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The Gender Dimension of Occupational Exposure to Contagion in Europe

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ABSTRACT

This study examines the gender dimension of occupational exposure to contagious diseases spread by the respiratory or close-contact route. It shows that in Europe, women are more exposed to contagion, as they are more likely than men to work in occupations that require high levels of contact and physical proximity at work. Women are also less likely to be able to work remotely, which contributes to their increased exposure. The study finds that gender is a more important factor in workers' exposure to contagion than their education or age. This gender difference in exposure can be largely attributed to patterns of sectoral segregation and to the segregation of women within sectors into occupations that require more interpersonal interactions. Finally, results reveal heterogenous cross-country patterns in gender gaps in exposure to contagion in the workplace, with Nordic, Continental, and Baltic countries showing relatively large gender gaps to the disadvantage of women.

KEYWORDS

COVID-19, contagion, exposure to disease, gender, occupations, working from home

JEL Codes: J01, I10, J44

HIGHLIGHTS

- In Europe, gender is more important than education or age in determining workers' levels of exposure to contagion.
- Women are more exposed to contagion in the workplace than men.
- Jobs performed by women require more contact and physical proximity at work than jobs performed by men.
- The gender gap in exposure can be largely attributed to patterns of sectoral segregation.
- The gender differences are particularly large in the Nordic, Continental, and Baltic countries.

INTRODUCTION

The COVID-19 pandemic has been spreading rapidly around the world. By May 30, 2020, almost 6 million people had been infected, and 365,000 people had died (Ensheng, Hongru, and Lauren 2020). It has quickly emerged that the SARS-CoV-2 virus has profoundly different effects on men and women. Sex and gender are important drivers of both the infection risk and its outcomes. Compared to women, men are more likely to die from COVID-19 and tend to have worse clinical results (Purdie et al. 2020). These differences in outcomes may be attributable to sex-based immunological differences or to gender differences in the prevalence of comorbidities or behaviors that turn out to be risk factors for COVID-19 (Wenham, Smith, and Morgan 2020).

However, on a global basis, women are as likely as men to be infected; and in the twenty-five European countries with available data, women make up the majority (56 percent) of those infected (Global Health 50/50 2020). Among the social factors that contribute to this gender gap are gender differences in the likelihood of being engaged in workplace interactions that are critical for the spread of infectious diseases transmitted by the respiratory or close-contact route, such as COVID-19 (Mossong et al. 2008; Klepac, Kissler, and Gog 2018). Indeed, it has been shown that the cross-country differences in levels of exposure to contagion at work predict the growth in cases and the number of deaths from COVID-19 (Lewandowski 2020). Such findings clearly indicate that workplace interactions represent an important transmission channel that can influence the severity of the pandemic in various countries. However, little is known about the gender differences in levels of work-related exposure to contagion that result from gender disparities in the frequency of social contacts at work. We seek to contribute to this strand of literature by providing empirical evidence for many European countries.

Why does the intensity of social contact at work differ between men and women? The first reason is the persistence of occupational and sectoral segregation by gender. As Piotr Lewandowski (2020) has shown, the frequency of social contacts differs across occupations, with health professionals and personal service, personal care, and other service workers facing the highest levels of exposure to contagion. Women make up a majority of the workers in these occupations, with most being low-paid "essential workers" (system-relevant workers). The second reason is that because of institutional and cultural factors, there are substantial cross-country differences in levels of exposure to contagion in comparable occupations in Europe. Therefore, the gender gaps in exposure to contagion may differ across countries. If, for instance, in country A the share of women nurses is higher than the share of men nurses, or the intensity of social contacts in occupations dominated by women (for

example, sales workers) is higher than in occupations dominated by men (for example, drivers) compared to country B, this will impact the size of the gender gap in exposure. Although data on infections by occupation are scarce, there is evidence of work-related transmission of disease not only among healthcare workers but also tourism, retail, and hospitality workers, transport and security workers, and construction workers (Koh 2020). Exposure to the illness in sectors other than healthcare may be especially problematic, as these workers are unlikely to be prepared to deal with diseases and may lack access to personal protective equipment (PPE) or ability to use it properly. Consequently, in March 2020, Norway became the first country to proscribe COVID-19 as an occupational disease (Moen 2020).

The consequences of exposure to contagion at work are likely to go beyond facing immediate health risks. It is generally expected that non-pharmaceutical interventions, such as social distancing and regulatory limits on mobility and economic activity, will be in place, at least periodically, until a vaccine or a cure is developed (Kissler et al. 2020). Existing evidence from real-time data shows that the COVID-19 crisis has exacerbated preexisting inequalities in labor markets and affected women's employment outcomes to a larger extent than those of men. It strongly affected the sectors dominated by women that require a lot of social contacts, but also because within industries women were more likely to lose jobs (Adams-Prassl et al. 2020). Thus, exposure to contagion at work can lead to increased stress, uncertainty, risk of joblessness, and economic hardship.

