working remote workers tend to work less compared to onsite.

When looking at the other demographic control variables, having children younger than 16 residing in their family affects real working hours negatively. It is normal that people with small kids might have additional providing care liabilities and subsequently may work less hours. Being single might be related with less providing care liabilities and accordingly might be related with longer working hours. Higher-educated individuals may have more opportunities for higher-paying jobs that require longer hours and higher-educated individuals had usually the luxury to work from home. Lower educated individuals work in sectors like in-service, this sector requires typically human interaction. Therefore, these individuals experienced substantial employment reduction. People in middle age group typically have established careers and may be working longer hour. (Goldin, 2022).

The result of model 3 suggest that both men and women saw a decrease in real working hours in 2020. There was not significantly different from each other. The fact that the pandemic affected all workers regardless of gender and had a broad and indiscriminate impact on the labor market is one possible explanation for this outcome. This could be because, as a result of government-mandated lockdowns, many industries were forced to shut down or reduce their operations. As a result, there was less demand for labor and fewer hours worked. Another possibility is that all kinds of people were similarly impacted by the need to adjust work and providing care liabilities during the pandemic. Many workers, both men and women, had to take on additional caregiving responsibilities for children or elderly relatives as a result of many schools and daycare centers closing, which may have reduced working hours for both genders. (Goldin, 2022) discusses that the gender gap between the genders was not necessarily because of the genders but other demographical factors, like education. From previous research, we learn that the pandemic had a positive effect on gender inequality

(M. Alon, 2020).

From the model 4, Hotel and restaurant's negative coefficient suggests that this industry is linked to fewer working hours. This could be because of the pandemic's effect on the service and the travel industry, as well as the restaurant business. Hotels and tourist attractions saw a significant drop in business as a result of lockdowns and restrictions on travel and gatherings. The pandemic also had the same significant impact on the restaurant industry.

The coefficient which belongs to construction suggests there is an increase in working hours during the pandemic construction was looked at as essential service, therefore there was an increase in demand for construction projects. Workers in this field had to get tested before going to work. If negative, they could work.

The negative coefficient for teachers claims that this industry is related with a lessening in working hours. This could be because of changes in the school system during the pandemic, for example, school terminations and remote realizing, which persuaded to less working hours for teachers. According to the negative coefficient for Health and Social Services, this industry is also associated with a reduction in working hours. This could be the result of changes in the healthcare system brought about by the pandemic, such as a decrease in procedures that are not absolutely necessary. It is important to emphasize that this sector both include health and social services. It might be that workers in the health department worked more, but the negative effect of the social workers overpowered the positive effect of the health workers. Extraction of oil and gas coefficient is positive, meaning workers in this field worked more hours.

The results of the empirical analysis tell us that COVID-19 did actually have a differential impact of labor supply of male employees than female employees. We learn that men's real working hours suffers more than the females. There is a significant difference in real working hours between the pre-2019 and post-2019 periods, with a stronger negative impact on male workers. That been said, male workers do still work more hours than female workers. Other demographics factor like industry and education have a significant effect on working hours.

As mentioned before, in Norway 85 percent of the Norwegian workforce works in a sector that is either dominated by women or men (NHO, 2018). Women are more likely to work part-time than men in most countries, and this gap has been relatively stable over time (ILO, 2018). To combat the gap between men and women in the labor market, according to the human capital model Norway should invest more in the human capital of women. This implies benefits such as economic growth for Norway and long term economic stability. The important part is that for women this implies an increase in female labor force participation, diversity in the workforce and talent pool. The most important is that it is essential for promoting gender quality and minimize the gender gap.

7 Conclusion

In conclusion, the objective of this thesis was sought to investigate what type of impact the global pandemic COVID-19 had on the female labor force in Norway on actual hours worked. Specially in Norway, because Norway is ranked as the best country to live in as a women and ranked number three in the degree of gender equality. Using a differences-in-differences design and analysing the Norwegian Labor Force Survey (AKU), several key findings have emerged.

The COVID-19 pandemic has triggered a deterioration in both genders actual hours worked in Norway. According to my empirical analysis I find that men's real working hours suffer more than women's during the time period post 2019, the decline is bigger for men than women. Concluding that COVID-19 deferentially impacted men labor supply relative to women. Male workers do work more hours even if they suffered more during COVID-19 relative to acutal working hours.

My key findings is in contrast with other research done by others. For example (M. Alon, 2020) mention that the pandemic has aggravated existing gender inequalities. The pandemic had a disproportionate impact on women's employment and labor force participation com-

pared to men. This research is for other countries and mine is for Norway. The difference in labor supply for men and women is due to other factors and not gender inequality. Just want to empathize the point that my research is based in Norway and not in other countries. The story of the female workers in other country is a different story based on research.

Norway as a country has come a long way in the fight for gender inequality, this is reflected on their ranking in the world. This been said, there is still much improvement needed. My secondary findings reveals that education had a positive effect on actual working hours. (Goldin, 2022) suggest that the divide between the genders is related to education rather than gender itself. What type of industry you work in also had a significant impact on actual hours, as some of the industries was directly impacted by the pandemic. Therefore, a direct impact on the demand of labor on the particular industry. 85 percent of the Norwegian workforce works in a profession that is either dominated by women or men, the part-time proportion is high for women (NHO, 2018). Norway has to invest more in the human capital of their female population, this will results in long term economic growth and an increase in female labor force participation.

