Urban labor market resilience during the COVID-19 pandemic – what is the promise of teleworking?

Simone Maria Grabner[1]
Bocconi University, Via Roentgen 1, 20136 Milan
simone.grabner@unibocconi.it

Alexandra Tsvetkova[2]
OECD Trento Centre for Local Development, Spatial Productivity Lab
Vicolo S. Marco, 1, 38122 Trento, Italy
alexandra.tsvetkova@oecd.org

Abstract

The emergence of the Covid-19 pandemic caused immense turbulences in the labor market and provoked a large-scale turn towards teleworking. This paper contributes to the understanding of how teleworking shapes regional economic outcomes by focusing on labor market resilience in U.S. cities during the 2020 COVID-19 emergency. The paper examines employment and labor demand, proxied by online job vacancy data, and finds that the pre-pandemic share of teleworkable jobs in a city is linked to stronger employment resilience in general and labor demand resilience during the onset of the pandemic and in smaller cities. The paper discusses possible mechanisms behind the link and policies that can help leverage the promise of teleworking for resilient labor markets.

Keywords: labor demand, regional resilience, COVID-19, teleworkability

JEL codes: J23; J21; L16; R11

[1] Corresponding author: Simone Maria Grabner (simone.grabner@unibocconi.it)
[2] Views expressed and arguments employed in this paper are the sole responsibility of the authors and do not represent the views of the OECD or of its member countries.

Introduction

The COVID-19 pandemic is like no other in recent history. Globalization made it possible for a local health emergency to spread quickly across the globe, forcing governments to implement restrictions and lockdowns: in the United States (U.S.) almost entire population was affected by state or local lockdown measures in April 2020 (Baek et al., 2020). The economic shock that came along the pandemic resulted in an abrupt recession with rapid and devastating effect on labor markets; the U.S. unemployment rate soared to over 14% in April 2020 [3], while labor demand collapsed by 44% between February and April 2020 (Forsythe et al., 2020). To maintain business continuity, many firms shifted to telework, where employees whose work tasks could be performed remotely, continued to work from the safety of their home (Brynjolfsson et al., 2020). Teleworking, i.e. performing one's employment duties remotely, became a predominant mode of work for many occupations where physical presence was not strictly required (OECD, 2021). Many observers agree that "teleworking is here to stay" with a potential of turning local labor markets into national or even global ones, at least for some occupations (OECD, 2020a; Maselli, 2020).

Much of academic research about teleworking discusses the productivity impacts, work-life balance and other employer- or employee-centered outcomes (Choudhury et al, 2021; George et al. 2021; Zhang et al. 2020). Policy discussion, in contrast to the academic one, often focuses on the national or regional outcomes of teleworking such as its potential effects on agglomerations and the promise of telework for reviving less central regions. Creating better conditions for remote work can attract digital workers, increase tax base of a region, expand demand for services creating jobs in the sector. These benefits would be particularly welcome and felt in places outside of large agglomerations, such as remote regions or smaller cities.

With all the recent hype around teleworking, however, it is important to collect and carefully evaluate empirical evidence on the actual effects of remote work on economic outcomes before formulating specific policy interventions. This paper contributes to the knowledge base about the regional economic impacts of teleworking. It focuses on labor market

[3] Source: Bureau of Economic Analysis, https://www.bea.gov/news/2020/gross-domestic-product-2nd-quarter-2020-advance-estimate-and-annual-update, accessed Nov. 13th.

performance in U.S. cities during 2020, the year when the pandemic started. The paper investigates the relationship between the share of teleworkable jobs before the pandemic and labor market performance in Metropolitan Statistical Areas (MSAs). It applies the resilience concept and uses data on total MSA employment and labor demand collected from online job postings to derive labor resilience indicators. The paper also investigates possible mechanism of the observed positive relationship and offers policy-relevant discussion on the promise of teleworking for labor market resilience in U.S. cities.

The empirical analysis finds support for the idea that the concentration of teleworkable jobs in a city can enhances the resilience of local labor markets. We show that employment resilience benefited from teleworkability throughout 2020 and especially in smaller cities with up to 500 thousand residents. While the effect of teleworkability on labor demand resilience is theoretically ambiguous, the analysis demonstrates a positive link during the first wave of COVID-19 (March to June 2020) and in smaller cities.

The positive relationship between teleworkability and labor market resilience likely works through two mechanisms. On the one hand, jobs that can be done remotely are less likely to be shed during a health emergency, as they can continue their activities even when normal operations from an office become impossible. On the other, the steady earnings flow to teleworking professionals was likely generating demand for services and supported jobs, as a positive link between teleworkability and labor demand resilience is stronger for nonteleworkable occupations.