We aim to contribute to the current knowledge on the gendered dimension of the COVID-19 pandemic in four ways. First, we examine whether there is a gender gap in levels of exposure to contagion due to differences in patterns of workplace interactions. Second, we explore cross-country differences in the size of the gender gap in exposure to contagion. Third, we investigate which factors, related to the organization and location of work as well as to physical proximity and work-related social contacts, contribute to this gender gap. Fourth, we assess whether occupational and sectoral segregation by gender influence the gender gap in exposure to contagion. Our study adds to the economic literature on the gender dimension of the pandemic with an occupational and workplace perspective and links it to the risk of disease contagion. The studies on gender inequality in the context of COVID-19 have so far focused on gendered differences in the risk of job loss and the household division of work and care (Adams-Prassl et al. 2020; Alon et al. 2020).

We find that in Europe women are more exposed to contagion in the workplace than men. Compared to men, women are more likely to work in jobs that, almost by definition, are more exposed, such as jobs in health and care, and they are more likely to be employed in

personal services, which require frequent interpersonal interactions. In twenty-three out of twenty-eight European countries we study, we observe that women are overrepresented in occupations that are highly exposed to contagion. There are substantial cross-country differences in the average occupational exposure to contagion in European countries, with workers in Central Eastern European countries being the least exposed and workers in Southern European countries being the most exposed. However, the size of the gender gap in exposure is not related to the average exposure in a country. Countries with a large gender gap in exposure levels (above 10 percentage points) include countries with high overall levels of workplace exposure to contagion, such as Germany, the Netherlands, or the United Kingdom, as well as countries with low overall exposure levels, such as Latvia and Lithuania. We show that women workers are disproportionately likely to be exposed to contagion largely because women are more likely than men to work in sectors that require contact with diseases, frequent contact with clients, and high levels of physical proximity at work. Women are also less likely than men to be able to work from home, even though they perform more unpaid care and household work. Consequently, we find that gender is a more important factor than education or age in determining workers' levels of exposure to contagion. We show that this gender gap can be largely attributed to patterns of sectoral segregation and to the segregation of women within sectors into occupations that require more interpersonal interactions.

METHODOLOGY AND DATA

In order to measure the occupational exposure to contagious diseases, we use the index proposed by Lewandowski (2020), based on the most recent Occupation Information Network (O*NET Resource Center 2018) and the 2015 European Working Conditions Survey (EWCS; 2020) data. The O*NET database provides detailed and periodically updated descriptions of the specific work activities and job demands associated with each occupation. Although the O*NET data are available only for the United States and are based on expert assessments or small survey samples, they are often applied to European countries as well. The EWCS data include broader definitions of occupations (two-digit ISCO-08 codes), but are collected in a large number of European countries. Hence, they allow for the measurement of cross-country differences in the nature of work in comparable occupations.

The index we use here is based on six variables that measure critical factors in the spread of infectious diseases transmitted by the respiratory or close-contact route: that is, social contacts, the mixing patterns of people in the workplace, and occupational hazards related to contact with disease. These variables are (1) occupational exposure to disease or

infections (O*NET); (2) physical proximity at work (O*NET); (3) dealing with clients, pupils, or patients at least around half of the time (EWCS); (4) working in public spaces at least several times a month (EWCS); (5) working at clients' premises at least several times a month (EWCS); and (6) not working from home or working from home no more than a few times a year (EWCS). Each indicator, E^k_{ic}, as well as the synthetic index calculated as their average, ETC_{ic}, are measured at the level of occupation i and country c. They range from 0 to 1, with higher values indicating higher levels of exposure. Next, we merge the index of occupational exposure to contagion with the worker-level European Union Labour Force Survey (EU LFS; Eurostat 2018) data that provide the most accurate estimates of occupational structures in European countries. Our final sample includes twenty-seven countries for which reliable EWCS and LFS data are available.

We define workers who are highly exposed to infectious diseases, $HETC_c$, as workers in occupations and countries in which the value of ETC_{ic} is above the European median (calculated with standardized weights that give every country the same total weight).

In order to analyze the differences between women and men in levels of exposure to contagion and in the probability of working in a highly exposed occupation, we estimate linear OLS (1 and 2) and logistic (3) regressions:

$$E^k_{jic} = \beta_0 + \beta_1 X_j + \lambda_r + \gamma_s + \varepsilon_{ijc} \quad (1)$$

$$ETC_{jic} = \beta_0 + \beta_1 X_j + \lambda_r + \gamma_s + \varepsilon_{ijc} \quad (2)$$

$$\Pr(HETC_{jic} = 1) = F(\beta_0 + \beta_1 X_j + \lambda_r + \gamma_s + \varepsilon_{ijc}) \quad (3)$$

where $F(Z) = \frac{e^Z}{1+e^Z}$, j stands for individual, i for occupation, and c for country; X_j is a vector of personal and workplace characteristics (sex, age, education, migrant status, contract type, and firm size); and λ_r are fixed effects pertaining to twenty-seven European countries (Iceland, Norway, UK, and EU-27, excluding Greece, Malta, and Cyprus, for which occupational data in the EWCS are unreliable). Finally, γ_s stands for sector fixed effects (twenty-one NACE sectors). We estimate two variants of models (1)–(3). In the first variant, we do not control for sector fixed effects, but we add these effects in the second variant, along with their interaction with gender. This allows us to assess to what extent the effects associated with gender are related to sectoral segregation.

