

DISCUSSION PAPER SERIES

IZA DP No. 13801

**How Does the COVID-19 Crisis Affect  
Labor Demand? An Analysis Using Job  
Board Data From Austria**

Omar Bamieh  
Lennart Ziegler

OCTOBER 2020

## DISCUSSION PAPER SERIES

IZA DP No. 13801

# How Does the COVID-19 Crisis Affect Labor Demand? An Analysis Using Job Board Data From Austria

**Omar Bamieh**

*University of Vienna*

**Lennart Ziegler**

*University of Vienna and IZA*

OCTOBER 2020

Any opinions expressed in this paper are those of the author(s) and not those of IZA. Research published in this series may include views on policy, but IZA takes no institutional policy positions. The IZA research network is committed to the IZA Guiding Principles of Research Integrity.

The IZA Institute of Labor Economics is an independent economic research institute that conducts research in labor economics and offers evidence-based policy advice on labor market issues. Supported by the Deutsche Post Foundation, IZA runs the world's largest network of economists, whose research aims to provide answers to the global labor market challenges of our time. Our key objective is to build bridges between academic research, policymakers and society.

IZA Discussion Papers often represent preliminary work and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be available directly from the author.

ISSN: 2365-9793

**IZA – Institute of Labor Economics**

Schaumburg-Lippe-Straße 5–9  
53113 Bonn, Germany

Phone: +49-228-3894-0  
Email: [publications@iza.org](mailto:publications@iza.org)

[www.iza.org](http://www.iza.org)

## ABSTRACT

---

# How Does the COVID-19 Crisis Affect Labor Demand? An Analysis Using Job Board Data From Austria\*

This study uses data from the largest Austrian job board to examine labor-demand responses in the first months after the start of the COVID lockdown in March 2020. Our analysis shows that the number of job postings declined by a third and remained low even when implemented restrictions were loosened again. The decrease in labor demand affected all levels of education to a similar extent. For the remaining vacancies, we observe lower wage offers. Analyzing job descriptions of vacancy posts, we also find that employers became more likely to offer teleworking options. When we control for changes in occupations, estimates remain very similar, suggesting that the impact is not driven by an increase in the demand for *teleworkable* occupations. To test the robustness of our results, we merge two external occupation-level teleworking measures to our sample. Both measures are highly correlated with telework references in job ads and yield comparable estimates for the differential impact of the pandemic on labor demand.

**JEL Classification:** J23, J31, J61, J63, O33, R23

**Keywords:** job postings, telework, COVID-19

**Corresponding author:**

Lennart Ziegler  
Department of Economics  
University of Vienna  
Oskar-Morgenstern-Platz 1  
1090 Vienna  
Austria

E-mail: [lennart.ziegler@univie.ac.at](mailto:lennart.ziegler@univie.ac.at)

---

\* We thank the IZA for support under its Emergency Research Thrust.

# 1 Introduction

As a response to the outbreak of COVID-19, many countries around the world have implemented far-reaching measures to contain the spread of the virus, leading to a partial shutdown of the economy. Because many businesses are temporarily closed or face reduced demand, the crisis will likely have severe consequences for the labor market. It can be expected that firms reduce their demand for new workers because of the immediate negative economic impact. Facing great uncertainty about the duration of the pandemic and limitations in the hiring process, some employers might also decide to postpone hiring decisions to a later date.

In this project, we examine to what extent labor demand, measured in terms of vacancy postings, has changed during the crisis. Using data on various job characteristics such as education, occupation and wage offers, we analyze what type of jobs are most affected. In particular, we study how the pandemic has affected teleworking in the labor market. Due to severe contact restrictions, there has been a significant rise in the number of people who work from home. These changes may have long-lasting effects on the organization of work. While telework used to be rather the exception than the norm in many firms, employers might have become more open to teleworking options. Furthermore, firms might increasingly hire for jobs where telework is feasible. Our database allows us to quantify the change in teleworking possibilities and analyze what occupations are particularly affected.

To measure the impact on labor demand, we examine data obtained from the largest online job board in Austria. Compared to administrative labor market data, job postings have several advantages for our analysis. First, job ads are a direct measure of current labor demand. As the prevention measures entail school closures, the current crisis also affects labor supply of workers who need to take care of their children. Observed changes in equilibrium employment levels might thus be driven by both labor demand and labor supply shocks. Second, changes on online job boards can be observed in real time and allow to analyze very recent changes due to the COVID prevention measures. Third, vacancy posts often include information on various relevant job characteristics which are typically not observed in administrative records.

Our analysis reveals that the number of job postings declined by a third in the first month after the lockdown and remained low throughout our period of observation.<sup>1</sup> While, in the first month, job ads requiring a university degree were less

---

<sup>1</sup>This effect is similar in magnitude to the decrease in Swedish vacancies as documented by Hensvik, Le Barbanchon and Rathelot 2020*a*.

affected, we observe similar decreases for all levels of education in later months. Due to the crisis, employers increasingly offer remote work arrangements in all affected months although many restrictions were loosened again during this period. Classifying occupations by the share of teleworking references before the pandemic, we further show that this effect is not driven by an increase in the demand for *teleworkable* occupations. To validate our results, we repeat the analysis using two alternative teleworking measures, which are constructed from the O\*NET database and the American Time Use Survey (see Dingel and Neiman, 2020; Hensvik, Le Barbanchon and Rathelot, 2020*b*). Merging these measures to occupations of job ads, we observe a high correlation between all three classifications. In line with our previous finding, neither of the two alternatives suggests an increase in the relative demand for teleworkable occupations.

