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The Impact of COVID-19 on the Gender Employment Gap

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Abstract

Since the outbreak of the *COVID-19* pandemic, unemployment has increased significantly, resulting in employees losing their job both temporarily and permanently. As the pandemic is recent, there is a need for more research regarding what impact *COVID-19* has on the gender employment gap and if any gender has been more affected than the other. Further, there is scant evidence on if there is any relationship between exposure to viruses due to profession and job loss due to *COVID-19*.

We investigate the impact of *COVID-19* on the gender gap in employment at the onset of the pandemic by using data from a Six-Country Survey. We extend the study by observing the impact of *COVID-19* throughout 2020 in the United States of America by using data from the Current Population Survey (CPS). Depending on data set and specification, we find that women are between 7 to 16 percent more likely to lose their job due to *COVID-19* than men. However, the immediate impact differs significantly across countries. For the US, we find that women are especially more likely to lose their jobs between May to August in 2020. Interestingly, our results indicate that the gender employment gap is not driven by women working in professions with high exposure but rather exacerbates the gap.

Keywords: COVID-19, Gender Gap, Employment, Job Loss, Exposure to Virus

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1. Introduction

In the beginning of 2020 a novel coronavirus, also known as *COVID-19*, started to spread rapidly all over the world and the World Health Organization (WHO) soon declared it a global pandemic (WHO, 2020). To stop and prevent the spread of the virus, countries chose to shut down and introduced lockdowns, quarantines, or curfews, encouraging people to practice social distancing. As a result, indirect negative outcomes such as closure of businesses appeared on the labor market. Consequently, individuals lost their job either temporarily or permanently, increasing unemployment significantly (Bureau of Labor Statistics, 2020). Due to the recent nature of the disease outbreak, literature regarding the impact of *COVID-19* on the labor market and the gender gap is scarce. Moreover, there are conflicting predictions about how the gender gap may change as a result of the pandemic. For instance, whether or not the pandemic has created new or exacerbated previous gender inequalities in terms of employment (e.g. Adams-Prassl et al., 2020; Reichelt et al., 2021).

There are no concrete answers to what the main driving force for the gender employment gap is. Multiple factors such as age, education, industry and place of residence may drive the gender gap. The current *COVID-19* pandemic opens the possibility to investigate whether the gap can increase when a health crisis disrupts the labor market. Therefore, we consider exploring if the level of exposure to viruses due to profession could be a driver of the gender gap in employment.

1.1 Purpose of Study

Our paper intends to contribute to the developing literature regarding the impact of *COVID-19* on the labor market and gender equality. We aim to examine the implications on the labor market, focusing on both temporary and permanent job loss and its effect on the gender gap. Further, we intend to investigate factors driving the gender employment gap. Our main focus here is to see if the level of exposure to viruses due to profession could explain the gender gap that may have arisen from *COVID-19*.

As a result, our research will focus on answering the following questions:
Are women and men equally likely to lose their jobs due to the COVID-19 pandemic?

If women and men are differently likely to lose their jobs, what demographic and job characteristics could explain this difference?

Given that the gender labor repercussions from *COVID-19* rely on heterogeneous characteristics of the market and country, we consider it crucial to understand if there are key traits that explain the current attitudes. This research is needed to prevent gender gaps from increasing in future health crises and help women facing difficulties in the labor market.

1.2 Research Boundaries

This research is confined by place, timeline and characteristics of the employee. In particular, the study is limited to the following six countries: China, Japan, South Korea, Italy, the UK and the US. These countries are chosen as they cover different geographical locations, but also because the progression of the virus and actions taken vary from one country to another. The examination of different countries would result in a more widespread study. However, due to limited time and data, this research will only focus on the mentioned countries at the onset of the pandemic, which is in April 2020.

To further the analysis, we extend the research by observing the changes in the labor market in the United States between May to December 2020 to see what effect the pandemic had on the gender employment gap throughout the year. This research will also be limited by only analyzing workers whose job loss is solely a consequence of *COVID-19,* considering that individuals could have lost jobs due to other factors.

1.3 Thesis Outline

This research paper is organized as follows: chapter 2 contains research and theoretical background that is related to this study. Chapter 3 introduces and describes the data together with the variables of interest. Chapter 4 explains the hypothesis and empirical method implemented. Chapter 5 includes an explanation of the main results as well as a discussion on the relation to the theoretical framework. Chapter 6 presents the limitations of the research. Finally, chapter 7 contains the conclusions and suggestions for future research.

2. Literature Review

The literature review is organized as follows: in the first part we present papers centered on women and labor during the *COVID-19* pandemic. Later we introduce papers that analyze the same control variables as us. Finally, we add research that will provide a theoretical base for this paper.

2.1 Related Research and Theoretical Framework

This study aims to evaluate if women and men are equally likely to lose their jobs due to *COVID-19* and there is recent literature suggesting the opposite. A study conducted by Dang and Nguyen (2021) focused on gender inequality in income, expenditure, savings and job loss during the pandemic. They find that women are 24 percent more likely to lose their job permanently than men. According to the authors, a possible reason for this is that women are more represented in the service sector than men, which is the sector that has been highly affected by the pandemic. They used data from Belot et al. (2020), which we also use in this study. Unlike them, we made a number of changes to our data. The most notable change is that respondents above the general retirement age are omitted. Therefore, our results will only exhibit the pattern of the current working population.

Another study related to our research, done by Adams-Prassl et al. (2020), examined multi-country variation in the effects that *COVID-19* caused.[1] In particular, they looked at the differences per country and job characteristics that allowed individuals to minimize the difficulties caused by *COVID-19*. Results show that women are more likely to lose their jobs in some countries. Regardless, this pattern is true for all the countries, except Germany.[2] They also find that women without a university degree are significantly more likely to have lost their job. Another cross-country study conducted by Reichelt et al. (2021) shows that women are suffering more from the changes that *COVID-19* has created.[3] They conclude that significantly more women lost their jobs and have received a lower income compared to men after the

[1] US, UK and Germany.

[2] No evidence showing that one specific gender was more likely to get unemployed or a lower income due to the virus. Furthermore, women who did not lose their jobs were no more likely to experience a fall in their income in comparison to men.

[3] U.S, Germany and Singapore.

outbreak of *COVID-19*. In brief, we can observe that women seem to be more negatively affected by the pandemic, but it is country-specific.

Also, many studies show contradictory results regarding how professions and women are related. For instance, Mongey and Weinberg (2020) analyzed which occupations are most likely to be performed remotely and have a reduced amount of personal contact. This research merged different data sets to observe differences between workers depending on their profession. The results indicate that women have a higher likelihood of working with two specific traits: working in occupations that require close contact and work that is done from home. This differs from Alon et al. (2020) suggestion, that *COVID-19* affected women more than men because the impact was in specific sectors. To examine this, Alon et al. (2020) used data from American Time Use Survey (ATUS) in 2017 and 2018.[4] The results show that women seldom work in places with the ability to work from home. Furthermore, women work less in critical occupations. Clearly, there is no consensus on the relationship between women and their profession.

This study includes age as a variable of interest to see if there are any specific differences in job loss by age category during the pandemic. There is extensive literature exploring age and the labor market in general. Nonetheless, we find one research with a similar motivation as us. Research by Montenovo et al. (2020) focused on the fragile labor market and the job loss in the United States during the beginning of the pandemic. They were interested in analyzing the behaviors of specific sub-groups of workers and their interaction in the market. To achieve this, they proposed four different analyzes and one of them explored age. They conclude that young workers had the worst fall in employment. The reason behind it was that they were working in sectors affected by measures such as social distancing.

We are particularly interested in exploring if there is a relationship between job loss and professions with different levels of exposure to the virus. Literature in this field is limited and continues to develop. Hence, we could not find any supporting research. Nonetheless, a recent study by Shah et al. (2020) focused on the transmission of *COVID-19*, controlling for exposed individuals. Authors find that exposed individuals are more likely to be infected by the virus

[4] Tabulated gender, occupation (whether is critical or not), proportion of workers per occupation that reported the ability to work from home and the total days in a year that actually worked from home.

and spread it to others. Our research considers this literature relevant given that if there is a positive relationship between exposure and women this would mean that women were more prone to get sick and spread the virus, increasing their disadvantage.

According to OECD (2020), the labor market remains unfavorable for women as they usually get paid less, but suggest there is considerable progress. And, the fact that *COVID-19* negatively impacted industries with physical interaction and is predominantly occupied by women increases this inequality. To illustrate, ILOSTAT (2020) estimates that on average, 60 percent of the workers in the food and beverage industry are women in OECD countries. Additionally, pandemic measures restricted different sectors depending on relevancy and those with close interaction were affected. For instance, the personal care industry such as beauty salons require close interaction, but are not considered essential. On the contrary, the health care and social assistance industry requires close contact, but is necessary during the pandemic. Hence, we suspect that it is also important to know the importance of the industries during the pandemic and include it as a variable.