These expected indirect income effects (when additional services demand from higher-paid remote workers stimulates local employment) seem to be an important part of the ongoing efforts by regions and countries to promote teleworking. Our analysis offers some preliminary (short-term) evidence that such expectations might be justified. Thus, the primary policy implication that follows from this paper is that regions should invest in teleworking capabilities, such as improved broadband infrastructure and digital education and skills (Clancy, 2020). This can support regional resilience also in the face of potential future disruptions linked to climate change or new episodes of healthcare emergencies, which might require employees to work remotely.

COVID-19 pandemic and the U.S. labor markets

The COVID-19 shock had an immediate impact on U.S. labor markets. Commonly, the health of labor markets is measured by employment levels or changes but research on past recessions shows that firm hiring is a dominant factor driving employment declines during downturns (Shimer, 2012). This means that during a crisis such as the COVID-19 pandemic, analyzing both employment and hirings offers a more comprehensive picture.

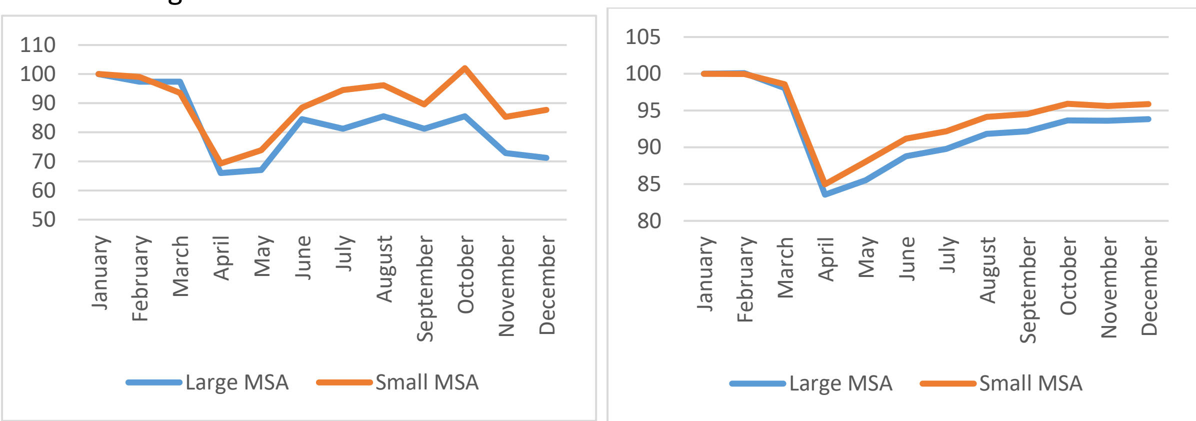
The evidence on the labor market performance after the COVID-19 emergency hit is still accumulating. Available indications suggest that disruptions to the U.S. economy happened simultaneously at many levels but not all sectors and regions were affected equally; employment losses have been concentrated disproportionately in the low-wage and face-to-face jobs (Cajner et al., 2020; Cortes and Forsythe, 2020). In contrast, high-skill and high-wage jobs were less likely to be shed during the great lockdown, although they do show a large decline in labor demand (Forsythe et al, 2020; Campello et al, 2020; Tsvetkova et al.,2020).

For example, Tsvetkova et al. (2020) report that the number of online vacancy announcements contracted the most in non-tradable service occupations, particularly those involving face-to-face interactions, such as *Food Preparation and Serving*. Other occupations, including those in healthcare, transportation and construction, experienced only a small decline or even an increase in demand. Using firm level data, Campello et al. (2020) document that small and large firms reduced their hiring by over 50% and 30–40% respectively and that hiring cuts affected high-skill jobs more than for low-skill jobs.

Spatially, labor markets were stronger affected in urban areas compared to their rural counterparts. In cities, as follows from an analysis of the U.S. Current Population Survey COVID-19 supplement, adults were more likely not to be paid for missed hours or be unable to work due to the spread of the virus. At the same time, urban dwellers were more likely to work remotely (Brooks et al., 2021). An analysis of an aggregate data suggests that employment losses were higher in MSAs than in non-metro areas, with the highest losses in MSAs with more than 5 million inhabitants (Cho et al., 2020). This pattern of stronger negative impacts in larger places is also confirmed for hiring: using online job postings data, Tsvetkova et al. (2020) find that labor demand declined more in MSAs with a population larger than 500 000.

Our data confirm these observations (Figure 1). Larger MSAs (above 500 thousand residents) experienced a bigger relative drop in both vacancies and total employment during 2020. After an initial drop, the comparative gap was stable across the two metropolitan size groups for employment but it expanded for online job postings.