Several papers document the prevalence and consequences of working from home. Oettinger (2011) investigates the growth in home-based work from 1980 to 2000. His findings suggest that employer costs of providing home-based work arrangements have decreased and that advances in information technology might be an important source of these falling costs. There is little evidence of the productivity gains or losses from switching to remote work arrangements yet. Conducting a randomized controlled trial within the call center of a Chinese travel agency, Bloom et al. (2015) show that working from home can increase performance. Many workers would also welcome more telework options. Mas and Pallais (2017) document that the average worker is willing to give up eight percent of wages to work from home.

Since the beginning of the pandemic, there has been a remarkable volume of research on the potential of remote work to respond to the crisis. Dingel and Neiman (2020) use occupational descriptions from the Occupational Information Network (O\*NET) to estimate the degree to which different occupations in the United States can be done remotely. They find that 37% of jobs in the United States can be performed entirely at home. Boeri, Caiumi and Paccagnella (2020) find similar results for Italy (24%), France (28%), Germany (29%), Spain (25%), Sweden (31%) and the United Kingdom (31%).

Recent survey evidence shows how the pandemic has affected telework. According to a survey conducted in 26 EU countries by Eurofound (2020), 37 percent of workers started to telework due to the pandemic. Austria is among the countries with the largest proportion of workers who switched to remote work arrangements (41 percent). Pointing to the potential benefits of teleworking, the same study finds that in countries where more people began working from home, fewer workers reported that their working time decreased. For the United States, Bick, Blandin and

Mertens (2020) find that about 35 percent of the workforce worked entirely from home in May 2020, up from 8.2 percent in February 2020. Brynjolfsson et al. (2020) report that nearly half of the individuals they surveyed said they were working from home during the first week of April 2020.

Our study adds to this literature by providing direct evidence on how employers change their demand for teleworkers. Analyzing vacancy data allows us to isolate the labor demand channel from the impact of labor supply shocks. We interpret our finding as an increase in the willingness of employers to offer remote work arrangements if the job can be done remotely. During the pandemic, many firms have invested in hardware and bandwidth to render teleworking feasible, and workers have learned how to use collaborative software. In light of these human, physical, and organizational investments, it could be that the pandemic has accelerated the already existing shift towards home-based work. This pattern is in line with evidence of a recent study by Hershbein and Kahn (2018), showing that recessions can accelerate structural changes in the labor market.

## 2 Data and empirical strategy

### 2.1 AMS e-jobroom

Our empirical analysis focuses on the Austrian labor market. The vacancy posts are obtained from the *AMS e-Jobroom*, which is the online job board of the public employment administration (AMS) in Austria. This platform offers the biggest pool of vacancies in Austria. According to a representative quarterly survey among establishments conducted by Statistics Austria, the AMS has covered about 50-60 percent of all open vacancies in recent years. For most job ads, the public employment administration processes the provided information and updates the corresponding job posts regularly. Daily checks for activity by AMS employees significantly reduce the number of inactive vacancies, which are common on online job boards (Cheron and Decreuse, 2017).

Job posts on the e-Jobroom contain both structured and unstructured information. Structured information includes characteristics reported in separate columns for all vacancies and often corresponds to the filters in the search mask. These data include firm name, firm location, occupation, required education, and work extent. Unstructured information includes attributes described in the open text section and needs to be extracted using text pattern matching. Characteristics that we obtain from the ad text are teleworking options, required work experience and posted

wages.<sup>2</sup>

Employers can mention possibilities to work from home in the job description. In total, we search for matches to 19 expressions commonly used in the German and English language to describe remote work (e.g. *telework* or *working from home*). We label a job as *teleworkable* if there exists at least one reference in the job description.

To classify occupations on the job board, the Austrian public employment service uses its own classification system, which distinguishes about 500 different occupations in our sample of job ads. The appendant occupational dictionary includes references to the corresponding 4-digit codes of the International Standard Classification of Occupations (ISCO 08).<sup>3</sup> We use the ISCO classification to group occupations by the degree to which remote work arrangements are feasible and to estimate the differential impact of COVID-related restrictions. The ISCO codes also allow us to link our dataset to external data that have been previously used to quantify teleworking. Following Dingel and Neiman (2020) and Hensvik, Le Barbanchon and Rathelot (2020b), we merge the job ads to data from the Occupational Information Network (O\*NET) and from the American Time Use Survey (ATUS), which enables us to corroborate our own teleworking measure and test the robustness of our estimates.

## 2.2 Descriptive statistics

Vacancy postings for all regular work contracts have been scraped from the job board once every month since November 2018. Our estimation sample covers 20 months up to June 2020 and contains information on more than 1.3 million job ads. To minimize measurement error, we drop a small number of postings with very short ad texts (<50 words) or without information on occupation and required education, which amount to 12 percent of the initial sample.

Table 1 provides summary statistics for the key outcomes and control variables of our analysis. The majority of ads lists basic school education or vocational training as required level of education. About 17 percent of ads are targeted towards applicants with higher secondary or university degree.

Overall, only 0.33% of ads contain a reference to teleworking but the share differs considerably by required education. While we find almost no matches for ads targeting lower levels of education, 1.64% of ads for higher educated workers

---

<sup>2</sup>For a more detailed description of the dataset and job posting regulations in Austria, see Ziegler (2020).