As the pandemic is still ongoing and the future economic consequences are hard to predict we also look to previous literature before the pandemic to explore possible outcomes. This will be discussed in the following section.

2.1.1 Gender Employment Gap and Recession

COVID-19 can be considered a health crisis with a "direct economic impact" (Rojas et al., 2020) because of the uncertainty that it has created. In February 2020, the United States economy hit its peak before it officially entered a recession due to the economic downturn caused by the pandemic (Smialek, 2020). This downturn marked the end of the longest expansion, which started in 2009 when the last recession ended.

Looking at the Great Recession, women fared better than men as the unemployment rate for men was notably higher than for women. One of the reasons for the gender gap in employment according to Sahin, Song and Hobijn (2010) is that men were overly represented in the goods-producing industries such as manufacturing and construction that suffered. Further, industries such as health care and education where women were more represented, fared better during the recession. A similar pattern could be seen in European countries (Hurley, Storrie & Jungblut, 2011).

Marchand and Olfert (2013) state that male-dominant industries such as construction, mining and manufacturing are cyclical industries. Meaning industries that supply goods people can either live without or wait to buy during economic downturns. On the other hand, female-dominant industries such as services, insurance and real estate and retail trade are considered non-cyclical, which means that these industries produce the basics that are needed even when the times are difficult. This could explain why men experience job loss to a larger extent than women during recessions.

Furthermore, extensive literature explores differences in male and female labor supply and unemployment occurring during economic instability. For example, Doepke and Tertilt (2016) analyzed the volatility of the labor supply of men and women using data from the Current Population Survey (CPS) from 1989 to 2014. They find that women's labor supply is less volatile than men´s, and married women have a less volatile labor supply than their spouses. Supporting these claims, Alon et al. (2020) refer to two possible reasons why women's labor is more stable than men's. First, married women tend to look for jobs in stable sectors when there are uncovered household expenses, increasing women's labor supply to the market. Second, women generally work in specific industries that are normally not affected by economic downturns. To summarize, both studies suggest that women tend to work more in stable sectors and men are usually more affected.

In the case of *COVID-19*, as previously mentioned there seems to be a higher volatility in women's sectors. Alon et al. (2020) argue that the global economic downturn caused by the pandemic is not like a typical recession as it has a huge impact on the female-dominant service industries such as restaurants and hospitality. Further, they state two significant factors that explain why some industries are more likely to be affected during the pandemic. First, how the demand of the industry is affected by the stay-at-home orders. For example, the need for pharmacies and grocery stores is high since they are still crucial. However, travel and hospitality decreased significantly. Second, if telecommuting within the industry is possible, then it should fare better. Therefore, industries such as manufacturing have been negatively affected, while higher education and business services have not.

In April 2020, the unemployment rate increased from 4.4 percent to 14.7 percent in the United States, which is the highest rate since the Great Depression. While the unemployment rates were almost equal at the beginning of 2020 for adult men and women – 3.3 and 3.2 percent, respectively – there was a marked difference at the onset of the pandemic. For adult men, the unemployment rate increased to 13.0 percent, while the rate for adult women increased to 15.5 percent, which is a 2.5 percentage point difference (Bureau of Labor Statistics, 2020). This supports Alon et al. (2020) argument that the recession caused by the pandemic is different from a typical recession as employed women have suffered more job loss.

2.1.2 Factors Affecting the Employment Gap

Research aiming to understand why women face more difficulties in the labor market than men is abundant. Variation within the literature relies on particular components that affect women, such as place or socio-economic situation. We find the following research important to explore given that we use a set of variables that control for the possible causes that can have an effect on women.

Blossfeld et al. (1997) analyzed attitude variation towards gender roles and women's employment in Croatia. The study focused on the relation of socio-economic and cultural characteristics as part of the trend explanation. By using the South-East European Social Survey, they assessed gender role attitudes and found that age, education and religion positively influenced gender role attitudes.

In the same way as Blossfeld et al. (1997), Campa et al. (2011) stressed that education has a great influence in reducing the employment gap. The latter studies whether gender culture has an effect on the behaviors displayed by individuals and firms in Italian provinces. This was done using data from the national labor market system from 1999 and 2003 to analyze the firm's culture. Additionally, they include data from the World Value Survey for the individual level. They find that both individual and firm culture towards gender have an impact on the gap in employment.

Ultimately, the employment gap depends on specific elements related to the interaction that women have in their surroundings. We can see that even when the literature is focused on a particular place and time, there are similarities among them, such as level of education. Given that there might be common issues, we decided to look more into the effect of exposure to virus and if this may influence the gender gap on average. The latter is one of the main contributions of this paper to the developing literature.

3. Data and Descriptive Statistics

For a comprehensive analysis of the impact of *COVID-19* on the gender employment gap, we used two different data sources. The first provides cross-country information from the early stages of the pandemic. To focus and extend the research within one country, we include a larger data set solely from the United States of America.

3.1 Six-Country Survey on COVID-19

Our first data source was collected by Belot et al. (2020) in the third week of April 2020. It contains information regarding individual profession, income, pandemic health behaviors, living arrangements, beliefs about the pandemic, exposure to the virus and ex-ante health characteristics. The data is publicly available and is a cross-country collection from six different countries: China, Japan, Korea, Italy, the UK and the US. It is important to highlight that the countries were chosen because they were at different stages of the pandemic at the time of data collection (see Table A.1 in Appendix). A total of 6,082 observations with roughly 1,000 observations per country were collected through an online survey. This collection was possible with the help of market research companies such as Lucid for the Western countries and dataSpring for the Asian countries. The respondents were selected to participate in the survey to make the sample nationally representative by age, gender and household income.

Our main variable of interest is *job loss due to COVID-19*, as we want to examine if there is a gender gap when it comes to losing a job due to the *COVID-19* pandemic. The variable *job loss due to COVID-19* is measured with the survey question: "Have you lost your job or has your activity (as self-employed) been stopped as a consequence of the Covid-19 pandemic?". To which the respondents could answer: "No", "Yes, temporarily" and "Yes, permanently". Individuals who were not in employment at the onset of the pandemic are not included in our sample. However, we consider it appropriate to include those who were self-employed.

Our main explanatory variable of interest is an indicator for the female respondent, and we limit the sample to individuals who chose either *male* or *female.*[5] Moreover, we only included working-age individuals aged between 18 and 65.

[5] The survey includes the question "*What is your gender?"*, to which respondents can select "male", "female" or "prefer not to say".

The effects of the pandemic on the labor market could depend on government and market-based shutdowns of industries, based on their importance. Therefore, we included an indicator variable categorizing industries into essential and non-essential. We follow Fairlie (2020) in classifying the industries based on *Delaware's List of Essential Businesses*. This is possible as the Six-Country Survey and the *Delaware List* follow the same sector classification.

Because we are interested in determining if the gender gap is driven by women working in professions that expose them more to viruses than their counterparts, we included the variable *exposure to virus.* The variable is drawn from the Occupational Information Network (O*NET) survey, measuring the frequency to which workers at different occupations are exposed to viruses. Respondents are asked to answer, "How often does this job require exposure to disease/infections?". Based on the response, occupations are assigned a score between 0 and 100, showing the frequency of exposure.

To explain further, O*NET allocates values of exposure as follows: 0 points are given to professions that never have contact with viruses; 25 points for once a year or more but not every month; 50 points for once a month but not every week; 75 points once a week but not every day and 100 points for every day. For this reason, those who have not specified their profession in the survey were excluded from the sample. Therefore, our total sample size is 3,793 observations and will be utilized as the final data set.

Furthermore, we added two dummies for high exposure and low exposure to explore if the level of exposure is a factor driving the job loss probability. If an individual has 25 points or less, they are considered to have a low exposure as they barely are exposed to viruses. On the other hand, if an individual has an exposure of 75 points or more, they are considered to have a high exposure due to profession as they are exposed once a week or more. To see the complete list of variables, please see Table A.2 in the Appendix.

To examine the Six-Country Survey, we compare the distribution by gender and divide it by demographic and labor variables. In Table 1, we can see that both genders are equally represented in the sample. The majority of the respondents are between the ages of 26 to 55. Still, there are some differences in the distribution of age between genders. For females, the smallest age group is the oldest one, while it is the youngest age group for males. When it comes to *job loss due to COVID-19,* we can see that men lost their job permanently slightly more than women. However, a higher percentage of women lost their job temporarily. We can also see that around 78 percent of the males and 66 percent of the females work in an essential industry. Interestingly, females have a higher exposure to viruses with an average exposure of 19 points compared to males 12 points. To see the distribution across industries and the average exposure for each industry, please see Table A.3 in the Appendix.

We can observe some differences in job loss between countries in Table A.4 in the Appendix. For example, a higher percentage of males in China have experienced job loss due to *COVID-19* both permanently and temporarily, in comparison to women. Also, a crucial similarity is that more men work in an essential industry, but women are more exposed to viruses due to their profession.