Next, we use the coefficients estimated in models (1) and (2) to decompose the variance of each dependent variable, e_{jic}, into the contributions of particular individual, job, and regional characteristics. In particular, the decomposition allows us to evaluate the contributions of gender differences to the overall differences in workers' levels of exposure to contagion, as well as to assess the role sectoral segregation by gender plays in these gender gaps. We use the covariance-based decomposition

proposed by Morduch and Sicular (2002). Formally, the contribution of a variable, x, to the cross-country variance of e_{jic} is defined as follows:

$$\sigma_{x\, e_{jic},} = \frac{cov(\beta_x x_{jic},\ e_{jic})}{var(\ e_{jic})} \tag{4}$$

RESULTS

Descriptive results

In Europe, women are more likely than men to work in occupations that are more exposed to contagion. Among the five occupations that are most exposed to contagion in Europe, four are dominated by women (Figure 1). These occupations are either directly involved in health- or personal care (health professionals, associate health professionals, personal care workers) or in services that inherently require social contacts (personal services

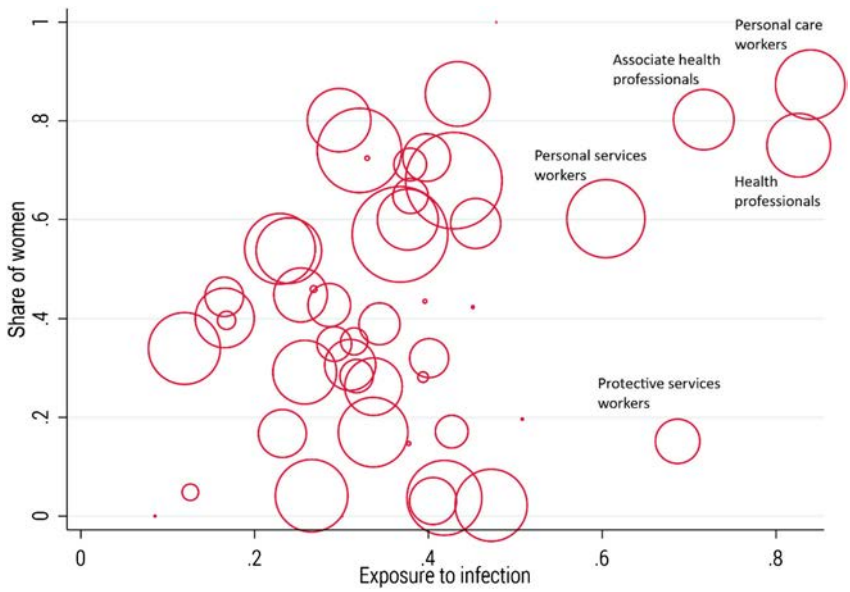

Figure 1 Differences in levels of exposure to contagion across two-digit ISCO occupations in Europe.
Notes: The bubble size indicates the average share of a given occupation in total employment in our sample of twenty-eght European countries, calculated with standardized weights. Exposure to infection is measured with the synthetic index ETC_{ic} presented in the methodology section. Sample size is 1,457,381.
Sources: Own calculations on the basis of EU LFS, EWCS, and O*NET data.

workers). Only one of the occupations that have the highest levels of exposure (protective services workers) is dominated by men. By contrast, occupations with low levels of exposure to contagion – such as agricultural workers, plant and machine operators, assemblers, as well as information and communications technology professionals – are usually dominated by men (Figure 1).

There are noticeable cross-country differences in the shares of jobs that are highly exposed to contagion. The shares of highly exposed workers are largest in Southern European countries, France, and the UK, while they are smallest in the Central and Eastern European countries (Lewandowski 2020). Importantly, in the vast majority of countries (twenty-three out of twenty-eight), the shares of highly exposed workers are larger among women than among men (on average, by 7.8 percentage points). These gender differences are particularly large in the Nordic countries, Germany, Belgium, and the Netherlands, as well as in Latvia and Lithuania where they exceed 12 percentage points. The shares of highly exposed workers are larger for men than for women (on average, by 2.7 percentage points) in only five of the countries studied (Austria, Croatia, Hungary, Italy, and Romania; see Figure 2).