Figure 1. Monthly vacancies (left) and employment (right) in 2020 (indexed to January) in small and large MSAs.



Source: Author's calculations based on EMSI Burning Glass data (vacancies), U.S. BLS (employment).

Labor market performance with respect to major disruptions is often examined through the concept of resilience, which generally refers to the responsiveness of systems to shocks or changes (Christopherson et al., 2010). Martin (2012) identifies four different dimensions of resilience. They are *resistance* (the degree of sensitivity of a regional economy to a recessionary shock), *recovery* (the speed and magnitude of the recovery), *reorientation* (the adaptation of a regional economy) and *renewal* (the resumption of the previous growth path or a shift to a new one). The Great Recession, which followed the 2008 financial crisis, triggered an academic focus on the resilience (resistance and recovery) of U.S. labor markets (Han & Goetz, 2015; Deller and Watson, 2016; Doran and Fingleton, 2018) . Yet, past empirical research may only provide limited guidance on regional labor market resilience in the context of the COVID-19 pandemic, as the magnitude and the nature of this shock is different along multiple dimensions. To examine resilience with respect to the COVID-19 shock, we focus on the resistance and (initial) recovery elements of resilience and consider two important components of labor market performance, total employment and hiring; the latter is approximated by online job postings. Labor demand (number of internet job postings) is a relatively small component of the labor market (the number of online vacancy announcements is only around 2% of the total number of jobs) but are an important forward-looking measure of the developments in the labor markets. Data on job postings is more detailed, which allows for additional analyses that can shed light on the mechanisms of a relationship between the two variables of interest in this study, teleworkability (discussed in the next section) and labor market resilience.

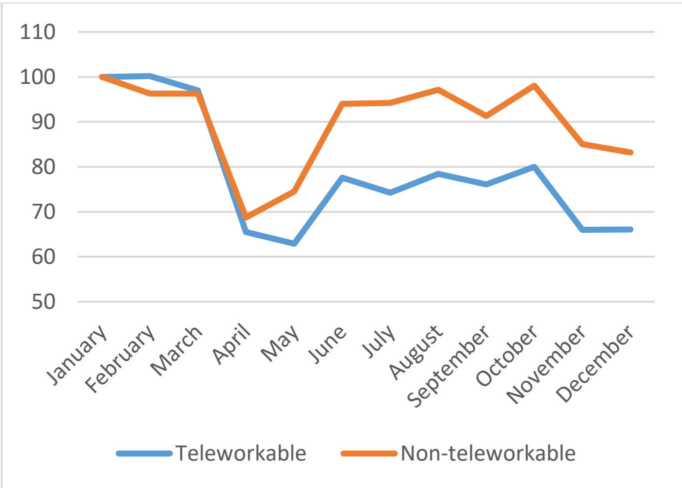
Teleworkability and the COVID-19 pandemic

The past crises impacted economies through channels such as the supply of capital (the 2008 financial crisis) or technology (industrial revolutions). In contrast, the COVID-19 pandemic hit the human capital component of the production process (Campello et al., 2020). To protect lives and curb the spread of COVID-19, state and local officials in the United States introduced stay-at-home orders and other restrictions. Baek et al. (2020) document that by the 4th of April 2020, nearly 95% of the U.S. population was under stay-at-home orders. Along restrictions and concerns about infections in the workplace came another immense change affecting the labor market - a large-scale shift towards remote work or teleworking.

Teleworking refers to work arrangements under which individuals work from a physically distant location (not where collaborating co-workers are located). The term is often used synonymously with remote work, smart work, telecommuting or working from home (Clancy, 2020). While the phenomenon is not new, the COVID-19 crisis forced firms to introduce telework on a large scale (OECD, 2020b). Fortunately, a considerable share of jobs are teleworkable, which made a widespread adoption of telework possible. Dingel & Neiman (2020) find that 37% of jobs in the United States can be performed remotely, but with a significant variation across industries. Teleworkable jobs tend to concentrate in high-education, high-skill and high-wage industries, and thus account for 46% of all U.S. wages. Firm survey data likewise suggest that the adoption of telework was much more common in industries with better educated and better paid workers (Bartik et al., 2020). According to Brynjolfsson et al. (2020), 35% of those who used to commute to work switched to teleworking as the pandemic began. The authors show that this switch was related to the incidence of COVID-19 but most changes were already in place by April 2020.