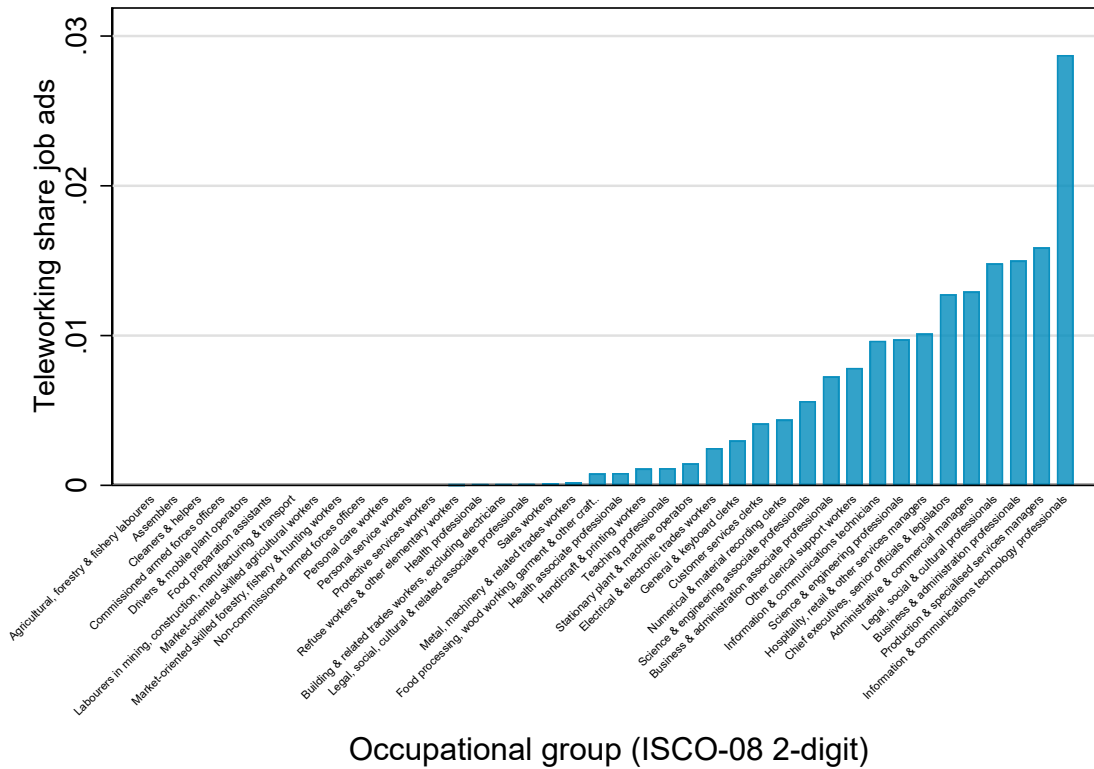
<sup>3</sup>The occupational dictionary is available at <https://www.ams.at/bis> (in German). If no unique match exists, we attribute the respective job ads to multiple ISCO codes with equal weight.

Table 1: Descriptive statistics

	Mean	SD		Mean	SD.
<b>Extent of work:</b>			# words	192.57	88.00
- Full-time	0.73	0.44	Posted monthly wage	2,117.79	618.81
- Part-time	0.16	0.37	Work experience required	0.48	0.50
- Full- or part-time	0.11	0.31	<b>Telework reference (<math>\times 100</math>):</b>		
<b>Required level of education:</b>			Overall	0.33	5.74
- Compulsory schooling	0.32	0.47	- Compulsory schooling	0.06	2.36
- Vocational training	0.52	0.50	- Vocational training	0.17	4.15
- Higher school / gymnasium	0.11	0.31	- Higher school / gymnasium	1.21	10.91
- (Applied) university	0.06	0.23	- (Applied) university	1.64	12.70

NOTE: The full sample contains 1,334,000 job postings observed between November 2018 and June 2020.

Figure 1: Teleworking by occupational group





mention teleworking. Because of these stark differences, we will also report changes in teleworking options during the crisis by educational group.

To determine the extent to which telework is feasible in different occupations, we use the sample of job ads observed before the crisis and compute the share of ad texts with teleworking reference for every occupation. Figure 1 reports the corresponding shares for each 2-digit ISCO code. As expected, for most blue-collar occupational groups such as drivers, assemblers or agricultural workers, employers report no teleworking options at all. For white-collar occupations, we observe large differences between the different groups, mostly ranging between 0 and 1.5 percent. Especially, professionals and managers are offered the possibility to telework more frequently. IT occupations constitute a clear outlier with the highest share of teleworking jobs (3 percent). While these shares appear to be too low to capture the full potential of teleworking in the labor market, the observed differences can be used to classify occupations by the degree of teleworking capabilities.

## 2.3 Estimation

Like many other countries, Austria implemented several measures to prevent the spread of COVID-19. A nationwide curfew, which included school closures, was enacted on 16 March 2020. Since our data collection always takes place at the beginning of each month, job ads posted in April, May and June are affected by the crisis. Between mid-April and mid-May, shops and other businesses were gradually allowed to reopen. Our data thus cover different stages of the crisis. While the country was still under lockdown in April, most restrictions have been loosened again by June.

To estimate the impact of the pandemic, we propose the following regression equation,