Nonetheless, recognizing the limitations of this study is important. The data has been collected from NSD. The disadvantage of this is that after the survey is completed, it becomes difficult to collect new data. The dataset does not fully align with my research question, it lacks certain variables. Variables describing wage and income of the employees, remote work opportunities and caregiving responsibilities are not observed. These variables may explain more vivid about the objective of this these. AKU was not developed by me, and is therefore not specified for my research field. The data structure is repeated-cross section, rather than a panel data, so that same individual is not followed over time.

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8 Tables

Table 1: The table presents the results of a regression analysis examining the impact of gender and the post-2019 period on real working hours. "Post2019" captures the effects of events occurring after 2019, while gender represents the gender of the individuals. Each observation corresponds to an individual-year combination in a repeated cross-sectional design.

	Dependent variable:
	Real_working_hours
Post2019	-0.939^{***}
	(0.216)
gender_m	4.958^{***}
	(0.135)
Post2019:gender_m	-1.005^{***}
	(0.301)
Constant	26.224^{***}
	(0.097)
Observations	69,181
R^2	0.023
Adjusted R^2	0.023
Residual Std. Error	15.879 (df = 69177)
F Statistic	551.534^{***} (df = 3; 69177)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 2: The table presents the results of a regression analysis examining the effects of demographic factors and year on real working hours. The variables include factors representing each year from 2017 to 2020, gender, age group, Child under 16, Single, High education, Middle Aged, Elder, a gender year trend, and a gender post2019 interaction term $gender_m : Post2019$. Each observation corresponds to an individual-year combination in the analysis.

	Dependent variable:
	Real_working_hours
factor(year)2017	−0.029
	(0.199)
factor(year)2018	−0.056
	(0.225)
factor(year)2019	−0.240
	(0.264)
factor(year)2020	−1.111***
	(0.260)
gender_m	522.054**
	(240.496)
Child_under_16	−2.312***
	(0.184)

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Table 2 – continued from previous page

	Dependent variable:
	Real_working_hours
Single	-0.732^{***}
	(0.162)
High_education	2.331^{***}
	(0.125)
Middle_Aged	6.931^{***}
	(0.204)
Elder	0.480
	(0.305)
gender_year_trend	-0.256^{**}
	(0.119)
gender_m:Post2019	-0.321
	(0.416)
Constant	20.587^{***}

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Table 2 – continued from previous page

	Dependent variable:
	Real_working_hours
	(0.269)
Observations	69,178
R^2	0.063
Adjusted R^2	0.

Table 3: The table presents the results of a regression analysis examining the impact of gender and year on real working hours, with a focus on the effects during the COVID-19 period (factor(year)2020). The variables include factors representing each year from 2017 to 2020, gender, education level, age group, Child under 16), and interaction terms between gender and each year. Each observation corresponds to an individual in the analysis, resulting in a total of 69,178 observations.

	Dependent variable:
	Real_working_hours
factor(year)2017	0.040
	(0.272)
factor(year)2018	−0.147
	(0.271)
factor(year)2019	−0.184
	(0.272)
factor(year)2020	−1.102***
	(0.271)
gender_m	4.131***
	(0.271)
High_education	2.348***
	(0.124)

Continued on next page

Table 3 – continued from previous page

	Dependent variable:
	Real_working_hours
Middle_Aged	6.736^{***}
	(0.162)
Single	-0.832^{***}
	(0.149)
Child_under_16	-2.326^{***}
	(0.183)
gender_m:year2016	0.876^{**}
	(0.378)
gender_m:year2017	0.483
	(0.373)
gender_m:year2018	0.536
	(0.370)
gender_m:year2020	-0.487

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Table 3 – continued from previous page

	Dependent variable:
	Real_working_hours
	(0.371)
Constant	20.781***
	(0.249)
Observations	69,178
R^2	0.063
Adjusted R^2	0.063
Residual Std. Error	15.554 (df = 69164)
F Statistic	357.745*** (

Table 4: This table presents the results of a regression analysis investigating the relationship between working hours and demographic factors, as well as industry sectors. The dependent variable is real working hours, and the independent variables include factors representing each year from 2017 to 2020, gender, education level, age group, Child under 16), and various industry sectors. The table also includes interaction terms between gender and each year. The analysis includes 69,178 observations.

	Dependent variable:
	Real_working_hours
factor(year)2017	0.035
	(0.272)
factor(year)2018	−0.145
	(0.271)
factor(year)2019	−0.180
	(0.271)
factor(year)2020	−1.105***
	(0.271)
gender_m	4.020***
	(0.271)
High_education	2.469***
	(0.127)

Continued on next page

Table 4 – continued from previous page

	Dependent variable:
	Real_working_hours
Middle_Aged	6.715^{***}
	(0.162)
Single	-0.812^{***}
	(0.149)
Child_under_16	-2.315^{***}
	(0.183)
Hotel_and_restaurant	-3.661^{***}
	(0.658)
Construction	2.831^{***}
	(0.448)
teachers	-1.945^{**}
	(0.883)
Health_and_social_services	-0.772^{***}

Continued on next page

Table 4 – continued from previous page

	Dependent variable:
	Real_working_hours
	(0.215)
extraction_of_oil_and_gas	3.059*
	(1.698)
gender_m:year2016	0.859**
	(0.377)
gender_m:year2017	0.480
	(0.373)
gender_m:year2018	0.535
	(0.370)
gender_m:year2020	−0.486
	(0.371)
Constant	20.852***
	(0.250)

Continued on next page

Table 4 – continued from previous page

	Dependent variable:
	Real_working_hours
Observations	69,178
R^2	0.064
Adjusted R^2	0.064
Residual Std. Error	15.545 (df = 69159)
F Statistic	263.859*** (df = 18; 69159)