The dynamics of job postings was clearly distinct for teleworkable and nonteleworkable occupations after the first shock of the COVID-19 pandemic in 2020. While the initial drop in demand for both types of occupations was comparable, recovery was slower and weaker for the jobs that can be performed remotely (Figure 2). This is in line with other authors' observations, who report that labor demand in teleworkable and high-skill occupations contracted more (Campello et al., 2020; Forsythe et al., 2020; Tsvetkova et al., 2020), while demand for certain nonteleworkable occupations such as healthcare and transportation experienced stable or increasing demand.

Figure 2. Monthly vacancies in 2020 (indexed to January) across teleworkable and nonteleworkable occupations

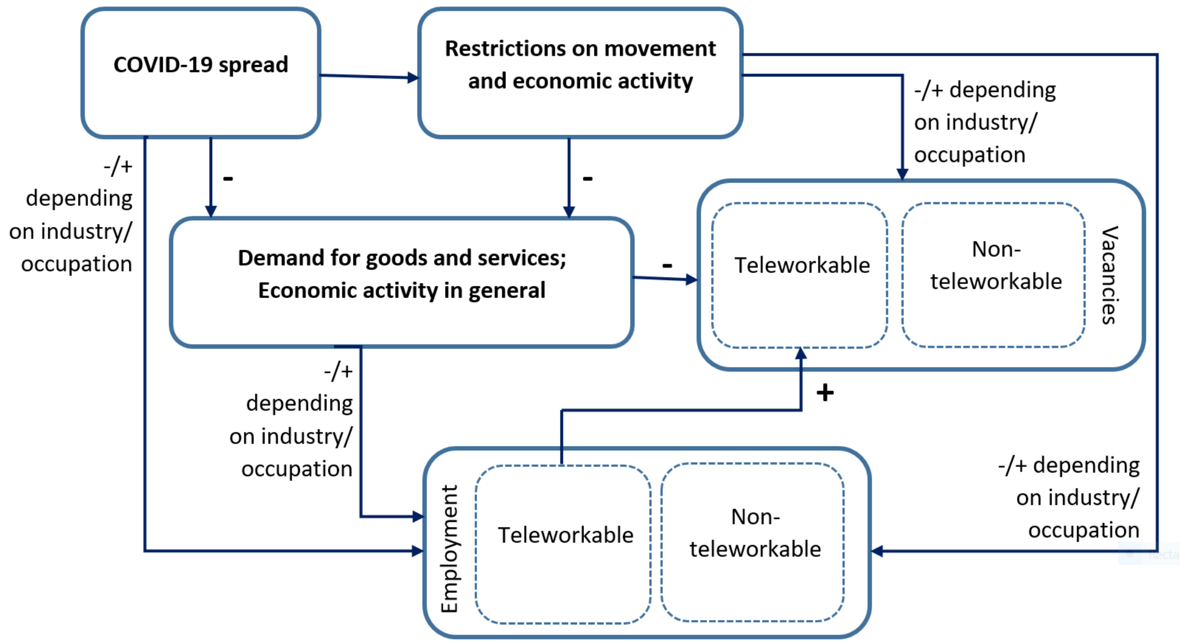


Source: Authors' calculations based on the EMSI Burning Glass data and Dingel & Neiman (2020) occupation classification.

Conceptual model – Link between teleworkability and labor market resilience

How could the ability to telework influence local labor market resilience during COVID-19? As follows from Figure 3, the relationship is not straightforward, as multiple processes are unfolding simultaneously and their links to the outcomes of interest (resilience of labor market) would depend on the industrial and occupational composition. While the figure is not intended to depict all the intricacies of the heterogeneity[4], it offers the main channels and differentiates between teleworkable and non-teleworkable occupations in the outcomes. Given that the negative effects from the spread of the virus and of the decrease in economic activity and demand for goods and services that followed affected more readily non-teleworkable occupations, concentration of such jobs in a local economy could serve as a cushion able to soften the blow of the crisis. While mitigating the devastating effects of the pandemic on the labor markets, teleworkability likely turned into a factor directly supporting local demand for goods and services and, hence, for workers.[5]

Figure 3. Conceptual model of the developments in the labor market and the role of teleworking



If one abstracts from the industrial and occupational heterogeneity in the effects and focuses on the scenarios that are expected (are more likely), teleworkability, the share of jobs in a location that can be performed remotely, is expected to be positively linked to employment

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[4] For example, the overall impact of COVID-19 on employment and vacancies is expected to be negative due to suppressed economic activity, except for healthcare professionals, and those supporting the needs of COVID-19 patients in particular. Likewise, while employment and vacancies in brick-and-mortar shops are expected to sharply decline, the demand for and employment of online retail and wholesale-related workers are expected to expand. At another level, restrictions should eventually affect the spread of COVID-19.