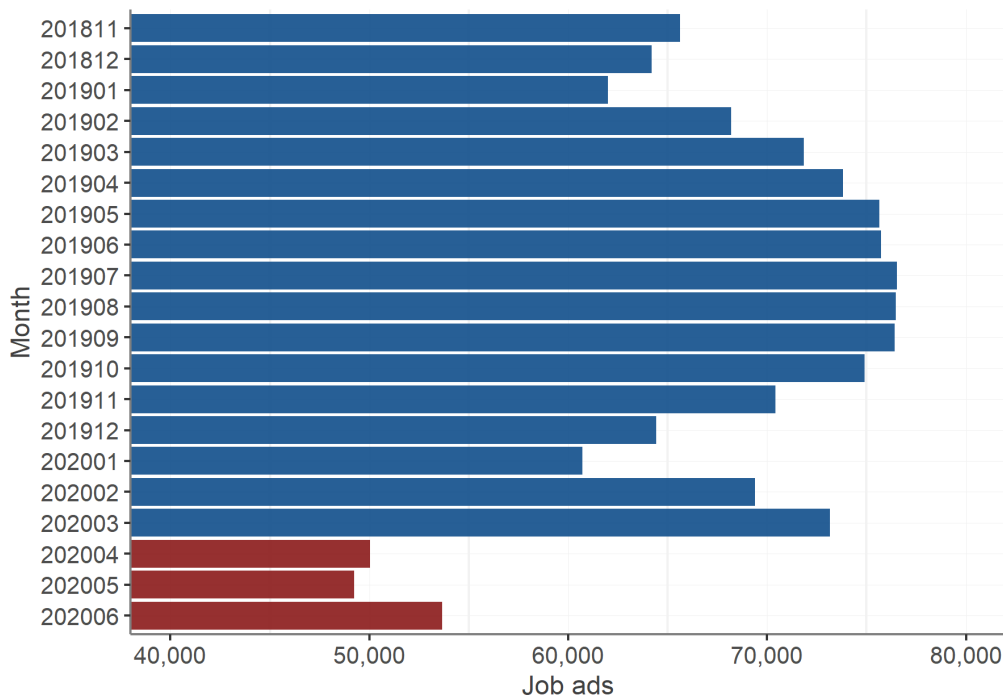
$$Y_{imy} = \alpha_m + \beta_y + \gamma D_{imy} + \delta X_{imy} + u_{imy}, \quad (1)$$

where  $Y_{imy}$  denotes the outcome and  $D_{imy}$  indicates whether job ad  $i$  was posted during the crisis (April to June). Month and year fixed-effects, denoted by  $\alpha_m$  and  $\beta_y$ , account for time trends and seasonality. To control for additional confounding factors, we also add a vector  $X_{imy}$  of job characteristics. Our base controls include indicators for labor market regions, the extent of work and required work experience. In some specifications, we additionally control for the required level of education as well as occupation and firm fixed-effects. To examine if effects change when restrictions are removed again, we also estimate regressions with separate indicators for the three affected months.

### 3 Empirical findings

Figure 2 illustrates the overall unadjusted impact of the pandemic on labor demand. The number of postings on the job board significantly dropped since April. While during the same months of the previous year, the job board listed about 75,000 job ads, we observe only about 50,000 during the crisis, which corresponds to a relative decrease of about one third. In the remainder of this section, we examine which vacancies are most affected and to what extent wage offers and teleworking options change as a response to the crisis.

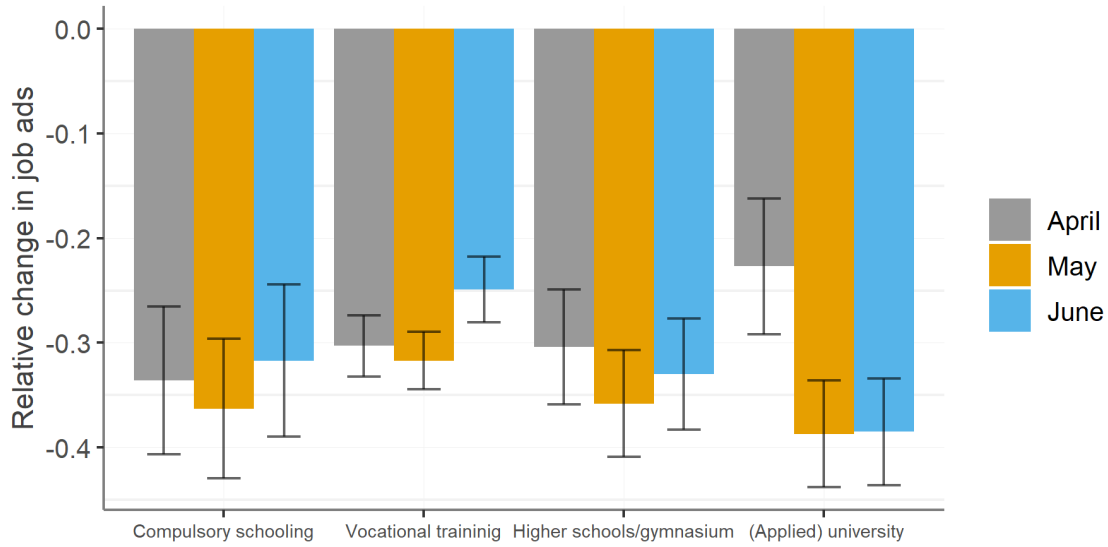
Figure 2: Overall impact of the pandemic on labor demand



#### 3.1 Education and wages

At the onset of the crisis, many low-educated workers such as retail workers or waiters were disproportionately affected by unemployment because shops and restaurants had to remain closed. Overall, our results suggest that differences in vacancy posts by education are less pronounced than changes in unemployment. Clear differences can only be observed at the onset of the crisis. In April, we estimate the largest decrease (38 percent) for job ads that require compulsory schooling. Vacancies for university applicants only decreased by about 22 percent. In the following two months, these differences disappear. In fact, the relative decrease is the largest among university graduates in May and June. These trends coincide with the timing

Figure 3: Impact by education



Note: Black lines indicate 95-percent confidence intervals.

of the restrictions implemented by the Austrian government. While the initial lockdown affected low- and medium-educated workers to a larger extent, the longer-run consequences of the crisis after the lockdown can be felt by all levels of education similarly.

Next, we examine how wage postings are affected by the pandemic. In Austrian job listings, employers are required to specify the starting gross wage excluding bonuses or other extra payments. Firms that do not comply with these rules may be fined for violation by local authorities. Whereas the posted wage cannot be below the respective collective bargaining wage of a position, employers can post higher wages. If firms want to attract qualified applications and are able to overpay, it can be advantageous to post a higher wage.