Table 1: Six-Country Survey - Proportion of respondents by gender

Descriptive Statistics

	Female	Male
Share (%)	48.17	51.83
Age Group (%)		
Between 18-25	14.56	9.41
Between 26-35	24.79	22.28
Between 36-45	23.81	27.11
Between 46-55	23.97	23.19
Between 56-65	12.86	18.01
Job Loss due to COVID-19 (%)		
Yes, permanently	5.53	5.95
Yes, temporarily	33.17	29.96
No	61.30	64.09
Industry (%)		
Essential	65.68	77.82
Exposure to Virus (%)		
0-20	69.46	82.66
21-40	15.43	11.14
41-60	6.90	3.00
61-80	3.34	1.83
81-100	4.87	1.37
Mean	19.28	12.30
Std.Dev.	23.71	16.80
N	**1,827**	**1,966**

Notes: The table reports the proportion of respondents by gender. The data was collected in the third week of April. Further, the sample is limited to the individuals whom we were able to allocate an exposure for their occupation. Observe that the mean and standard deviation of exposure are not in percentage.

3.2 Current Population Survey

We used the monthly U.S household survey from the Bureau of Labor Statistics (BLS) and the U.S Census Bureau (Flood et al., 2020) as our second data source. The Current Population Surveys (CPS) are conducted during the week that contains the 19th of each month, and the questions refer to one week prior.

A total of around 1.67 million observations were collected in 2020. We limit the sample by including data that was collected between May 2020 and December 2020 to see what the impact of *COVID-19* was after April. Also, we only include individuals that were in the labor force at the time. This means that the respondents were either at work, held a job but were temporarily absent from work, seeking work or were temporarily laid off from a job during the given week. We further limited our sample to observations that we were able to allocate exposure for. These restrictions result in a sample size of 358, 965 observations, with roughly 45,000 observations for each month.

Most of the variables are analogous to the previous data set. However, our main variable of interest, *job loss due to COVID-19*, is created using two other variables. The first asks if the respondent was unable to work during the last four weeks because their employer closed or lost business due to *COVID-19*. The second variable asks why the respondent was unemployed, with possible answers being that they lost their job, quit their job or were re-entering the labor force. If a respondent answers "Yes" to the question "Are you unable to work due to covid-19?" and has also answered "Job loser - on layoff", "Other job loser" or "Temporary job ended" they are considered as losing their job due to *COVID-19*.

To clarify, individuals who answered "No" to the question "Are you unable to work due to covid-19?" or selected "Re-entrant" and "Job leaver" are not considered as losing their job due to *COVID-19*.

Our main explanatory variable is an indicator for female respondents. To control for demographic characteristics, we included *age group* and *education level* (university degree) as variables. Additionally, we include an indicator variable for the first four months of the pandemic captured by our data set (May-August). This is done to understand if there is a different probability of losing a job during the first period compared to the second one. We are also interested in observing the specific effect that females obtained during the first four months. Therefore, an interaction term between *May to August* and *female* is introduced to observe this. We divide this indicator into May-August and September-December because the recovery of the unemployment rate has been slow but steady in the later part of 2020 compared to the earlier part of 2020, when the unemployment rates were decreasing significantly (Bureau of Labor Statistics, 2020).

In the same way as the Six-Country data, we included an indicator variable for essential industries. For this case, the list and the survey both follow the same 4-digit coding from North American Industry Classification System (NAICS). Also, the survey does not provide information regarding the exposure to the virus respondents had due to profession. Therefore, we included the variable *exposure to virus* externally by linking occupation to the O*NET codes manually. It is important to mention that values are averaged out when allocating the level of exposure with similar occupations for the ones we could not find exposure for.

Similar to the multi-country data set, we include two indicator variables for high and low exposure. To deepen the analysis, an interaction term with *essential industry* is used to explore if there exists a relation between essential industries and exposure that impacts the probability of losing a job. Please see Table A.5 in the Appendix for the complete list of variables.

Before reporting the results, it is relevant to understand the composition of respondents by gender. Table 2 shows that both females and males have similar distribution for age, with a prevalence in the age group 36 to 45 years old. Despite females having a higher completion of at least a university degree than males, women are more prone to losing their job.

Interestingly, almost 80 percent of the males work in an industry deemed essential compared to females 67 percent. However, it appears that females are the ones that have a higher exposure to viruses, with an average exposure of close to 30 points compared to 17 points for males. In fact, from Table A.6 in the Appendix, we observe the same trend as 23 percent of females work in the health care and social assistance industry. While males are more represented in construction and manufacturing with 13 and 12 percent, respectively. Although these results partly come from the classification utilized to distinguish essentiality within industries, there exists a clear opposing force between exposure and essential industries.

Table 2: Current Population Survey - Proportion of respondents by gender

Descriptive Statistics	Female	Male
Share (%)	47.85	52.15
Age Group (%)		
Between 18-25	12.66	12.53
Between 26-35	22.66	22.59
Between 36-45	22.99	23.24
Between 46-55	22.28	22.23
Between 56-65	19.42	19.42
Education (%)		
University degree	44.24	39.77
Job Loss due to COVID-19 (%)		
Yes	4.22	3.72
Industry (%)		
Essential	66.62	79.52
Exposure to Virus (%)		
0-20	49.20	75.79
21-40	20.95	13.78
41-60	14.09	5.55
61-80	5.14	2.47
81-100	10.62	2.41
Mean	29.71	16.80
Std.Dev.	28.33	19.60
N	**171,764**	**187,201**

Notes: The table reports the proportion of respondents by gender. The sample is drawn from CPS monthly data from May until December. Moreover, the sample is limited to the individuals whom we were able to allocate an exposure for their occupation. Observe that the mean and standard deviation of exposure are not in percentage.

4. Empirical Method

Our main hypothesis is that the *COVID-19* pandemic created differences between men and women in the labor market. To examine the effect of *COVID-19* on female employment, we will regress our response variable on gender as well as control variables:

$$Y_{i,j} = \beta_0 + \beta_1 female_{i,j} + \beta_2 X_{i,j} + \theta_j + \varepsilon_i \qquad (1)$$

Where $Y_{i,j}$ is the outcome variable *job loss due to COVID-19* for individual *i* in country *j*. The independent variable $female_{i,j}$ is binary, taking the value of 1 for female and 0 for male. The basic control variables, $X_{i,j}$ include age group and essential industry. θ_j represents the country fixed effects included only for the regressions on the Six-Country Survey.

We are interested in observing if the estimated coefficient is positive and significant for the female indicator. This will suggest that on average, there is a higher likelihood of losing a job if you are a woman compared to men.

Additionally, our second hypothesis explores if exposure to viruses explains changes in the gender gap in employment during the pandemic. Specifically, whether this is related to the profession and the amount of exposure to viruses it has.

Correspondingly, we will estimate the following specification to explore this premise.

$$Y_{i,j} = \beta_0 + \beta_1 female_{i,j} + \beta_2\, exposure\ to\ virus_{i,j} + \beta_3 X_{i,j} + \theta_j + \varepsilon_i \qquad (2)$$

This adds the explanatory variable *exposure to virus.*

As before, the coefficient and the significance of the female indicator will be examined. For this case we will make a comparison from the previous specification. If the estimated coefficient on *female* decreases compared to the first model when introducing *exposure to virus* as a control, it suggests that the gender gap decreases. This means that the gender gap in job loss due to *COVID-19* is driven by women working in professions more exposed to the virus.

We will estimate these models using ordinary least squares (OLS) regressions. Since the outcome is binary, this is a linear probability model (LPM). In the LPM, coefficients can be interpreted as a percentage point increase/decrease in the probability of the outcome, conditional on the other controls. We consider this framework ideal for the context and aim of this paper, since it will provide a straightforward and simple interpretation of the results.

This method is chosen as it is similar to the method used by Adams-Prassl et al. (2020), whose main interest was to understand the specific job characteristics of individuals that mitigate the effects of the crisis. Unlike the study done by Adams-Prassl et al. (2020), we are not only interested in knowing if the probability of losing a job due to the *COVID-19* is higher between genders. But also, we deepen the analysis to one specific country and control for more factors that can affect the job loss probability.

Even though the basic specifications are the same, there are distinct differences across data sets. To clarify, we created three different model specifications to test our first premise. Likewise, two more specifications are utilized to evaluate the second one. In the following sections, we will give the details for each model per data set.

4.1 Six-Country Survey

For the Six-Country data set, the model specifications are as follows. Model A is a basic model which only includes a binary variable for *female*.

$$Y_{i,j} = \beta_0 + \beta_1 female_{i,j} + \theta_j + \varepsilon_i \tag{3}$$

Model B adds to the basic model with the indicator for *essential industry*, and Model C in turn, adds on the *age group* indicators to see if there are any changes in the probability of losing a job as a female. Model D builds on the basic model and includes *exposure to virus*, two indicator variables for *low exposure* ($\leq$ 25 points) and *high exposure* ($\geq$ 75 points) to see if the *female* coefficient changes in comparison to Model A.