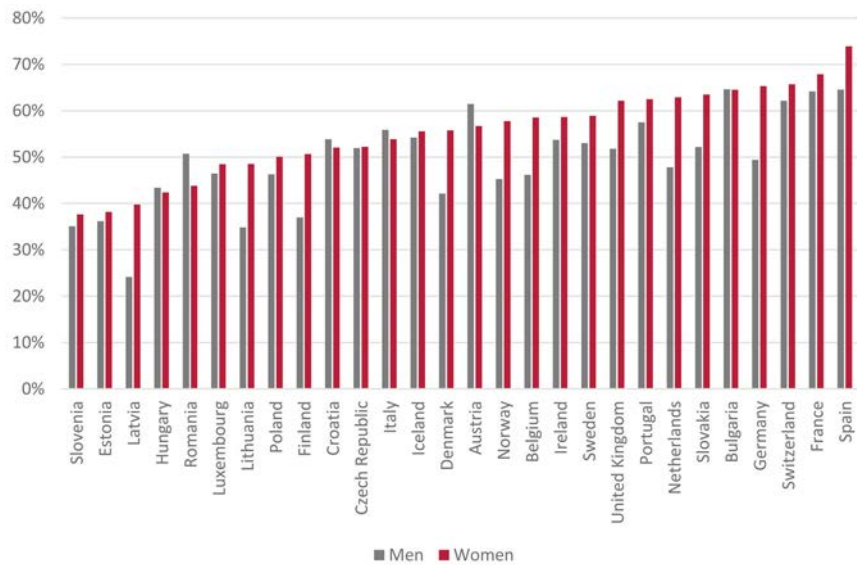

Figure 2 The share of workers highly exposed to contagion in Europe, by gender.
Notes: Countries are sorted by the share of women workers who are highly exposed to contagion at work, as measured by index $HETC_c$, presented in the methodology section.
Sources: Own calculations on the basis of EU LFS, EWCS, and O*NET data.

Econometric results

In order to quantify the gender gaps in the exposure to contagion, we use estimated models 1–3 to calculate marginal effects pertaining to gender, as well as age-specific and education-specific marginal effects pertaining to gender, presented in Table 1. We complement them with marginal effects pertaining to particular variables and interactions, presented in Table A1 in the Supplemental Online Appendix.

Probability of working in a highly exposed occupation

Our econometric results show that women workers face higher probability to work in highly exposed occupations (by almost 7 percentage points compared to men; column 1 of Table 1). However, these gender differences in levels of occupational exposure to contagion are largely driven by patterns of sectoral segregation, that is, by women being more likely than men to work in certain sectors of the economy, such as health, care, education, and hospitality (Weichselbaumer and Winter-Ebmer 2005; Borrowman and Klasen 2020). When we control for the economic sector in which an individual works, the overall effect of sex is not statistically significant (column 2 of Table 1).

Women appear to be more likely than men to work in highly exposed occupations in all age groups, but this again is partly explained by sectoral segregation. Still, among younger women (ages 15–24) the probability of working in a highly exposed occupation is significantly higher than among younger men, even after controlling for sectoral segregation.[1] This is mainly because younger women tend to work in environments that require close proximity, and they are more likely than men to interact with clients, pupils, or patients. Interestingly, women of all ages are more exposed to contagion than men, but this again reflects a strong sectoral segregation pattern. Adjusting for sectoral segregation, we find that women ages 35 and older are not more likely to work in a highly exposed occupations and are, in fact, less exposed on average. While women with at least secondary education are more likely to work in highly exposed occupations, this effect becomes insignificant after adjusting for sectoral segregation (columns 1–2 of Table 1). In fact, once the sectoral segregation is adjusted for, the effects are similar for men and women regardless of their educational attainment, with a small gap arising only for women with the lowest levels of education who are less exposed to contagion (column 4 of Table 1).

Dimensions of occupational exposure to contagion

In order to examine factors behind the gender gap in occupational exposure to contagion, we investigate which dimensions of work that

Table 1 Selected marginal effects on probability of working in a highly exposed occupation (column 1–2) and occupational exposure to contagion index (column 3–4) with its components (columns 5–16)