[5] Perhaps the most salient deviation from the labor demand dynamics when it comes to teleworkable vs. non-teleworkable occupations is healthcare services. These jobs are naturally often non-teleworkable. In the empirical section we check sensitivity of our results to omitting medical-related occupations from the analysis wherever the data allow doing so.

performance *ceteris paribus.* This is so because restrictions on movement and stay-at-home orders would have minor ability to disrupt the working process provided employees have the needed technology and infrastructure (personal computers and good-quality Internet connection) at home. When it comes to labor demand, however, the effect is ambiguous. On the one hand, teleworkability can have a negative effect on labor demand, as teleworkable jobs are less likely to be shed during the crisis and, combined with overall reduced demand and economic activity, this would translate in lower need for new hires. Forsythe et al. (2020) show that teleworkable occupations experienced a smaller employment loss and fewer UI claims but a similar decline in job postings compared to non-teleworkable occupations. On the other hand, teleworkability can also be positively linked to labor demand through a local demand effect. Teleworkable jobs tend to pay higher wages compared to the non-teleworkable ones (Brussevich et al., 2020; Dingel & Neiman, 2020) and, thus, are likely to contribute to local demand for goods and services supporting labor demand indirectly. Indeed, the study by Tsvetkova et al. (2020) shows that teleworkability in U.S. MSAs was positively related to the number of job postings in the first semester of 2020.

In this paper, we investigate the ability of teleworking to soften the negative impact on urban labor markets during the year when the pandemic hit. We study both direct and indirect effects (interaction with COVID-19-related restrictions) and separately explore a possibility that local teleworkable jobs support labor demand.

Estimation approach

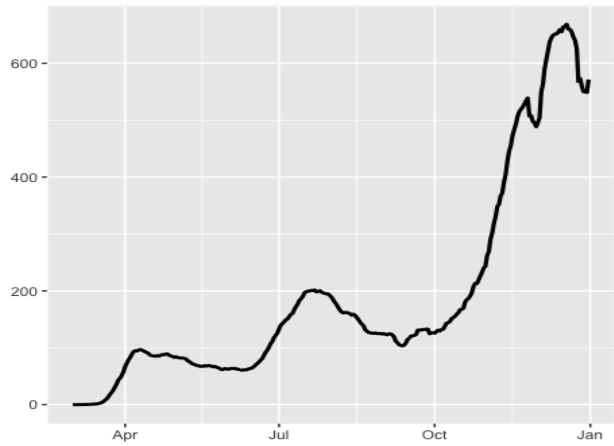
Time period and COVID-19 waves

In this paper, we focus on labor market resilience in the first months of the pandemic, from March to December 2020. While the choice of this timeframe is motivated by data availability, the period is well-suited to answer our research question and to investigate whether teleworkability in the U.S. MSAs was linked to greater resilience of the labor markets. Especially the initial unfolding of the pandemic was an extreme and unexpected emergency. It brought about very high uncertainty, which rapidly translated in changes in labor markets with greater volatility in hiring choices (Campello et al, 2020). During the first wave of COVID-19, almost the entire U.S. population was at some point affected by the lock-down measures

(Baek et al.,2020). Moreover, Brynjolfsson et al. (2020) document that the transitions to remote work were mainly completed by April, with little changes in the consecutive waves despite changing pandemic and economic conditions throughout 2020.

To further explore the link and to allow for a variation in the relationship between teleworkability and labor market resilience over time, we separately analyze three COVID-19 waves that can be observed during 2020 – from March to June, from July to September and from October to December (Figure 4).

Figure 4. U.S. daily new confirmed COVID-19 cases per million people in 2020



Note: Seven-day rolling average

Source: Our World In Data, https://ourworldindata.org/

Dependent variable – labor market resilience based on employment and online job vacancy data

We aim to understand the short-term reaction of labor markets to an external shock, and therefore opt for a commonly used index of labor market resilience that captures resistance and recovery. The measure we use is based on Lagravinese (2015) and Martin et al. (2016). It compares performance of each labor market during a period of study in 2020 to the corresponding period in 2019, last pre-pandemic year (Equation 1), and benchmarks each MSA's performance to the average performance across all MSAs combined (Equation 2). The resultant index is centered around 0, where a positive value suggests that a MSA is more resilient than the average and a negative value implies that an MSA is less resilient than the average. Such approach is widely used in studies of resilience (Cainelli et al., 2019; Giannakis & Bruggeman, 2017).

$$BM_m = \frac{\sum\ LMP^i_{m2020} - \sum\ LMP^i_{m2019}}{\sum\ LMP^i_{m2019}} \quad (1)$$

$$Resilience^i_m = \frac{\frac{LMP^i_{m2020} - LMP^i_{m2019}}{LMP^i_{m2019}} - BM_m}{|BM_m|} \quad (2)$$

BM_m is the benchmark reaction in period m, and refers to the average change in labor market performance (LMP) indicator across all MSAs (i), which is then used to calculate the resilience of labor market in MSA i in period m. We calculate the resilience index for three separate periods according to COVID-19 waves (March-June, July-September and October-December).