The final model, Model E, includes all of the control variables. Here as well as in the latter parts γ_i will represent *age group* indicators.

$$Y_{i,j} = \beta_0 + \beta_1 female_{i,j} + \beta_2\, essential\ industry_{i,j} + \beta_3 exposure\ to\ virus_{i,j} + \beta_4\, low\ exposure_{i,j} + \beta_5\, high\ exposure_{i,j} + \beta_6\, \gamma_i + \theta_j + \varepsilon_i \quad (4)$$

Moreover, we will include country fixed effects when we run the regression using the Six-Country data set since the main interest is to observe the average effect in the labor market for women. Also, since each country has distinct labor markets, we will carry out the previously mentioned regressions per country as well. This will allow us to see the differences among women in the labor market with respect to changes occurring within each country.

Before we perform the models for the Six-Country Survey, we test Model A (Table B.1 in Appendix) to see if there is a gender gap in employment when including all of the individuals in working age. Thus, we also include respondents that were not in employment at the time. We find that less women in the sample lost their job due to *COVID-19* compared to men. This is because most of the respondents who were not in employment and answered "No" to the lost job question were women. As a result of this and the fact that we do not have the exposure for those who were not in employment, they are excluded from here

4.2 Current Population Survey

Similar to the Six-Country Survey, we created the following model specifications for the Current Population Survey. Model F only includes the indicators for *May to August* and *female*. The main interest with Model F is the *female* coefficient because we want to see if the probability for job loss is positive or negative.

$$Y_i = \beta_0 + \beta_1 female_i + \beta_2\, may\ to\ august_i + \varepsilon_i \quad (5)$$

Model G builds on the specification, including two indicator variables for whether the industry was essential and if the individual had a university degree. This will allow us to see if the *female* coefficient changes with respect to individuals with university degree and if the industry they work in is essential. Model H adds to G with *age group* indicators and the interaction between *May to August* and *female*. This is done in order to analyze if women were more vulnerable in the labor market at a specific point in time, specifically if it was during the first months recorded by CPS.

Model I includes an indicator for *May to August* and *exposure to virus*. Additionally, we build upon the effect of exposure on job loss probability by including the two indicators for the level of exposure (high and low). For this we expect to see how this new variable (*exposure to virus*) impacts *female* and see whether exposure and job loss has a linear relationship.

Model J adds to I with indicator variables for *age groups*, *essential industry*, *university degre*e and an interaction term between *May to August* and *female*. Also, since we expect two opposing forces between the level of exposure and whether or not industries are essential, we include an interaction term among both. This is done to observe the effect on the job loss probability. Here we want to see how the female coefficient reacts when including all the control variables.

$$Y_i = \beta_0 + \beta_1 female_i + \beta_2 may\ to\ august_i + \beta_3\ essential\ industry_i + \beta_4\ university\ degree_i + \beta_5\ may\ to\ august * female_i + \beta_6\ exposure\ to\ virus_i + \beta_7\ low\ exposure_i + \beta_8 high\ exposure_i + \beta_9\ exposure * essential_i + \beta_{10}\ \gamma_i + \varepsilon_i \quad (6)$$

4.2.1 Robustness Check

We consider a reformulation of the *job loss due to COVID-19* variable crucial to avoid possible identification misspecifications, since this can lead to incorrect association to the true effect in the population. In order to inspect the validity of our inferences, we present an alternative variant of Model J.

The construction of the dependent variable was done with two variables. The first one asks whether people were unable to work during the previous four weeks because their employer closed or lost business due to the pandemic. The second one asks why the individual was unemployed. For the latter, we made use of only three categories. However there might be a different impact on the labor market as a result of *COVID-19*.[6] In this case, we are concerned with excluding specifically females whose work was negatively affected by the pandemic, but not because they were fired or laid off. Instead, they have had to quit to take care of children for instance, or sought to enter but there was no possibility due to constraints in the market. Consequently, we redefined our dependent variable by including individuals who quit their job and re-entered the labor force.

[6] Categories utilized: "Job loser-on layoff", "Other job loser" and "Temporary job ended"

5. Empirical Results and Discussion

In the following sections, we present and analyze the results obtained for the Six-Country and US data sets. We include the most important tables in the main analysis, while supporting tables can be found in the Appendix.

5.1 Six-Country Survey

The results for Model A (Table 3) show that women were around 2.7 percentage points (7.3 percent) more likely to lose their job due to *COVID-19* compared to men. The coefficient is statistically significant at the ten percent significance level. In Model B and C, we see that the female coefficient is smaller than Model A. However, it is not significantly different from Model A, as the biggest difference is half the size of the standard error. The differences between the models could be due to there being a negative relationship between *job loss due to COVID-19* and *essential industry*, but a positive relationship between *female* and *essential industry*, which can be found in the correlation matrix (Table B.2 in Appendix). Thus, women working in an essential industry may be less likely to lose their job compared to women working in a non-essential industry, causing the coefficient to decrease.

This decrease is not robust to the addition of controls and the female coefficient is not statistically significant in Model B and C. Therefore, we cannot say that the probability of women losing their job at the onset of the pandemic is higher than men for the whole population, when controlling for *essential industry* and *age groups*. This could be due to country-specific traits that are not shown. We will analyze this issue further in subsection 5.1.1, since it is crucial to distinguish between heterogeneities.

The results in Model C also indicate that working in an essential industry decreases the probability of losing a job by 4.9 percentage points. Furthermore, all of the binary variables for the age groups are negative, meaning that older workers were less likely to lose their jobs at the onset of the pandemic than the youngest age group, holding everything else constant. The results align with the findings from previous literature suggesting that the younger generation has suffered more.

Table 3: Six-Country Survey - Regression Results

Explanatory variables	Model A	Model B	Model C	Model D	Model E
Female (female = 1, others= 0)	2.7*	2.1	1.9	2.7*	2.0
	(1.5)	(1.6)	(1.6)	(1.6)	(1.6)
Essential Industry		-5.0***	-4.9***		-4.2**
		(1.8)	(1.8)		(1.8)
Age group (18 to 25)	Reference Category				
Age group (26 to 35)			-5.5**		-5.6**
			(2.8)		(2.8)
Age group (36 to 45)			-2.3		-2.3
			(2.8)		(2.8)
Age group (46 to 55)			-4.0		-4.1
			(2.8)		(2.8)
Age group (56 to 65)			-5.9*		-6.2**
			(3.0)		(3.0)
Exposure to Virus				0.2**	0.2**
				(0.1)	(0.1)
Low exposure (≤25)				5.6	5.4
				(4.0)	(4.0)
High exposure (≥75)				-19.8***	-18.1***
				(6.1)	(6.2)
Country F.E.	Yes	Yes	Yes	Yes	Yes
Constant	42.2***	46.4***	50.0***	35.2***	42.7***
	(1.9)	(2.4)	(3.2)	(4.8)	(5.5)
Observations	3,793	3,793	3,793	3,793	3,793
R-squared	0.046	0.048	0.050	0.049	0.052

Notes: The outcome variable is an indicator for whether a respondent lost their job due to Covid-19 at the onset of the pandemic. Age groups are binary variables and indicate in which category the respondents are located in. Essential industry is based upon the Delaware´s State Classification list on essential or non-essential industries. Exposure to virus is a continuous variable that measures the exposure a profession has to viruses. Additionally, to explore the effect of level of exposure, two indicator variables are included to point the lowest and highest level of exposure.

The results presented are already modified to be in percentage points.
Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Overall, the results indicate that *COVID-19* has increased the probability of women losing their job in comparison to men. However, as the results are not statistically significant for all models, we cannot say that this is true for the whole population. As Marchand and Olfert (2013) stressed, a reason for this could be that women are generally overrepresented in service industries and underrepresented in manufacturing industries, which can also be seen in Table A.3 (in Appendix). The pandemic has affected the service industry to a larger extent compared to the manufacturing industry, causing more women to lose their jobs. Alon et al. (2020) mentioned that women usually work in more stable sectors compared to men. Conversely, as some of these sectors have experienced a higher unemployment rate during the pandemic, it cannot be seen as a normal economic downturn.

In Model D, we can see that adding the controls for exposure neither changes the coefficient nor the significance on *female* from Model A. This result indicates that the *COVID-19* gender employment gap is not affected by the amount of exposure a profession has. Also, the results show that a one-point increase in exposure will increase the probability of losing a job by 0.2 percentage points. On the other hand, there is a slight negative relationship between *job loss due to COVID-19* and *exposure to virus* (Table B.2), indicating that being exposed to the virus will decrease the chances of losing a job due to *COVID-19*.

However, the indicator variable for high exposure indicates that the relationship between job loss and exposure is non-linear as those with higher than 75 points in exposure are less likely to lose their job due to *COVID-19* at a one percent significance level. Interestingly, there is a positive correlation between *female* and *high exposure*, but a negative correlation between *female* and *low exposure* (Table B.2). Meaning that women are more represented in the higher exposure category than men. This could, for instance, be due to more women working in the health care and social assistance industry and having a higher exposure to viruses than men, but remain secure as the industry is crucial.