	Probability of working in an occupation highly exposed to contagion		*Occupational exposure to contagion*		*Exposure to disease or infections*		*Physical proximity at work*		*Dealing with clients, pupils, or patients*		*Working at clients' premises*		*Working in public spaces*		*Unable to work from home*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*
Women	0.068***	− 0.005	0.046***	− 0.003	0.110***	0.024***	0.074***	− 0.003	0.104***	0.040***	− 0.081***	− 0.062***	− 0.018***	− 0.023***	0.007	0.011***
	(0.019)	(0.015)	(0.007)	(0.004)	(0.011)	(0.004)	(0.010)	(0.005)	(0.008)	(0.006)	(0.009)	(0.007)	(0.006)	(0.004)	(0.005)	(0.003)
	Age-specific marginal effects for women															
15–24	0.156***	0.069***	0.071***	0.020***	0.111***	0.039***	0.107***	0.031***	0.148***	0.080***	− 0.080***	− 0.062***	0.001	− 0.011**	0.017***	0.009**
	(0.019)	(0.016)	(0.008)	(0.005)	(0.015)	(0.007)	(0.011)	(0.007)	(0.008)	(0.007)	(0.011)	(0.008)	(0.007)	(0.006)	(0.005)	(0.004)
25–34	0.093***	0.018	0.052***	0.006	0.102***	0.025***	0.079***	0.008	0.112***	0.053***	− 0.073***	− 0.057***	− 0.008	− 0.013***	0.008*	0.007**
	(0.018)	(0.014)	(0.007)	(0.004)	(0.011)	(0.004)	(0.010)	(0.005)	(0.008)	(0.006)	(0.008)	(0.006)	(0.006)	(0.004)	(0.005)	(0.003)
35–44	0.047**	− 0.015	0.037***	− 0.007*	0.101***	0.020***	0.063***	− 0.007	0.097***	0.038***	− 0.086***	− 0.066***	− 0.021***	− 0.024***	0.006	0.012***
	(0.020)	(0.016)	(0.007)	(0.004)	(0.011)	(0.004)	(0.010)	(0.006)	(0.009)	(0.006)	(0.010)	(0.007)	(0.006)	(0.005)	(0.005)	(0.004)
45–54	0.047**	− 0.026	0.041***	− 0.011***	0.116***	0.022***	0.070***	− 0.012**	0.095***	0.028***	− 0.086***	− 0.066***	− 0.025***	− 0.029***	0.006	0.012***
	(0.021)	(0.017)	(0.007)	(0.004)	(0.012)	(0.004)	(0.011)	(0.006)	(0.009)	(0.007)	(0.010)	(0.007)	(0.006)	(0.005)	(0.005)	(0.004)
55–64	0.051**	− 0.028	0.046***	− 0.011**	0.127***	0.025***	0.072***	− 0.017**	0.095***	0.021***	− 0.076***	− 0.059***	− 0.025***	− 0.030***	0.004	0.012***
	(0.023)	(0.017)	(0.008)	(0.004)	(0.013)	(0.005)	(0.013)	(0.007)	(0.009)	(0.007)	(0.010)	(0.008)	(0.006)	(0.005)	(0.006)	(0.005)

(*Continued*).

Table 1 Continued.

	Probability of working in an occupation highly exposed to contagion		*Occupational exposure to contagion*		*Exposure to disease or infections*		*Physical proximity at work*		*Dealing with clients, pupils, or patients*		*Working at clients' premises*		*Working in public spaces*		*Unable to work from home*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*
	Education-specific marginal effects for women															
Primary or less	0.090	0.020	0.024	− 0.031**	0.153***	0.042***	− 0.012	− 0.089***	0.021	− 0.017	− 0.060	− 0.056	− 0.016	− 0.024	0.015	0.013
	(0.065)	(0.052)	(0.020)	(0.015)	(0.031)	(0.016)	(0.039)	(0.034)	(0.032)	(0.026)	(0.054)	(0.042)	(0.019)	(0.022)	(0.012)	(0.010)
Lower secondary	0.031	− 0.046*	0.036***	− 0.014*	0.128***	0.042***	0.047***	− 0.029**	0.064***	0.007	− 0.084***	− 0.067***	− 0.014	− 0.024***	0.013*	0.011
	(0.029)	(0.025)	(0.011)	(0.007)	(0.017)	(0.009)	(0.018)	(0.013)	(0.014)	(0.011)	(0.017)	(0.013)	(0.009)	(0.008)	(0.008)	(0.007)
Secondary	0.076***	− 0.009	0.048***	− 0.004	0.118***	0.031***	0.073***	− 0.008	0.128***	0.057***	− 0.097***	− 0.078***	− 0.021***	− 0.029***	0.006	0.008*
	(0.026)	(0.021)	(0.009)	(0.006)	(0.015)	(0.006)	(0.013)	(0.008)	(0.012)	(0.009)	(0.013)	(0.010)	(0.008)	(0.006)	(0.005)	(0.004)
College or higher	0.066***	0.012	0.048***	0.003	0.091***	0.008	0.089***	0.017***	0.091***	0.032***	− 0.060***	− 0.041***	− 0.015***	− 0.015***	0.006	0.014***
	(0.019)	(0.012)	(0.007)	(0.004)	(0.012)	(0.006)	(0.011)	(0.006)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.008)	(0.005)
Sector controls	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
Observations	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652	1,473,652

Notes: The coefficients estimated in pooled regressions are estimated in a worker-level model with standardized weights that give each country equal importance. All models include controls for gender, age, education, firm size, contract type, country, and migrant status. Reference groups: men, ages 35–44, lower secondary education, firm size up to ten workers, permanent contract, native worker, Germany, wholesale and retail trade. Standard errors clustered at country by occupation level. The marginal effects were computed following the method of marginal standardization. Marginal effects for interactions measure the influence of gender on respondent's education, and age, respectively. ***, **, * denote statistical significance at the 1, 5, and 10 percent levels, respectively.
Sources: Own estimation based on EU LFS, EWCS, and O*NET data.

determine levels of occupational exposure to contagion (namely, exposure to diseases or infections; physical proximity at work; dealing with clients, pupils, or patients; working in public spaces; working at clients' premises; not being able to work from home) are behind the significantly higher levels of exposure to contagion among women workers.