Table 2 reports changes in the logarithm of monthly wage offers. Using only our base controls, we find that posted wages increased by 0.8 percentage points in April to June. Yet, estimates in column (2) to (4) show that the positive effect is entirely driven by changes in employers and occupations. Because high-paying firms offer relatively more jobs and high-paid occupations are in higher demand during the pandemic, we observe a small but significant decrease in posted wages of about 0.25 percentage points when accounting for fixed-effects. The lower part of Table 2 reports changes separately for all affected months. Although the negative impact steadily attenuates over time, posted wages still remain 0.2 percentage points lower three months after the onset of the crisis.

Table 2: Impact on posted wages

	(1)	(2)	(3)	(4)
Overall	0.836*** (0.044)	-0.058 (0.054)	-0.133*** (0.044)	-0.247*** (0.044)
April	0.870*** (0.030)	-0.190*** (0.033)	-0.061 (0.036)	-0.301*** (0.038)
May	0.896*** (0.029)	0.009 (0.032)	-0.177*** (0.036)	-0.240*** (0.041)
June	0.744*** (0.030)	0.015 (0.036)	-0.160*** (0.038)	-0.198*** (0.041)
Firm FE		✓		✓
Occupation FE			✓	✓

NOTE: 1,334,000 observations. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . The dependent variable is the logarithm of posted monthly wages. Estimates are reported in percentage points. All regressions control for region, extent of work and required work experience. Standard errors are clustered at the month-year level.

These estimates suggest that employers have become, on average, less generous, which may negatively affect the wage level of new hires during the crisis. This finding is consistent with our hypothesis that firms post high wages to attract more qualified applicants. Because of the strong decrease in labor demand, such wage incentives might not be necessary anymore.

### 3.2 Teleworking and occupations

Our hypothesis is that the pandemic has affected the demand for *teleworkable* vacancies. Especially at the onset of the crisis, jobs without telework options might not be possible to execute due to contact restrictions and closed premises. Because employers face uncertainty about the duration of implemented measures, they might postpone hiring for such vacancies. As a result, occupations where teleworking is feasible should experience a weaker drop in labor demand. Furthermore, we expect that employers are more likely to offer teleworking for a given occupation. Due to the strict contact restrictions, many workers were forced to work from home. If employers, who were initially reluctant to allow teleworking, realize that their employees can be equally productive at home, they may decide to introduce this option even to new hires.

By law, there exists neither a right nor an obligation in Austria to telework unless explicitly specified in the work contract. On 10 March, the government advised firms

to allow teleworking. About one week later, a decree by the social ministry required that all firms had to switch to teleworking if the job did not require the presence of the employee. A second decree, which is in effect since 1 May and lasts until 31 December 2020, further specifies that employers have to guarantee that employees can always keep a minimum distance of one meter. If it is not possible to keep the minimum distance, other suitable safety measures such as dividing walls or working in fixed teams are required.<sup>4</sup> Our period of observation thus covers one month (April) in which all teleworkable jobs had to be done from home and two months (May and June) in which some workers already returned to their workplace.

Regression results of Table 3 show how the crisis affected teleworking references in job ads. We observe a small overall increase of about 14 percent in the likelihood of mentioning teleworking opportunities, which can be explained by job ads posted immediately after the crisis. Later on, the coefficient decreases and fades to be statistically significant. When we split the sample by required level of education, we observe that most of the increase, both in absolute and relative terms, stems from vacancies for job seekers with at least higher secondary schooling. Compared to an average share of 1.56 percentage points in the month before the crisis, teleworking references increased by a fourth in this group. Although the impact decreases again over time, the estimated coefficient still remains large in June. For vacancies targeted at university graduates, we only observe a significant increase in teleworking in April.

To examine whether changes in employers or occupations can explain the rise in teleworking, we additionally control for firm and occupation fixed-effects. Because most of the impact comes from job ads for higher educated workers, we restrict our estimation sample to this group. The corresponding estimates are reported in Table 4. Adding firm fixed-effects decreases the estimated effect by one third. Employers who used to offer teleworking already before the crisis should indeed be less affected by the contact restrictions. As a result, the negative labor demand effect is less pronounced for these firms. Furthermore, we observe that the impact explained by firm fixed-effects diminishes in later months of the crisis, when remote work was not required anymore.

It is likely that a similar correlation also exists between teleworking and occupations. Yet, controlling for occupations leaves the coefficients in columns (2) and (4) remarkably unchanged. Only about 5-10 percent of the overall impact can be explained by changes in occupations. This shows that the observed increase is not driven by higher demand for teleworkable occupations.

To better understand the underlying trends, we estimate changes for each ma-

---

<sup>4</sup>See decree [Covid-19-Lockerungsverordnung](#) issued by the Austrian social ministry (in German).

Table 3: Impact on teleworking by education

	All	Compulsory schooling	Vocational training	Higher schooling	(Applied) university
Overall	0.054* (0.027)	0.025*** (0.008)	0.018* (0.010)	0.407*** (0.107)	0.136 (0.191)
April	0.122*** (0.018)	0.024*** (0.008)	0.032*** (0.009)	0.509*** (0.095)	0.435*** (0.133)
May	0.031* (0.018)	0.036*** (0.008)	0.005 (0.009)	0.385*** (0.095)	-0.086 (0.118)
June	0.010 (0.018)	0.015* (0.008)	0.018* (0.009)	0.324*** (0.105)	0.039 (0.123)
Pre-COVID mean	0.39	0.08	0.22	1.56	1.38
Observations	1,352,432	429,173	700,607	145,972	76,680