To increase the analysis, we add all of the control variables to Model E and find that the *female* coefficient is still positive and not significantly different from Model A. Thus, we conclude that exposure is not driving the gender gap in the probability of losing a job at the beginning of the pandemic.

We also analyze Model A and E further by dividing the outcome variable into permanent and temporary job loss. We find that women in the sample were less likely to lose their jobs permanently, but more likely to lose their job temporarily (Table B.3 in Appendix). However, only the latter is significant. Women were 9.5 percent more likely to lose their jobs temporarily compared to men. Also, the results indicate that those who work in an essential industry and have high exposure are less likely to lose their jobs temporarily. The results contradict Dang and Nguyen's (2021) findings that women are 24 percent more likely to lose their job permanently than men. As mentioned earlier, similar to our study, they have used the data from the Six-Country Survey on *COVID-19*. Admittedly, the reason why we get contradicting results could be because we limit our sample by including respondents in the working age and that we have exposure for. While Dang and Nguyen (2021) include the whole sample, thus also capturing the probability of older women losing their job due to *COVID-19*.

5.1.1 Country Heterogeneity

To see if there are any differences between the six countries, we estimate Model A and E separately for each country. The complete table (Table B.4) can be found in the Appendix.

What all of the countries, except China, have in common is that they have a positive coefficient on *female*. In Japan, women were almost 40.6 percent more likely to lose their job due to *COVID-19*, and in South Korea the percentage was 34.3. For Japan as well as South Korea, the *female* coefficient is significant at the five percent level. However, when including control variables, the percentage decreases to 29.5 percent and 28.2 percent, respectively. Thus we can conclude that women in these two countries were more negatively affected by the pandemic in employment than men. The findings align with Adam-Prassl et al. (2020), as women are more likely to lose their jobs in some countries. There could be multiple reasons that would explain this result, but this is beyond the limits of this research.

Surprisingly, in China more men in the sample lost their jobs as a consequence of the pandemic. The results are not statistically significant, which means that we cannot say if this was true for the whole population. Also, we find that the older age groups had a higher probability of losing their job compared to the younger ones, which is not true for the other countries.

In Japan, South Korea and Italy, we find that working in an essential industry decreases the probability of losing a job. For the other countries, we find the opposite. As the results are not statistically significant, we cannot say if it is true for the population. This could be due to the different measures that the countries have taken. For example, in China, the UK and the US required closure of businesses or remote work for all except essential workplaces such as grocery stores and health clinics. While in Japan, there were only recommendations to close or work from home (Hale et al., 2021). Also, the differences between countries could be due to the classification used for industries since our definition is derived from the United States.

Even though we find a significant role for exposure in some countries, we can see that the relationship between job loss and exposure is non-linear as most of them show that an exposure of 75 points or higher decreases the probability of losing a job. We find the opposite for Italy and the UK, which means that people in these two countries had a higher likelihood of losing their job. However, the results are not statistically significant.

5.2 Current Population Survey

We now move onto understanding the outcomes for the United States of America, for May to December 2020. Models F and G coincide (Table 4), women are more likely to lose their job due to *COVID-19* compared to men. The results show statistical significance at one percent level. However, the magnitudes of the effects differ between 0.6 and 0.3 percentage points (16.1 and 8.0 percent), respectively. This change suggests that women are differentially likely to have a university degree and to work in an essential industry, which impacts the likelihood of job loss.

The correlation matrix (Table B.5 in Appendix) shows a negative relationship between *job loss due to COVID-19* and *university degree*, but positive with *female*. This suggests that women with a university degree are less likely to lose their job.

Holding a university degree decreases the probability of job loss for workers, since they are almost 3 percentage points (75.3 percent) less likely to be laid off. Further, it follows Adams-Prassl et al. (2020) suggestion that workers without a degree are significantly more likely to lose labor. Also, as Blossfeld et al. (1997) and Campa et al. (2011) stressed that education influences the reduction of the employment gap. This points out that education is an important characteristic.

Additionally, working in an industry considered essential decreases the probability of workers losing their job by 4 percentage points. It is worth noting that the correlation suggests that *essential industry* and *female* have a negative relationship. This could explain the decreasing coefficient on *female* in Model G. Women are less likely to work in essential industries, thus less prone to job loss. We find it particularly relevant to mention that the classification of industries could influence the behavior pattern it follows. Considering that the *Delaware Classification* list was not applicable everywhere in the United States, but was chosen due to the comprehensive nature. As shown in Table 4, these results follow the same pattern for all the model specifications that include essential industry.

Table 4: Current Population Survey - Regression Results

Explanatory Variables	Model F	Model G	Model H	Model I	Model J
Female (female = 1, others= 0)	0.6***	0.3***	-0.3***	0.8***	-0.2**
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
May to August	3.9***	3.9***	3.3***	3.9***	3.3***
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Essential Industry		-4.3***	-4.3***		-4.9***
		(0.1)	(0.1)		(0.2)
University degree		-2.8***	-2.8***		-2.7***
		(0.1)	(0.1)		(0.1)
May-August*Female			1.2***		1.2***
			(0.2)		(0.2)
Age group (18 to 25)			Reference Category		
Age group (26 to 35)			0.1		0.1
			(0.2)		(0.2)
Age group (36 to 45)			-0.5***		-0.5***
			(0.2)		(0.2)
Age group (46 to 55)			-0.4**		-0.4**
			(0.2)		(0.2)
Age group (56 to 65)			-0.4***		-0.4***
			(0.2)		(0.2)
Exposure to Virus				0.03***	-0.12
				(0.00)	(0.00)
Low exposure (≤25)				1.0***	0.6***
				(0.2)	(0.2)
High exposure (≥75)				-4.4***	-2.9***
				(0.3)	(0.3)
Exposure*Essential					0.04***
					(0.00)
Constant	2.0***	6.4***	6.7***	0.9***	6.7***
	(0.1)	(0.1)	(0.2)	(0.2)	(0.3)
Observations	358,965	358,965	358,965	358,965	358,965
R-squared	0.009	0.023	0.023	0.011	0.024

Notes: The table show the weighted regressions with linear probability for the Current Population Survey. The outcome variable is an indicator for whether a respondent lost their job due to Coronavirus pandemic during May to December 2020. An indicator for the first four months (i.e., May to August) was included to observe changes occurring during the timespan. Age groups are binary variables and indicate in which category the respondents are located. Essential industry indicator is based upon Delaware´s State Classification list on essential or non-essential industries. University degree is a binary variable that takes the value of 1 for individuals who have a university degree or more. Exposure to virus is a continuous variable that measures the exposure a profession has to viruses. Additionally, to explore the effect of level of exposure, two indicator variables are included to point the lowest and highest level. Interaction between female and the indicator variable for the first four months is added. Interaction between exposure and essential industry is also included.

The results presented are modified to be in percentage points.
Robust standard errors in parentheses
***p<0.01, **p<0.05, *p<0.1

The indicator *May to August* is consistent in all models, but there are minor differences among them.[7] The probability of losing a job due to *COVID-19* was almost 4 percentage points higher from May to August than from September to December. This finding is expected given that

[7] Model specifications H and J had the same downwards variation compared to models F, G and I.

strong social distancing measures were implemented at early stages, increasing constraints for businesses and ultimately impacting negatively on the unemployment rate.

Model H adds controls for *age group*, *education level*, *essential industry,* an indicator of *May-August* and an interaction of *May to August* and *female*. With these controls, females are 0.3 percentage points (8 percent) less likely to lose a job due to *COVID-19*. This may be due to the interaction term between *female* and *May to August*, meaning that women had a higher probability of losing their job in the early stages of the pandemic. Further, the interaction suggests that women had a higher likelihood of losing a job in the first four months by 1.2 percentage points.

As we expected, older adults are less likely to lose their job than their younger equivalents. The finding is in line with Montenovo et al. (2020), younger workers have suffered more during past economic downturns. With this result, we can observe that younger workers struggled more in the labor market during the pandemic, when compared to older ones. Even though not statistically significant, it is interesting to mention that individuals from 26 to 35 years old are more likely to lose their jobs than 18 to 25 years old. A plausible explanation for this may be that workers around this age are more likely to have childcare obligations. This, in turn, makes them more suitable to be laid off from their work or forced to quit because they cannot fulfill tasks completely.

Overall our results from models F to H coincide with Alon et al. (2020) argument, suggesting that *COVID-19* affected women more than men because the pandemic hit specific sectors, creating an atypical reaction from the economy. Since the likelihood of job loss during this period is higher for women. Moreover, the results show that individual characteristics and time are important for the probability of women losing their job. In other words, we see that women were more prone to lose their job during the first four months of the pandemic. Also, when including controls for *university degree* and *essential industry*, the likelihood of losing a job decreases.