We find that compared to men, women are significantly more exposed to diseases and infections (column 5 of Table 1); have significantly higher levels of physical proximity at work (column 7 of Table 1); and are more likely to be dealing with clients, pupils, or patients (column 9 of Table 1). Only some of these effects are attributable to sectoral segregation: in the case of physical proximity, the effect of gender is insignificant when we control for sectors (column 8 of Table 1). Yet, even adjusting for sectoral segregation, women are more likely to interact with clients, pupils, and patients and are more exposed to infections (columns 10 and 6 of Table 1, respectively).

There are also important differences in the particular dimensions of occupational exposure among various age groups. While the higher risk of exposure to diseases and infections and the higher probability of dealing with clients and patients concerns women of all ages, the higher risk associated with higher proximity at work concerns young women only (columns 7–8 of Table 1). Women of all ages are less likely to work at client's premises and in public spaces.

Importantly, we find that women are more likely to be unable to work from home (compared to men). The gender gap in the ability to work from home is significant, especially if we control for sectoral segregation (column 16 of Table 1). This means that although women more often work in sectors conducive to working from home (for example, services), they are more likely to be unable to work from home due to the occupational segmentation within particular sectors. This effect is particularly pronounced for women over age 35, who during pandemic lockdowns are expected to juggle work and family by working from home while also bearing most of the burden of unpaid household chores and care work, which during the pandemic often includes homeschooling children (Sayer 2005; Gausman and Langer 2020). It is also particularly large for women with college or higher education.

We also find some workplace-related factors that mediate the gender gap in the exposure to contagion. First, women are less likely than men to be working at clients' premises (columns 11–12 of Table 1). Second, women are less likely than men to work in public spaces (columns 13–14 of Table 1). These differences are the most pronounced among women with lower secondary or secondary education and again can be partly attributed to occupational segregation.

We also find some differences between countries (see Table A1 in the Online Appendix). Compared to Germany (our reference country),

workers in Nordic, Southern, and Continental European countries exhibit significantly higher incidence of working in public spaces and of dealing with clients, pupils, or patients, which are both risk factors for exposure to contagion. Workers in Central and Eastern European countries have significantly lower incidence of dealing with clients and of working at clients' premises, which reduced the exposure in these countries. Finally, there are noticeable differences in the incidence of not being able to work from home: it is significantly lower among workers in Continental Europe (for example, Austria, Belgium, France, Netherlands) and Nordic countries, and it is significantly higher among workers in some Central and Eastern European countries (for example, Bulgaria and Slovakia). These differences can be mainly attributed to countries' development level and internet access of households *(*Hatayama, Viollaz, and Winkler 2020*)*.

Variance decomposition

Next, we discuss the results of variance decompositions that allow us to assess the economic significance of gender and other individual and workplace characteristics for the observed differences in levels of exposure to contagion among European workers. We find that gender plays a key role. The contribution of gender to the total variance of exposure to contagion (columns 1–2 of Table 2) is greater than that of other individual characteristics. It is also true in the case of several dimensions of this exposure – namely, levels of exposure to infections (columns 3–4 of Table 2), dealing with clients (columns 7–8 of Table 2), and working at clients' premises (columns 9–10 of Table 2). The contribution of gender to the differences in levels of physical proximity at work is also noticeable and comparable to the contribution of educations (columns 5–6 of Table 2). In the case of exposure to disease or infections and in working at clients' premises, these contributions are partly driven by sectoral segregation. Of the sectors, human health and social work activities account for most of the variance of exposure to contagion and of its abovementioned dimensions.[2] In other words, it is the fact that women are much more likely than men to work in the sectors of the economy associated with human health and social work that drives women's higher risk of exposure to infections.

Finally, we find that the contribution of gender to the differences in working from home and to differences in the frequency of working in public spaces is tiny. In the case of working from home, education has the largest contribution among the individual characteristics. In the case of working in public spaces, most of the differences are attributable to differences between countries (discussed earlier), rather than to personal or workplace characteristics.