To reach more complete representation of the dynamics unfolding during the first months of the pandemic[6] we use two metrics to capture the health of metropolitan labor markets: firstly, total monthly employment and secondly, labor demand as proxied by online job vacancy postings.

Vacancy data was provided by Burning Glass Technologies (BGT), currently EMSI Burning Glass, a company that scrapes up-to-date job postings from online job boards and company websites. Scraped information is saved at a vacancy level and has information on each vacancy's date of posting, location, industry, and occupation, as well as other characteristics such as the name of on employer and required skills.

While the use of this data source in academic and policy research is on the rise (examples include Cammeraat and Squicciarini, 2020; Forsythe et al., 2020; Hershbein & Kahn, 2018), there are obvious advantages and limitations of using these data. In general, the advantages of the data set are granularity, timeliness and sample size. From the perspective of the organization of economic activity in space and for the purposes of this paper, the strength of the data is the granularity of location and, most importantly, occupation data, which is classified at the 6-digit Standard Occupational Classification (SOC) level.

[6] Unfortunately, we are unable to also track hirings and firings, for which data are not available at the MSA level.

Yet, there are several well-documented limitations of this data source that need to be kept in mind. The first limitation is that announcements collected by BGT are a subset of job openings as they by design cover only online postings. Labor demand in industries that are less likely to advertise online (e.g. construction or agriculture) may be higher than what can be inferred from the online vacancy ads. A corollary of this is that the BGT data tend to have more postings for larger cities and for higher-skilled occupations. Nevertheless, the use of Internet to hire workers is expanding, particularly in the U.S. where online job advertisements are very common. The distribution of online job postings across occupations in U.S. MSAs was found to be comparable to that found in the Occupational Employment Statistics (Hershbein and Khan, 2018) and it is hoped that using the last full year of data available to the authors at the time of writing further mitigates this concern.

While the employment data are available only at the MSA level without any additional details, we take advantage of the granularity of the online vacancy data to, first, better understand the trends in the metropolitan labor demand for teleworkable and nonteleworkable occupations during the pandemic and, second, to better fit our models where we are able to remove the influence of the occupation-specific fixed effects. To achieve the former, we use 6-digit occupation teleworkability index developed by Dingel and Nieman (2018) to calculate resilience of labor demand in MSAs separately for teleworkable and nonteleworkable occupations. For the latter, we calculate the resilience index for MSA-occupation pairs for 22 occupational groups[7].

Table 1 shows summary statistics for the 5 different dependent variables. As can be seen from the Table, the two metrics, employment and labor demand, indeed seem to capture differing dynamics in the labor market with labor demand showing quicker adjustments, as evidenced by the changes over time and by the magnitude of the standard deviation. **Error! Reference source not found.**5 shows the maps of the resilience index during the first COVID-19 wave

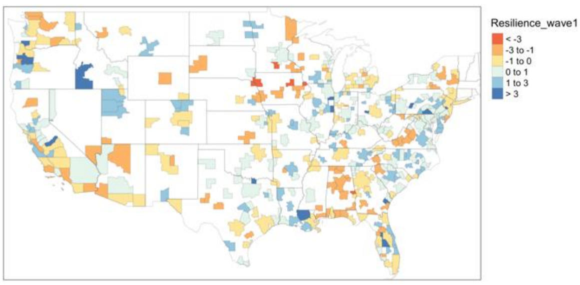
[7] The groups are: (11) Management; (13) Business and Financial Operation; (15) Computer and Mathematical; (17) Architecture and Engineering; (19) File, Physical, and Social Sciences; (21) Community and Social Service; (23) Legal; (25) Education, Training, and Library; (27) Arts, Design, Entertainment, Sports, and Media; (29) Healthcare Practitioners and Technical; (31) Healthcare Support; (33) Protective Service; (35) Food Preparation and Serving Related; (37) Building and Grounds Cleaning and Maintenance; (39) Personal Care and Service; (41) Sales and Related; (43) Office and Administrative Support; (45) Farming, Fishing, and Forestry; (47) Construction and Extraction; (49) Installation, Maintenance, and Repair; (51) Production; (53) Transportation and Material Moving.