Model I allows us to observe the effect of *exposure to virus* on the *female* coefficient. It is important to mention that all the coefficients are statistically significant at the one percent level. After adding this control, we can see that women had a 0.8 percentage point (21.5 percent) higher likelihood of losing their jobs than men. This is slightly higher than in Model F, suggesting that the level of exposure to the virus increases the probability of women's job loss. The result shows the opposite relation to the argument suggested by Mongey and Weinberg (2020), stating that women work in professions that require close contact. This implies that exposure should have an effect and the female coefficient should decrease.

When analyzing the exposure variable we see that a one percentage point increase in exposure leads to 0.03 percentage points higher probability of job loss. Upon further exploration, we observe that workers with a lower level of exposure had a one percentage point increase in job loss probability. In contrast, those with higher levels were less likely to be laid off by 4 percentage points. This shows that in Model I, there is a contradiction between the exposure at a continuous form and the indicators for the exposure level.

If we only look at exposure in continuous form, we would conclude that individuals that increase their closeness to viruses would be more prone to job loss, while those with less exposure would be secured. This would mean that industries like health care or service will have a higher likelihood of job loss. But in reality, this is only true for the service industry. Here, exposure indicators show the opposite; workers with higher exposure are secure, while workers with low exposure are more likely to lose their job. The result continues to show a discrepancy with reality, since administrative workers whose exposure to viruses is low were safer.

From the interpretation above we can point out two characteristics. First, exposure does not impact *female* in a linear form and second, there is an opposing force between the classification of essential industries and exposure. Notably, the correlation matrix shows that *female* and indicators for low and high exposure have an opposite relation. Meaning that the relation between *female* and *low exposure* is negative, while it is positive with *high exposure*. Ultimately, pointing out that females have a trend to work in highly exposed environments.

Finally, Model J follows the same patterns expressed for Model H but with minor differences in magnitude, this may be due to the inclusion of the interaction term *exposure to virus* and *essential industry*. Regarding *exposure to virus*, the coefficient is not statistically significant. Still, it shows that for a one percentage point increase in exposure, the likelihood of losing a job decreases, which is the same outcome shown by the indicators for the level of exposure.

High exposure and *low exposure* remain the same as in Model I but with a minor variation among them.

Analyzing the interaction variable between *exposure to virus* and *essential industry* shows an interesting outcome. There is a difference in the effect of an extra level of exposure for essential industries of 0.04 percentage points compared to non-essential.

To clarify the result, an additional degree of exposure when the industry is essential decreases job loss probability by -0.08 percentage points. In comparison, for non-essential the decrease is larger as it is -0.12 percentage points. This can be interpreted as when industries are essential, the effect that exposure has on job loss is lower. It is important to consider that the coefficient for exposure is not statistically significant, meaning that we can only make inferences on the coefficient of the interaction term. The interaction coefficient is statistically significant at the one percent level.

Given the above, we can determine that *exposure to virus* introduces an added probability for women to lose their jobs. We expected the female coefficient to decrease when compared to Model F, implying that differences in occupational exposure by gender explained part of the gender gap. Since we find the opposite effect, we conclude that the gender gap is not driven by the level of exposure women have.

5.2.1 Robustness Check

In Table B.6 in the Appendix we report the estimates for Model J with the reconstructed dependent variable. The results are similar to the main model but with minor variations (upwards or downwards). One interesting finding is that *exposure to virus* became statistically significant at a ten percent level, implying that for every percentage point increase in exposure, the probability of job loss is 0.13 percentage points. Which is consistent with the magnitude of the effect from the level indicators of exposure, from model specifications I and J. These results reassure us that our main findings are not driven by ignoring these other types of labor market effects.

6. Limitations of Research

The findings of this research have potential drawbacks and limitations. We consider it relevant to explain the most concerning issues for this paper.

Survey design and interpretation

The Six-Country Survey and CPS rely on answers provided by the respondent and are subject to possible misinterpretation that may lead to an incorrect review of the true effect in the population. Additionally, inaccurate survey design may introduce confusion to the respondents. For instance, Belot et al. (2020) classified individuals as "Unemployed" but answered "Yes" to job loss due to *COVID-19*. This may be due to the combination of the previous points and ultimately impacting the analysis. Meaning that we exclude unemployed individuals since they did not lose their job in theory, but in reality they did. Hence, this prevents us from capturing the full effect that *COVID-19* had on the labor market.

Another drawback is the possible incorrect allocation of *exposure to virus*, given that respondents may have answered their current profession rather than the one they lost. For instance, someone may have lost a job within some other industry, but was working at a new place when the survey was conducted and have been given the points for exposure to their existing profession instead of the job they lost due to *COVID-19*. This may lead to our study not observing the actual effect of *exposure to virus* on the job loss probability.

Data collection

Shortcomings specifically for data collected by Belot et al. (2020) impose constraints on our analysis. First, the collection was done at an early stage of the pandemic, preventing us from making associations for the future. Secondly, rapid survey implementation leads to omitting individual data that may be key to understanding job loss drivers. Previous literature has linked individual characteristics, such as education, to the probability of job loss, but we are unable to include it in the analysis for the Six-Country data set. Nevertheless, we extend our study by including a larger data set, where we control education. Third, un-accounted country-specific characteristics driving variations cannot be observed in our results, as we can only see average effects.[8] Although we partially addressed this by comparing effects between countries heterogeneities, we cannot say why differences exist.

Another possible drawback comes from a variable used in both data sets, which is *exposure to virus*. The measure of exposure (O*NET) is drawn from a general classification and is not specially targeted to *COVID-19*. Thus, the exposure points allocated to professions may not reflect the true level of exposure to *COVID-19.*

Framework

There are some limitations with the LPM method that has been used for this study. Linearity yields a relatively simple method, but can be subject to possible constraints. The model can predict probabilities that are more than one or less than zero. This may lead to the results being nonsensical. Moreover, nonlinearity of the model can be corrected by using either *Logit* or *Probit* regressions (Stock & Watson, 2015). Nonetheless, this paper considered the use of the LPM for analysis purposes more insightful. The presence of heteroscedasticity in the residuals implies biased standard errors. This was corrected when doing the estimations by using White-Huber standard errors. Finally, since Y is binary, the error terms cannot be normally distributed. Concerning the sample size for the multi-country analysis, we gathered a large enough data set, resulting in a reliable approximation when using the LPM.

[8] Such as institutions, government, momentum of the pandemic or sanitary measures implemented.

7. Conclusion

Our study attempts to understand if women and men have a different probability of losing their job due to the *COVID-19* pandemic. To do this, we used different points in time, individual characteristics and a cross-country setting.

This study finds that women and men are not equally likely to lose their jobs during *COVID-19*. On average, women have a higher likelihood of losing their job. More specifically, women have suffered more temporary job loss at the onset of the pandemic compared to men. This is true for the analysis done on a multi-country basis. Furthermore, we find that these negative effects for women are heterogeneous by country. The most notable finding is that women in Japan and South Korea have suffered job loss to a more considerable extent than the rest. Results from the CPS show the same patterns as cross-country, but we see that women in the United States were more at risk to lose their job between May to August than from September to December.

For the United States, we observe that having a university degree decreases the probability of losing a job. It seems that working in an essential industry decreases the probability of job loss for workers for the US and per country as well. Moreover, both variables affect the likelihood of women losing their job since the inclusion diminishes the probability. The differences between ages are relevant for job loss probability as people between 36 to 65 years have a decreased likelihood than younger workers. Generally, our results are consistent with previous literature findings, which makes our results reaffirm the vulnerability of women in labor during *COVID-19*.

We also add to the literature by examining how occupational exposure to viruses affects job loss and the gender employment gap. Higher exposure to viruses due to profession does not increase the probability of losing a job during *COVID-19* among genders for early stages of the pandemic, in a multi-country setting. For the US, including exposure increases the probability of job loss for women, meaning that the gender gap is not driven by women working in professions with high exposure, but rather exacerbates the gap.

For both data sets we find similar results regarding the exposure variables. We observe different impacts of the exposure indicators compared to *exposure to virus*. Low levels of exposure

(≤ 25 points) have an increased likelihood of job loss, while high levels of exposure (≥ 75 points) have the opposite effect. Since this differs from the continuous exposure variable coefficient, it suggests that the impact of exposure on job loss is in a non-linear form.

A clear example of this is that people working in the healthcare and social assistance industry have the highest exposure to diseases among industries, but have been the most crucial one during the pandemic. Meaning that the jobs within this industry are secured and also needed more than ever before. The US shows a different effect for every additional level of exposure between essential and non-essential industries. This indicates that when industries are essential, higher exposure has a lower effect on job loss probability.

7.1 Future Research

Throughout this analysis, we have found several points that deserve further research. Given the variation between countries depending on the measures introduced, we consider it interesting to observe patterns among countries. For instance, if rich countries and poor countries have commonalities that can be tied to gender repercussions. This can be done by aggregating countries with similarities in development and pandemic measures. Further, adding countries by zones may yield higher accuracy, since proximity can be an element of imposed measures.

Another suggestion is to analyze a different time period to include possible variations from indirect externalities. For example, the ramifications of the virus depended on the interconnection of countries. The US showed effects even before the virus was in the country. Countries stopped producing or manufacturing, impacting on the labor needed.