Table 2 Results of variance decomposition of the occupational exposure to contagion index (columns 1–2) and its components (in percentage of total variance)

	Occupational exposure to contagion		*Exposure to disease or infections*		*Physical proximity at work*		*Dealing with clients, pupils, or patients*		*Working at clients' premises*		*Working in public spaces*		*Unable to work from home*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*
Women	1.99	3.04	5.59	4.77	2.03	3.40	5.57	5.56	4.15	2.95	0.44	0.50	0.02	0.58
Education	0.46	0.51	0.01	− 0.02	3.25	3.21	4.92	2.99	0.07	0.08	0.16	0.11	12.77	9.94
Age group	0.1	0.08	0.07	0.01	0.41	0.33	0.1	0.03	0.21	0.14	− 0.01	− 0.02	0.47	0.43
Other workplace factors	0.19	0.11	0.24	0.09	0.36	0.28	0.53	0.33	0.1	0.05	0.10	0.04	0.18	0.17
Migrant	0.01	0.01	0.01	0.02	0	0	0.13	0.09	0.11	0.05	− 0.02	− 0.06	0.17	0.11
Country	5.48	3.54	1.7	0.62	1.74	1.00	8.92	7.09	8.11	7.63	9.14	8.43	11.86	11.68
Sector	–	30.92	-	38.83	-	27.81	-	26.32	-	18.8	-	9.77	-	17.33
Share of variance explained	8.24	38.21	7.62	44.31	7.79	36.04	20.16	42.41	12.73	29.7	9.8	18.77	25.46	40.24

Notes: Variance decomposition calculated in line with equation (5) based on the estimation results presented in Table 1. All models include controls for gender, age, education, firm size, contract type, country, migrant status. Reference groups: men, ages 34–45, lower secondary education, firm size up to ten workers, permanent contract, native worker, Germany, wholesale and retail trade.

Sources: Own estimation based on EU LFS, EWCS, and O*NET data.

DISCUSSION AND CONCLUSIONS

We have shown that in Europe women are more likely than men to work in occupations that are more exposed to the risk of being infected by contagious diseases spread by the respiratory or close-contact route. This is primarily because women are more likely than men to be employed in sectors that require contact with diseases, frequent contact with large numbers of people, and high levels of physical proximity at work, such as health, care, education, and hospitality. On average, women account for 73 percent of workers in these sectors in European countries. We also found that across all sectors of the economy, women are more likely than men to be employed in occupations that require workers to deal frequently with clients, pupils, or patients. Moreover, women are more likely than men to be unable to work from home, even though they spend more time on unpaid care and household work. However, certain workplace-related factors narrow the gender gap in levels of exposure to contagion: compared to men, women are less likely to work at clients' premises or to work in public spaces. In general, we find that gender is a more important factor in workers' levels of exposure to contagion than their education or age.

We have also found that younger workers are generally more exposed to contagion than prime-aged workers. This is especially true for younger women. Workers ages 15–24 are likely to work in most exposed occupations: they make up 19 percent of sales workers, 18 percent of personal service workers, and 13 percent of personal care workers, while they constitute 8.6 percent of all workers in European countries in our sample.

We have also shown that the gender gaps in the exposure to contagion in the workplace have heterogenous cross-country patterns. In the vast majority of countries, the shares of highly exposed workers are larger among women than among men. The Nordic countries, the Continental countries (for example, Germany, Belgium, and the Netherlands), and the Baltic countries have relatively large gender gaps in exposure levels to the disadvantage of women, but the shares of highly exposed workers in these countries are slightly larger for men. Large gender gaps in exposure in countries traditionally associated with gender equity, such as the Nordic countries, are related to the fact that high employment rates of women in these countries are associated with especially large employment of women in jobs that require a lot of social contacts, such as those in health, care, and services sectors. The shares of highly exposed workers are slightly larger among men than among women in only a handful of countries (for example, Austria, Hungary, and Italy). However, we have shown that most of these differences can be attributed to gendered differences in occupational structures and sectoral

segregation. Only in some Central and Eastern European countries, exposure to contagion is significantly lower across the occupational distribution, which can be related lower complexity of these economies (Lewandowski 2020).

To sum up, we find that while there are several individual-, workplace-, and country-level characteristics that influence workers' levels of exposure to contagious diseases such as COVID-19, workers' gender appears to be the one with the greatest impact.

Our results have important policy and research implications. Women are disadvantaged by their greater exposure to diseases in the workplace. Indeed, women make up the majority of people who are infected with COVID-19, although they are less likely than men to die from it. This adds to the list of women's disadvantages in pandemic conditions, which already include the unequal division of home production, care, and educational duties. Any labor market policies aimed at lowering the risks of contagion in the workplace should take the gender dimension into account. Social partners – both trade unions and employers' associations – have a key role to play in this respect, with a pressing need to have more women engaged in collective bargaining where they have been underrepresented so far. The gender lens could be applied to design more effective pandemic-related health and workplace safety policies, including those focused on the risk of workplace contagion. However, more research is needed on the consequences of women's greater workplace exposure to contagion for their labor market and health outcomes, both in the short- and long-term. We also see a need for studies on cultural factors, gender norms, and gender roles that might affect differences in women's and men's vulnerability to infection exposure.