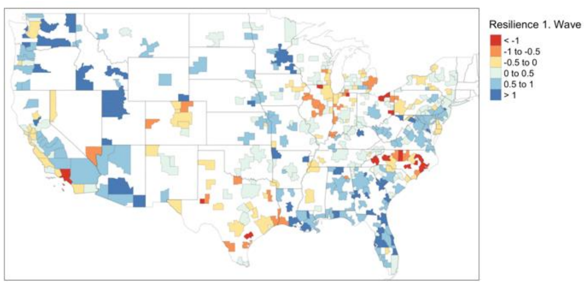
(March – June 2020). Maps of resilience values during the subsequent waves can be found in the Appendix Figure A1 and Figure A2.

Table 1 - Summary statistics Resilience Index

Resilience Index based on employment data, MSA level							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Resilience 1. Wave	364	0.33	0.68	-1.54	-0.06	0.77	2.13
Resilience 2. Wave	364	0.21	0.40	-2.30	0.04	0.45	1.20
Resilience 3. Wave	364	0.28	0.51	-3.03	0.06	0.61	1.46
Resilience Index based on online job vacancies, MSA level							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Resilience 1. Wave	364	0.25	1.58	-4.95	-0.79	1.17	6.69
Resilience 2. Wave	364	1.40	2.47	-5.27	-0.36	2.71	11.01
Resilience 3. Wave	364	2.25	3.35	-6.86	-0.04	4.55	11.43
Resilience index of teleworkable job vacancies, MSA level							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Resilience 1. Wave	364	4.86	15.71	-28.31	-5.00	11.47	79.12
Resilience 2. Wave	364	3.23	4.41	-3.69	0.15	5.07	26.35
Resilience 3. Wave	364	0.98	1.28	-1.02	0.12	1.42	7.67
Resilience index of non-teleworkable job vacancies, MSA level							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Resilience 1. Wave	364	0.51	2.81	-7.51	-1.41	2.03	11.39
Resilience 2. Wave	364	2.40	7.64	-10.58	-2.57	5.32	48.72
Resilience 3. Wave	364	2.30	4.97	-6.59	-0.68	4.19	29.54
Resilience index based on job vacancies, MSA-occupational (2-dig SOC) level							
Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Resilience 1. Wave	7,769	0.53	5.88	-45.83	-1.73	2.34	37.70
Resilience 2. Wave	7,769	1.81	5.57	-24.70	-0.84	3.70	45.57
Resilience 3. Wave	7,769	1.68	5.74	-23.60	-0.69	3.28	44.23

Figure 5. A map of metropolitan labor market resilience during the first COVID-19 wave (left panel - vacancies; right panel - employment)





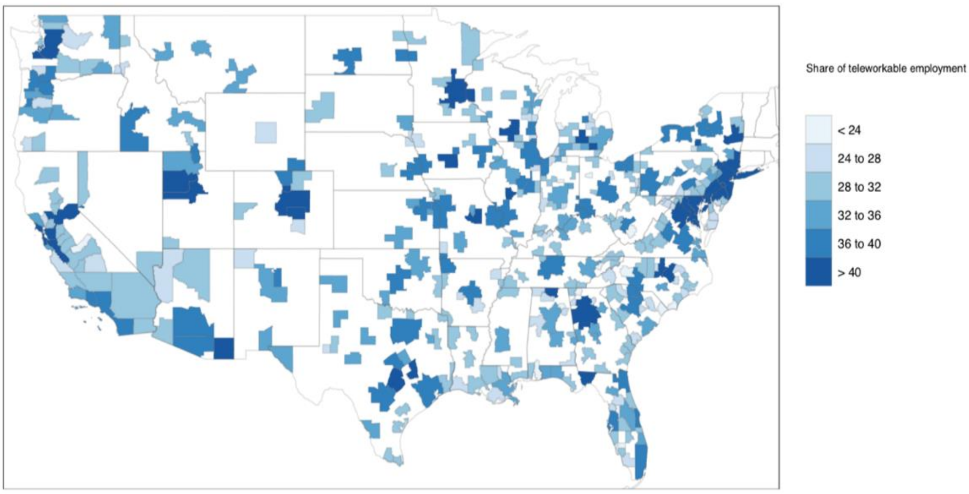
Source: Authors' calculations based on data from EMSI Burning Glass (vacancies) and U.S. BLS

Explanatory variable – teleworkability

The 2018 share of teleworkable jobs in an MSA (teleworkability) is the main explanatory variable. The MSA-level measure is provided by Dingel & Neiman (2020) and is widely used in the related literature (Bartik et al., 2020; Cho et al., 2020; Delventhal, 2020; Tsvetkova et al., 2020 among others). The authors first classify detailed occupations (at the six digits of the SOC developed by the U.S. Bureau of Labor Statistics) by the feasibility of remote work based on surveys of worker experience. In the next step, they merge this classification with the 2018 MSA occupational employment counts to get the share of all jobs in an MSA that can be performed remotely.