Equal gender representation among industries may provide a more in-depth insight into the actual impact women have compared to men. Therefore, our final suggestion is to use an industry that has a balanced number of men and women. This will require extensive research given that each country differs in the role women play in the labor market.

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Appendix A: Data description

Six-Country Survey

Table A.1: Official reported numbers of the spread of Covid-19

	China	Japan	Korea	Italy	UK	US
Cases	83,944	14,088	10,765	203,591	165,221	1,039,909
Deaths	4,637	415	247	27,682	26,097	60,966

Notes: This is an extract of the information provided by Belot et al. (2020) as of the third week of April 2020 (date of collection). Official sources collated by Our World in Data.

Table A.2: Six-Country Survey - Variable description

Name	Information	Values	Final Form	Purpose
Country	The survey was sent out in six countries.	1= China 2= Japan 3= South Korea 4= Italy 5= UK 6= US	Binary, taking the value of 1 for each country.	Fixed effect
Age Group	How old are you?	1 = Between 18 and 25 2 = Between 26 and 35 3 = Between 36 and 45 4 = Between 46 and 55 5 = Between 56 and 65	Binary, taking the value of 1 for each age group.	Control variable
Female	What is your gender?	0 = Male 1 = Female	Binary (0,1)	Independent variable
Exposure to Virus	What is your profession? (choose profession within industry) How often does this job require exposure to disease/infections?[9]	0 - Never 25 - Once a year or more but not every month 50 - Once a month or more but not every week 75 - Once a week or more but not everyday 100 - Everyday	Continuous scale from 0-100	Control variable
Job Loss due to COVID-19	Have you lost your job or has your activity (as self-employed) been stopped as a Consequence of the Covid-19 pandemic?	0= No 1 = Yes, permanently/Yes, temporarily	Binary (0,1)	Dependent variable
Essential Industry	Based upon Delaware´s State Classification list of essential and non-essential industries.	0 = Non-essential industry 1 = Essential industry	Binary (0,1)	Control variable

[9] Details can be found at https://www.onetonline.org/find/descriptor/result/4.C.2.c.1.b?a=1

Table A.3: Six-Country Survey - Share of industries by gender

Distribution Across Industries

	Female		Male
Accommodation and Food Services	5.58		3.76
		(15.14)	
Administrative and Support Services*	7.28		5.80
		(10.96)	
Agriculture, Forestry, Fishing and Hunting	1.86		2.49
		(10.94)	
Arts, Entertainment, and Recreation*	2.79		2.80
		(12.46)	
Construction	5.42		9.92
		(7.51)	
Educational Services*	12.97		5.49
		(26.27)	
Finance and Insurance	5.04		6.77
		(4.66)	
Government	3.23		4.48
		(21.42)	
Health Care and Social Assistance	9.74		3.92
		(59.98)	
Information	3.94		8.14
		(4.35)	
Management of Companies and Enterprises	3.67		3.20
		(4.74)	
Manufacturing	7.77		14.04
		(5.70)	
Mining, Quarrying, and Oil and Gas Extraction	0.33		0.25
		(3.45)	
Other Services (Except Public Administration)	8.54		5.14
		(19.98)	
Professional, Scientific, and Technical Services	5.42		6.87
		(8.62)	
Real Estate and Rental and Leasing*	0.99		0.61
		(7.60)	
Retail Trade*	10.29		7.48
		(19.63)	
Transportation and Warehousing	2.19		4.27
		(15.73)	
Utilities	0.16		0.76
		(14.33)	
Wholesale Trade	2.79		3.81
		(6.52)	

Notes: The table reports the proportion of respondents by industry and gender. The values should be interpreted as the proportion of female or male. (*)Correspond to the non-essential industries from the Delaware´s State Classification of industries. Additionally, we include the mean exposure per industry in parenthesis.

Table A.4: Six-Country Survey - Proportion of respondents by gender and country

Descriptive Statistics	China		Japan		South Korea		Italy		UK		US	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Share (%)	52.61	47.39	50.52	49.48	42.31	57.69	47.58	52.42	48.11	51.89	44.87	55.13
Age Group (%)												
Between 18-25	17.51	14.07	15.09	9.06	11.36	4.00	10.88	9.24	13.77	10.94	16.73	7.64
Between 26-35	19.35	25.83	27.51	16.62	28.18	18.33	26.67	21.34	25.57	20.97	24.49	30.23
Between 36-45	29.03	24.55	18.34	24.77	24.55	25.67	25.26	27.71	25.90	22.80	17.14	38.54
Between 46-55	23.50	18.93	25.44	25.98	24.55	30.33	24.56	25.48	24.59	22.80	20.82	16.61
Between 56-65	10.60	16.62	13.61	23.56	11.36	21.67	12.63	16.24	10.16	22.49	20.82	6.98
Lost Job due to Covid-19 (%)												
Yes, permanently	1.84	3.32	5.33	2.42	3.18	1.33	8.77	9.87	6.89	6.08	8.98	13.62
Yes, temporarily	39.86	42.46	17.46	12.69	30.00	22.33	42.11	35.03	33.44	34.35	35.10	30.23
No	58.29	54.22	77.22	84.89	66.82	76.33	49.12	55.10	59.67	59.57	55.92	56.15
Industry (%)												
Essential	76.50	79.80	72.78	77.95	60.00	72.67	64.21	76.11	55.08	75.99	56.73	84.05
Exposure to Virus (%)												
0-20	84.10	86.70	64.20	77.95	66.82	81.00	68.42	85.35	61.97	79.33	63.67	85.05
21-40	11.29	9.21	15.98	13.90	20.00	11.33	14.74	7.32	16.72	15.50	17.14	9.63
41-60	2.30	1.79	6.80	3.02	5.91	3.67	9.12	4.14	9.18	2.74	10.61	2.99
61-80	0.69	1.53	6.51	2.42	5.45	3.00	1.75	2.23	3.61	1.22	3.27	0.66
81-100	1.61	0.77	6.51	2.72	1.82	1.00	5.96	0.96	8.52	1.22	5.31	1.66
N	**434**	**391**	**338**	**331**	**220**	**300**	**285**	**314**	**305**	**329**	**245**	**301**

Notes: The table reports the proportion of respondents by gender and country. The values should be interpreted as the proportion from the female or male population. Also, the sample is limited to the individuals whom we were able to allocate an exposure for their occupation.

Current Population Survey

Table A.5: Current Population Survey - Variable description

Name	Information	Values	Final Form	Purpose
Month	Indicates the calendar month of the CPS interview.	5 = May 6 = June 7 = July 8 = August 9 = September 10 = October 11 = November 12 = December	Binary, taking the value of 1 for the first four months.	Control variable
Age Group	Indicates the age group the respondent is located	1 = Between 18 and 25 2 = Between 26 and 35 3 = Between 36 and 45 4 = Between 46 and 55 5 = Between 56 and 65	Binary, taking the value of 1 for each age group.	Control variable
Female	Gender of the respondent	0 = Male 1 = Female	Binary (0,1)	Independent variable
Exposure to Virus	What is your profession? (choose profession within industry) Respondents are given exposure based on the profession chosen. How often does this job require exposure to disease/infections?	0 - Never 25 - Once a year or more but not every month 50 - Once a month or more but not every week 75 - Once a week or more but not everyday 100 - Everyday	Continuous scale from 0-100	Control variable
Essential Industry	Based upon Delaware´s State Classification list of essential and non-essential industries.	0 = Non-essential industry 1 = Essential industry	Binary (0,1)	Control variable
Educational Attainment	Reports the respondent's highest level of educational attainment.	0 = No university degree 1= At least a University degree	Binary (0,1)	Control variable
Job Loss due to COVID-19	Created with the help of *whyunemp* and *covidunaw*	0 = No 1 = Yes	Binary (0,1)	Dependent variable

Name	Information	Values	Final Form	Purpose
Reason for unemployment	Specifies why respondents were unemployed during the previous week.	0 = NIU 1 = Job loser- on layoff 2 = Other job loser 3 = Temporary job ended 4 = Job leaver 5 = Re-entrant	Categorical	To create *Job Loss due to Covid-19.*
Unable to work due to covid-19 pandemic	Reports whether the respondent was unable to work during the previous four weeks because the employer closed or lost business due to Covid-19.	01 = No 02 = Yes 99 = NIU	Categorical	To create *Job Loss due to Covid-19.*
May-August Female*	Reports whether females are more prone to job loss from May to August.	N/A	Interaction	Independent variable
*Exposure*Essential*	Reports what the effect of exposure is on essential industries.	N/A	Interaction	Independent variable