Our paper has its limitations. First, the available data do not allow verifying if there are differences in the exposure to contagion within narrowly defined, finely disaggregated occupations. Second, we quantify the pre-lockdown world. The exposure to contagion changed as lockdowns were introduced in European countries, and it is possible that it has not returned to the pre-pandemic period. To this end, the ongoing labor force surveys could be adapted to measure post-lockdown contagion exposure and understand the related gender differences.

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NOTES

[1] Men ages 15–24 also exhibit higher exposure to contagion than prime-aged men, see Table A1 in the Online Appendix.
[2] The results for particular sectors are available upon request.

SUPPLEMENTAL DATA

Supplemental data for this article can be accessed at https://doi.org/10.1080/13545701.2021.1880016.

REFERENCES

Adams-Prassl, Abi, Teodora Boneva, Marta Golin, and Christopher Rauh. 2020. "Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys." *Journal of Public Economics* 189: 104245.

Alon, Titan, Matthias Doepke, Jane Olmstead-Rumsey, and Michèle Tertilt. 2020. "The Impact of COVID-19 on Gender Equality." Working Paper 26947, National Bureau of Economic Research.

Borrowman, Mary and Stephan Klasen. 2020. "Drivers of Gendered Sectoral and Occupational Segregation in Developing Countries." *Feminist Economics* 26(2): 62–94.

Dong, Ensheng, Du Hongru, and Gardner Lauren. 2020. "An Interactive Web-Based Dashboard to Track COVID-19 in Real Time." *Lancet Infectous Diseases* 20(5): 533–4.

EuroStat. 2018. "European Union Labour Force Survey (EU LFS)." https://ec.europa.eu/eurostat/web/microdata/european-union-labour-force-survey.

European Foundation for the Improvement of Living and Working Conditions (EWCS). 2020. "European Working Conditions Survey Integrated Data File, 1991–2015." UK Data Service. http://doi.org/10.5255/UKDA-SN-7363-8.

Gausman, Jewel and Ana Langer. 2020. "Sex and Gender Disparities in the COVID-19 Pandemic." *Journal of Women's Health* 29(4): 465–6.

Global Health 50/50. 2020. "The COVID-19 Sex-Disaggregated Data Tracker." https://globalhealth5050.org/the-sex-gender-and-covid-19-project/.

Hatayama, Maho, Mariana Viollaz, and Hernan Winkler. 2020. "Jobs' Amenability to Working from Home: Evidence from Skills Surveys for 53 Countries." Policy Research Working Paper, World Bank.

Kissler, Stephen M., Christine Tedijanto, Edward Goldstein, Yonatan H. Grad, and Marc Lipsitch. 2020. "Projecting the Transmission Dynamics of SARS-CoV-2 through the Postpandemic Period." *Science* 368(6493): 860–8.

Klepac, Petra, Stephen Kissler, and Julia Gog. 2018. "Contagion! The BBC Four Pandemic – The Model Behind the Documentary." *Epidemics* 24: 49–59.

Koh, David. 2020. "Occupational Risks for COVID-19 Infection." *Occupational Medicine* 70(1): 3–5.

Lewandowski, Piotr. 2020. "Occupational Exposure to Contagion and the Spread of COVID-19 in Europe." IBS Working Paper, Instytut Badan Strukturalnych.

Moen, Bente E. 2020. "COVID-19 Should Be Recognized as an Occupational Disease Worldwide." *Occupational Medicine* 70(5): 299.

Morduch, Jonathan and Terry Sicular. 2002. "Rethinking Inequality Decomposition, with Evidence from Rural China." *The Economic Journal* 112(476): 93–106.

Mossong, Joël, Niel Hens, Mark Jit, Philippe Beutels, Kari Auranen, Rafael Mikolajczyk, Marco Massari, et al. 2008. "Social Contacts and Mixing Patterns Relevant to the Spread of Infectious Diseases." *PLOS Medicine* 5(3): e74.

O*NET Resource Center. 2018. "O*NET Database." https://www.onetcenter.org/database.html*overview.

Purdie, Anna, Sarah Hawkes, Kent Buse, Kristine Onarheim, Wafa Aftab, Nicola Low, and Sonja Tanaka. 2020. "Sex, Gender and COVID-19: Disaggregated Data and Health Disparities." *BMJ Global Health Blog*, March 24.

Sayer, Liana C. 2005. "Gender, Time and Inequality: Trends in Women's and Men's Paid Work, Unpaid Work and Free Time." *Social Forces* 84(1): 285–303.

Weichselbaumer, Doris and Rudolf Winter-Ebmer. 2005. "A Meta-Analysis of the International Gender Wage Gap." *Journal of Economic Surveys* 19(3): 479–511.

Wenham, Clare, Julia Smith, and Rosemary Morgan. 2020. "COVID-19: The Gendered Impacts of the Outbreak." *Lancet* 395(10227): 846–8.