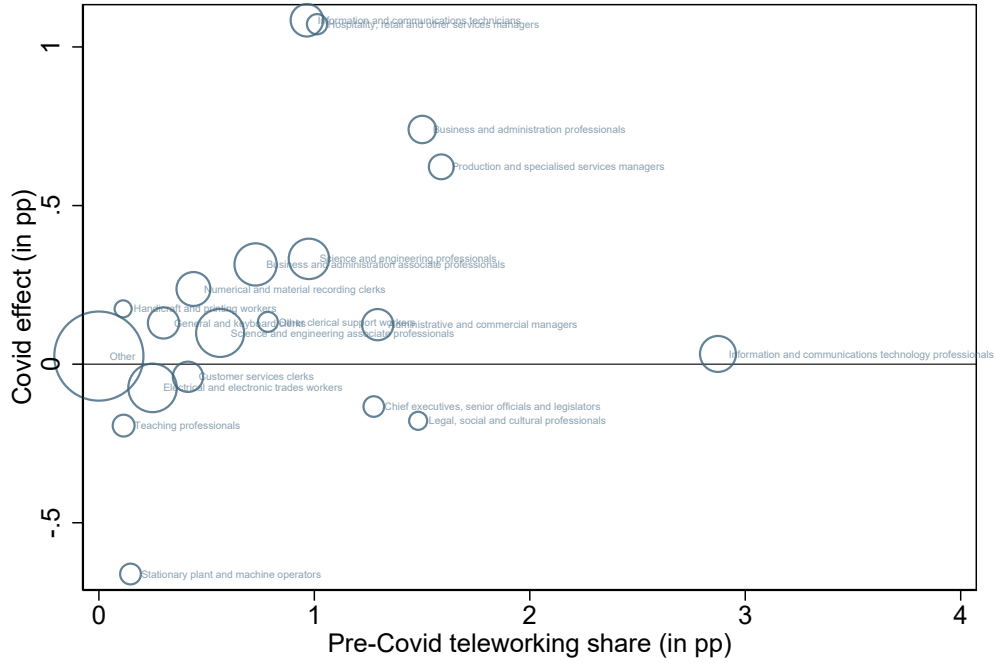
NOTE: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . The dependent variable is a telework-reference indicator. Estimates are reported in percentage points. All regressions control for region, extent of work and required work experience. Standard errors are clustered at the month-year level.

major occupational group (2-digit ISCO code) separately. Figure 4a plots the group-specific change in teleworking references by the share of references observed before the crisis. Analogue to our previous regression estimates, the likelihood of teleworking increases for most occupations. Overall, we observe a positive correlation between pre-COVID levels and increases after March, with some notable exceptions. As expected, occupations with almost no references before the crisis are not affected because the associated tasks cannot be done from home. Instead, job postings for occupations with medium levels of teleworkability, such as business and administration professionals, increase opportunities for remote work. Occupations in the group of IT and communication professionals, which were already highly teleworkable before the pandemic, exhibit no significant changes. Most of the estimated increase thus stems from occupations with medium pre-crisis levels. This is in line with the hypothesis that some employers refrain from offering telework even though the job would allow to work remotely. Due to the pandemic, teleworking has become a more common feature for these occupations.

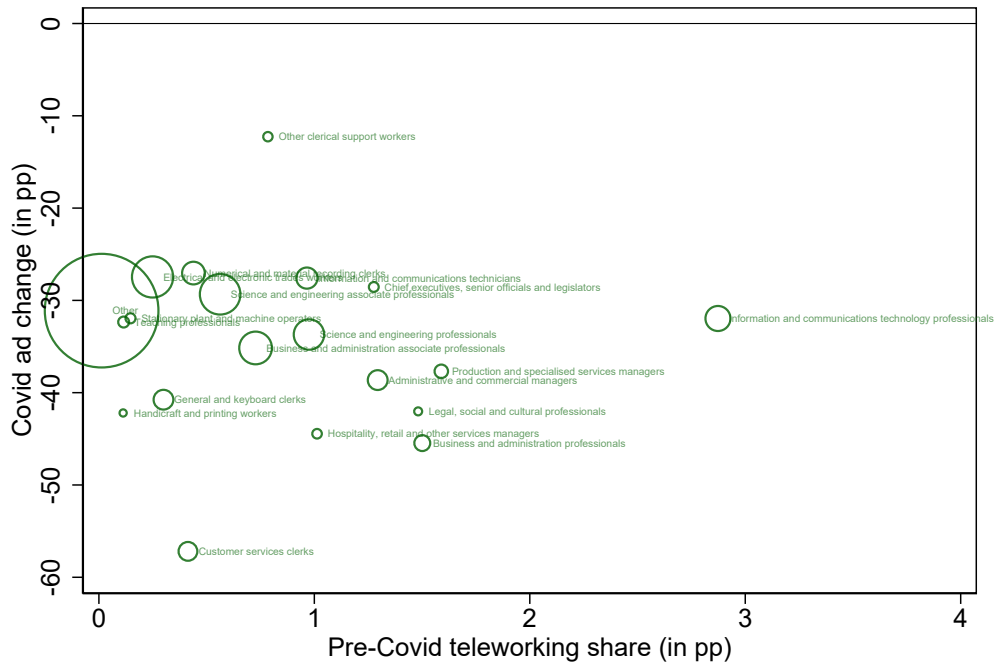
Our regression estimates in Table 4 indicate that the rise in telework does not result from an underlying change in labor demand for specific occupations. To illustrate this finding, we compute the change in the number of vacancies for all major occupational groups and sort them again by their pre-COVID share of remote-work references. Figure 5b shows that all groups experience a significant drop in vacancies and that the decrease in labor demand does not depend on the pre-pandemic level of teleworkability.

Figure 4

(a) Change in teleworkability by pre-pandemic teleworkability levels



Note: *Other* includes all occupational groups with a pre-Covid teleworking share below 0.1pp.