Table A.6: Current Population Survey - Share of industries by gender

Distribution Across Industries	Female		Male
Accommodation and Food Services	6.88		5.66
		(16.71)	
Administrative and Support Services*	3.47		4.61
		(19.77)	
Agriculture, Forestry, Fishing and Hunting	1.03		2.44
		(16.21)	
Arts, Entertainment, and Recreation*	1.81		1.88
		(15.48)	
Construction	1.75		13.09
		(11.36)	
Educational Services*	13.9		5.28
		(22.53)	
Finance and Insurance	5.62		4.19
		(11.31)	
Government	5.4		5.54
		(23.08)	
Health Care and Social Assistance	23.31		5.62
		(53.59)	
Information	1.48		1.93
		(12.55)	
Management of Companies and Enterprises	0.06		0.05
		(14.58)	
Manufacturing	5.74		12.03
		(10.08)	
Mining, Quarrying, and Oil and Gas Extraction	0.2		1.17
		(9.67)	
Other Services (Except Public Administration)	5.24		4.06
		(23.97)	
Professional, Scientific, and Technical Services	7.32		8.74
		(16.76)	
Real Estate and Rental and Leasing*	2.03		1.79
		(10.20)	
Retail Trade*	10.31		10.51
		(13.42)	
Transportation and Warehousing	2.53		6.87
		(21.07)	
Utilities	0.44		1.5
		(17.05)	
Wholesale Trade	1.46		3.06
		(8.96)	
N	**171,764**		**187,201**

Notes: The table reports the proportion of respondents by industry and gender. The sample is drawn from CPS monthly data from May until December. The values should be interpreted as the proportion of female or male. (*)Correspond to the non-essential industries from the Delaware´s State Classification of industries. Additionally, we include the mean exposure per industry on parenthesis.

Appendix B: Additional tables

Six-Country Survey

Table B.1: Six-Country Survey - Model A, including individuals not in employment

Explanatory variables	Model A
Female (female = 1, others= 0)	-0,2
	(1.3)
Country fixed-effects	Yes
Constant	42,9***
	(1.8)
Observations	5,045
R-squared	0.041

Note: The outcome variable is an indicator for whether a respondent lost their job due to Covid-19 at the onset of the pandemic. Those who were in not employment at the time of the survey are also included in the observation sample.

The results presented are already modified to be in percentage points.
Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B.2: Six-Country Survey - Correlation matrix

Correlation Matrix	Job loss due to Covid-19	Female	Essential Industry	Exposure To Virus	Low exposure	High exposure
Job loss due to Covid-19	1					
Female	0.03	1				
Essential Industry	-0.01	0.17	1			
Exposure to Virus	-0.05	-0.14	-0.09	1		
Low exposure (≤25)	0.01	-0.17	0.09	-0.84	1	
High exposure(≥75)	-0.04	0.11	0.04	0.72	-0.42	1

Table B.3: Six-Country Survey - Model A and E divided by permanent and temporary job loss

Explanatory variables	Permanent Job Loss		Temporary Job Loss	
Female (female = 1, others= 0)	-0.3	-0.4	3.0**	2.4
	(0.8)	(0.8)	(1.5)	(1.5)
Essential Industry		-0.9		-3.3*
		(0.9)		(1.7)
Age group (18 to 25)		Reference		Reference
Age group (26 to 35)		-0.3		-5.3*
		(1.5)		(2.7)
Age group (36 to 45)		-1.5		-0.8
		(1.4)		(2.7)
Age group (46 to 55)		-4.1***		-0.1
		(1.4)		(2.7)
Age group (56 to 65)		-5.1***		-1.1
		(1.5)		(2.9)
Exposure to Virus		-0.02		0.2*
		(0.05)		(0.1)
High exposure (≥75)		-1.3		-16.8***
		(3.2)		(6.0)
Low exposure (≤25)		0.7		4.8
		(1.7)		(3.9)
Country F.E.	Yes	Yes	Yes	Yes
Constant	2.7***	5.0**	39.5***	37.7***
	(0.7)	(2.5)	(1.9)	(5.4)
Observations	3,793	3,793	3,793	3,793
R-squared	0.021	0.030	0.039	0.044

Note: The outcome variable in the first two columns is an indicator for whether a respondent lost their job permanently due to Covid-19, while the last two columns correspond to whether a respondent lost their job temporarily. Age Groups are binary variables and indicates in which category the respondents are located in. Essential industry indicator is based upon Delaware´s State Classification list on essential or non-essential industries. Exposure to virus is a continuous variable that measures the exposure a profession has to viruses. Additionally, to explore the level of exposure two indicator variables are included to point the lowest and higher levels of exposure.

The results presented are already modified to be percentage points.
Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table B.4: Six-Country Survey – Model A and E by country

Explanatory variables	China	Japan	South Korea	Italy	UK	US
Female (female = 1, others= 0)	-4.1	7.7**	9.5**	6.0	-0.1	0.2
	(3.5)	(3.0)	(4.0)	(4.1)	(3.9)	(4.3)
Constant	45.8***	15.1***	23.7***	44.9***	40.4***	43.9***
	(2.5)	(2.0)	(2.5)	(2.8)	(2.7)	(2.9)
R-squared	0.002	0.010	0.011	0.004	0.000	0.000
With Controls						
Female (female = 1, others= 0)	-4.6	5.6*	7.8*	3.8	1.4	3.1
	(3.4)	(3.1)	(4.2)	(4.3)	(4.2)	(4.8)
Essential Industry	2.0	-9.7**	-7.7	-11.9***	3.6	1.2
	(4.2)	(3.9)	(4.8)	(4.6)	(4.3)	(5.2)
Age group (18 to 25)			Reference Category			
Age group (26 to 35)	-11.0**	-14.2**	0.4	-6.4	-6.8	0.9
	(5.4)	(6.2)	(8.4)	(7.7)	(7.0)	(7.7)
Age group (36 to 45)	8.3	-16.7***	3.8	-8.8	-11.1	4.7
	(5.4)	(6.0)	(8.4)	(7.5)	(6.9)	(7.7)
Age group (46 to 55)	17.5***	-12.4**	1.9	-14.7*	-20.1***	-2.6
	(5.7)	(6.1)	(8.3)	(7.6)	(6.9)	(8.1)
Age group (56 to 65)	14.8**	-18.4***	1.5	-16.3*	-15.0**	-13.5
	(6.4)	(6.1)	(8.9)	(8.4)	(7.5)	(8.4)
Exposure to Virus	0.5***	0.2	0.6**	-0.1	-0.2	0.4
	(0.2)	(0.2)	(0.3)	(0.3)	(0.2)	(0.3)
High exposure (≥75)	-19.6	-19.3	-40.5***	17.4	13.1	-31.6*
	(17.6)	(12.1)	(14.6)	(17.1)	(14.4)	(17.2)
Low exposure (≤25)	16.2*	0.7	1.2	10.8	-1.4	13.1
	(9.6)	(8.0)	(9.9)	(11.1)	(9.4)	(11.2)
Constant	19.7***	34.3***	10.6	75.7***	53.9***	27.1*
	(6.3)	(10.8)	(14.8)	(15.0)	(12.6)	(14.6)
Observations	825	669	520	599	634	546
R-squared	0.054	0.048	0.040	0.035	0.022	0.018

Notes: The results presented are already modified to be in percentage points.
Robust standard errors in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1

Current Population Survey

Table B.5: Current Population Survey- Correlation matrix

Correlation Matrix	Job loss due to Covid-19	Female	Essential Industry	Exposure to Virus	Low exposure	High exposure	University degree
Job loss due to Covid-19	1						
Female	0.01	1					
Essential Industry	-0.08	-0.15	1				
Exposure to Virus	-0.02	0.25	0.07	1			
Low exposure (≤25)	0.00	-0.24	-0.00	-0.83	1		
High exposure(≥75)	-0.03	0.18	0.15	0.74	-0.40	1	
University degree	-0.06	0.08	-0.05	0.08	-0.08	0.08	1

Table B.6 Current Population Survey – Robustness check

Explanatory Variables	Model J
Female (female 1=1, others=0)	-0.2***
	(0.1)
May to August	3.4***
	(0.1)
May-August*Female	1.3***
	(0.2)
Essential Industry	-5.1***
	(0.2)
University degree	-2.9***
	(0.1)
Age group (18 to 25)	Reference
Age group (26 to 35)	-0.2
	(0.2)
Age group (36 to 45)	-0.9***
	(0.2)
Age group (46 to 55)	-0.8***
	(0.2)
Age group (56 to 65)	-0.9***
	(0.2)
Exposure to Virus	-0.13*
	(0.000)
Low exposure (≤25)	0.5**
	(0.2)
High exposure (≥75)	-3.1***
	(0.3)
Exposure*Essential	0.04***
	(0.000)
Constant	7.6***
	(0.3)
Observations	358,965
R-squared	0.024

Notes: The table show the weighted regressions with linear probability for the Current Population Survey. The outcome variable is an indicator for whether a respondent lost their job due to Coronavirus pandemic during May to December 2020 and also includes respondents that answered "Job leaver" or "Re-entrant" to the why unemployed question. .

The results presented are already modified to be in percentage points.
Robust standard errors in parentheses
***p<0.01, **p<0.05, *p<0.1