Note: *Other* includes all occupational groups with a pre-Covid teleworking share below 0.1pp.

(b) Change in number of jobs by pre-pandemic teleworkability levels

Table 4: Impact on teleworking for higher educated

	(1)	(2)	(3)	(4)
Overall	0.322** (0.130)	0.299** (0.126)	0.209*** (0.063)	0.199*** (0.061)
April	0.514*** (0.096)	0.478*** (0.094)	0.242*** (0.065)	0.229*** (0.064)
May	0.250** (0.095)	0.234** (0.092)	0.221*** (0.056)	0.209*** (0.054)
June	0.192* (0.102)	0.175* (0.100)	0.159** (0.064)	0.154** (0.062)
Occupation FE		✓		✓
Firm FE			✓	✓

NOTE: 218,999 observations. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . The dependent variable is a telework-reference indicator. Estimates are reported in percentage points. All regressions control for region, extent of work and required work experience. Standard errors are clustered at the month-year level. Pre-COVID outcome mean: 1.49.

Can our results be interpreted as a structural change in the organization of work, or do they represent the mechanical effect of social distancing rules? One may argue that the increase in the share of teleworkable jobs represents the response of employers to cope with social distancing and limited office space. However, since the end of the lockdown in Austria, many employees were able to return to their workplace. Given that the estimated impact persists throughout June, we interpret the results as an actual organizational change, which may have long-lasting effects.

### 3.3 Robustness

Our definition of teleworking is solely based on information provided by the employer in job postings. While this procedure allows to easily classify job ads, it is not clear to what extent short job descriptions can actually capture teleworking options. To validate our measure, we consider two external teleworking measures that have been used in recent related studies. Dingel and Neiman (2020) construct a teleworking measure ranging from zero to one, which is based on detailed task descriptions from the Occupational Information Network (O\*NET). Hensvik, Le Barbanchon and Rathelot (2020*b*) use the American Time Use Survey (ATUS) to estimate the share of work done from home. We merge both measures by ISCO-08 occupation to



our dataset.<sup>5</sup>

Table 5 reports high correlations between our teleworking measure, calculated in the pre-pandemic period, and the two external measures (O\*NET and ATUS). Depending on the ISCO level of aggregation, the correlation coefficients range from 0.5 to 0.8. This shows that by and large all three measures lead to a similar classification of teleworkable occupations. Figure 5 visualizes the relationship between our teleworking measure and the O\*NET classification at the ISCO 2-digit level. Despite the strong correlation, some occupational groups such as teaching professionals are teleworkable according to O\*NET but do not provide teleworking references, and vice versa. While, for example, many tasks of teachers could theoretically be done from home, it may not be a very usual work arrangement for this group of workers.

Table 5: Correlations of teleworking measures

	ISCO-08 4-digit		ISCO-08 2-digit	
	Corr. coef.	Groups	Corr. coef.	Groups
Job ads - O*NET	0.588	327	0.757	38
Job ads - ATUS	0.543	331	0.739	38
O*NET - ATUS	0.676	323	0.798	38

NOTE: Estimated correlations are weighted by the number of job ads in each group. Column 2 and 4 report the number of occupation (sub-)groups for which data are available.

To test the robustness of our finding that teleworkable occupations are not in higher demand, we again estimate crisis effects using all three teleworking measures of occupations as outcome. To make coefficients comparable, we normalize each measure to have mean zero and standard deviation one in the first month of observation. Note that, contrary to results reported in Tables 3 and 4, we do not use actual teleworking references as outcome but the average share of references by occupation observed before the crisis. As shown in Table 6, none of the three measures reveals strong differences by teleworkability of occupations. If at all, our results suggest that teleworkable occupations are slightly more affected by the downturn but the estimated coefficients are very small.

<sup>5</sup>Both datasets are publicly available. Dingel and Neiman (2020): <https://github.com/jdingel/DingelNeiman-workathome>; Hensvik, Le Barbanchon and Rathelot (2020b): <https://github.com/tlebarbanchon/home-working-ATUS>.

Figure 5: Telework references and O\*NET-based values by ISCO 2-digit groups

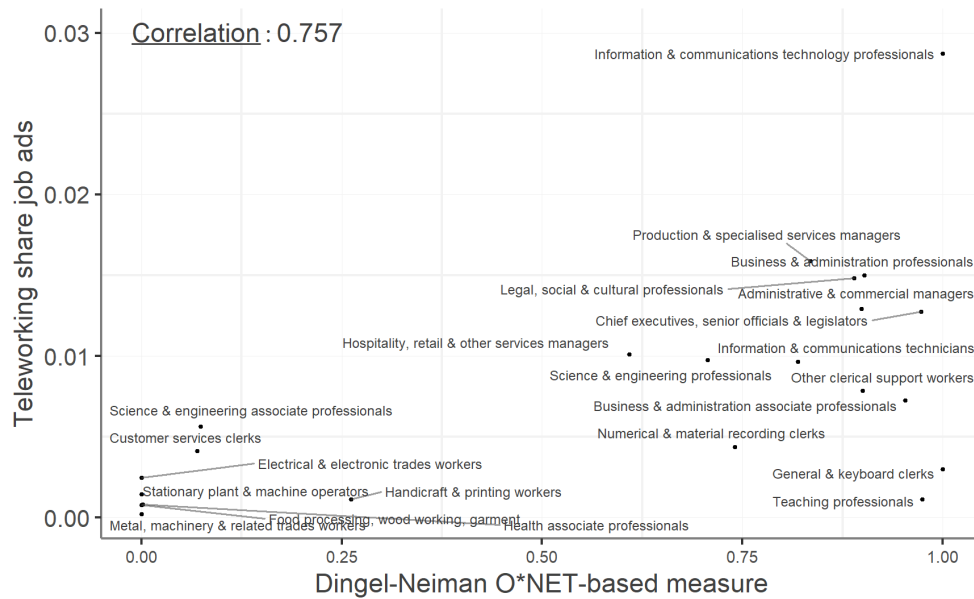


Table 6: Impact on *teleworkable* occupations

	Ad measure		O*NET measure		ATUS measure	
	(1)	(2)	(1)	(2)	(1)	(2)
Overall	-0.005** (0.002)	-0.001 (0.001)	-0.014*** (0.004)	-0.014*** (0.002)	0.001 (0.004)	-0.017*** (0.003)
April	0.005*** (0.002)	-0.001 (0.002)	0.001 (0.002)	-0.010*** (0.002)	0.014*** (0.001)	-0.009*** (0.001)
May	-0.010*** (0.002)	-0.001 (0.001)	-0.018*** (0.002)	-0.017*** (0.002)	0.001 (0.001)	-0.017*** (0.001)
June	-0.011*** (0.002)	-0.001 (0.002)	-0.025*** (0.002)	-0.016*** (0.002)	-0.013*** (0.001)	-0.025*** (0.001)
Firm FE		✓		✓		✓

NOTE: 1,311,062 observations. \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . The dependent variable is the respective occupation-level teleworking measure. All measures are normalized to have mean zero and standard deviation one in the first period. All regressions control for region, extent of work, required work experience and level of education. Standard errors are clustered at the month-year level.

## 4 Conclusions

The COVID-19 pandemic has caused an unprecedented sudden shock to the labor market. Within days, many businesses were put on hold and a large share of the

workforce was not allowed to return to their workplace. This study provides novel evidence on the immediate effect on labor demand by examining changes in vacancy postings. Using data from the largest Austrian job board, we document a substantial drop in vacancies during the first months of the crisis. The decrease in labor demand affected all skill groups to a similar extent. For the remaining ads, we observe that employers reduce wage offers to new hires.

The shock was unique in the sense that despite the restrictions many jobs could still be done from home. This raises the question to what extent physical presence is still required when many workers can complete their tasks remotely in today's economy. Improvements in IT and communication technologies have substantially increased the feasibility of teleworking over the last decades. It is possible that many firms have not made use of these opportunities yet and still rely on traditional work arrangements. Some employers may fear that workers are less productive at home due to distractions and the lack of suitable equipment. If experiences with remote work during the pandemic are positive, this crisis might lead to persistent changes.

Our analysis indeed shows that employers are more likely to offer teleworking to new hires. Due to the crisis, some firms might have realized that telework is a feasible option for them. Yet, there is no evidence that the negative demand shock in the first months of the pandemic is less pronounced for occupations that were associated with teleworking before the crisis. Using two alternative measures of teleworkability, we obtain very similar results. It is possible that other occupation-specific demand shocks are correlated with telework and thus disguise potential increases in the demand for teleworkable occupations.

A large-scale switch to teleworking represents a fundamental change in the labor market. If physical location does not matter anymore for some occupations, workers become much more mobile and worker competition increases in the absence of local labor markets. Workers and firms will also be able to save commuting time and expenses. It remains to be seen if the increase in teleworking opportunities caused by the pandemic prevails. Future research will show whether the observed changes persist in the long run when all contact restrictions are lifted again and the labor market has fully recovered from the economic downturn.

## References

- Bick, Alexander, Adam Blandin, and Karel Mertens.** 2020. “Work from home after the COVID-19 outbreak.” CEPR Discussion Paper No. 15000.
- Bloom, Nicholas, James Liang, John Roberts, and Zhichun Jenny Ying.** 2015. “Does working from home work? Evidence from a Chinese experiment.” *Quarterly Journal of Economics*, 130(1): 165–218.
- Boeri, Tito, Alessandro Caiumi, and Marco Paccagnella.** 2020. “Mitigating the work-safety trade-off.” *CEPR Press - Covid Economics*.
- Brynjolfsson, Erik, Daniel Rock, John Horton, Adam Ozimek, Garima Sharma, and Hong Yi Tu Ye.** 2020. “COVID-19 and remote work: An early look at US data.” NBER Working Paper No. 27344.
- Cheron, Arnaud, and Bruno Decreuse.** 2017. “Matching with phantoms.” *Review of Economic Studies*, 84(3): 1041–1070.
- Dingel, Jonathan I., and Brent Neiman.** 2020. “How many jobs can be done at home?” *Journal of Public Economics*, 189.
- Eurofound.** 2020. “Living, working and COVID-19: First findings, April 2020.” COVID-19 series, Publications Office of the European Union, Luxembourg.
- Hensvik, Lena, Thomas Le Barbanchon, and Roland Rathelot.** 2020*a*. “Job search during the COVID-19 crisis.” CEPR Discussion Paper No. 14748.
- Hensvik, Lena, Thomas Le Barbanchon, and Roland Rathelot.** 2020*b*. “Which jobs are done from home? Evidence from the American Time Use Survey.” IZA Discussion Paper No. 13138.
- Hershbein, Brad, and Lisa B. Kahn.** 2018. “Do recessions accelerate routine-biased technological change? Evidence from vacancy postings.” *American Economic Review*, 108(7): 1737–72.
- Mas, Alexandre, and Amanda Pallais.** 2017. “Valuing alternative work arrangements.” *American Economic Review*, 107(12): 3722–59.
- Oettinger, Gerald S.** 2011. “The incidence and wage consequences of home-based work in the United States, 1980-2000.” *Journal of Human Resources*, 46(2): 237–260.

**Ziegler, Lennart.** 2020. “Skill demand and posted wages. Evidence from online job ads in Austria.” Vienna Economics Papers No. 2002 ([Link](#)).