Figure 6 shows geographical distribution of the share of employment that can be done remotely across U.S. MSAs. The map shows that larger cities tend to have higher shares of teleworkable jobs. **Error! Reference source not found.**2 lists the top 10 and the bottom 10 MSAs in terms of teleworkability in 2018. The shares vary widely across MSAs, ranging from over 50% in California-Lexington Park (MD) and San Jose-Sunnyvale-Santa Clara (CA) to less than 20% in The Villages (FL).

Figure 6. Share of teleworkable employment, 2018



Source: Dingel & Neiman,2020.

Table 2. MSAs with the highest and the lowest shares of teleworkable jobs

Top 10 MSAs	Share Teleworkable	Bottom 10 MSAs	Share Teleworkable
California-Lexington Park, MD	51.9	Hartford-West Hartford-East Hartford, CT	23.7
San Jose-Sunnyvale-Santa Clara, CA	51.1	Lima, OH	23.5
Washington-Arlington-Alexandria, DC-VA-MD-WV	49.8	Muskegon, MI	23.3
Trenton, NJ	49.5	Daphne-Fairhope-Foley, AL	23.2
Boulder, CO	48.5	Punta Gorda, FL	22.8
Durham-Chapel Hill, NC	46.0	Kahului-Wailuku-Lahaina, HI	22.7
Austin-Round Rock, TX	45.5	Elkhart-Goshen, IN	21.6
Ann Arbor, MI	44.9	Dalton, GA	21.4
San Francisco-Oakland-Hayward, CA	44.8	Gadsden, AL	20.8
Olympia-Tumwater, WA	44.1	The Villages, FL	19.3

Control variables

All models include a set of controls, which are meant to factor out the likely influence of a range of policy, epidemic, economic and social factors that can be linked to the resilience of labor markets.

The presence and severity of restrictions (as well as their enforceability and the willingness of the citizens to follow the guidelines) which aimed at curbing the spread of COVID-19 should be of great relevance to the performance of the labor markets in cities. In the U.S., usually states were imposing such restrictions, which resulted in a heterogenous landscape of COVID-19 response policies. This is related to the federal system of government, but also to rising political contestations (Hale et al., 2020), where the stringency and adherence to restrictions was often a matter of political preferences (Rothwell and Makridis, 2020). To account for the severity of the restrictions, we utilize the Oxford COVID-19 Government Response Stringency Index from the COVID-19 government response tracker, which was developed and maintained by the Blavatnik School of Government at the University of Oxford (Hale et al.,2021). This stringency index measures the intensity of restrictions based on nine response indicators. Among those are school closures, workplace closures, the cancellation of public events, restrictions on gatherings, closing public transport and travel bans. The stringency index ranges from 0-100 and is reported as a daily series at the state level, which we aggregate into an average value over a given wave of the pandemic. For multi-state metropolitan areas, we assigned the state where most of the MSA's population resides.

Further controls include: the spread of COVID-19; MSA population density to account for agglomeration effects (Cho et al., 2020; Duranton & Kerr, 2015); population and wage growth and the unemployment rate to control for pre-crisis economic trends (Martin & Sunley, 2015); related and unrelated variety describe the local economic structure in terms of diversity and relatedness (Boschma, 2015; Xiao et al., 2017) and education (Doran & Fingleton, 2015).

Error! Reference source not found.3 describes all dependent and independent variables and indicates data sources. Summary statistics of the control variables and a correlation matrix of the independent variables as well as VIF statistics for the model estimating the first COVID-19 wave can be found in the Appendix Table A1, Table A2 and Table A3.

Table 3. Variables

Dependent Variables			
	Description	**Data source**	**Period**
Resilience Index - Employment	Relative change in MSA employment compared to change in all MSAs; MSA level	US Bureau of Labor Statistics	Monthly, 2019-2020, aggregated to COVID-19 waves
Resilience Index – Vacancies I	Relative change in MSA job postings compared to change in all MSAs; MSA level	EMSI Burning Glass	Monthly, 2019-2020, aggregated to COVID-19 waves
Resilience Index – Vacancies II	Relative change in MSA job postings per occupational group (2-dig SOC) compared to change in all MSA and occupations; MSA – occupation level	EMSI Burning Glass	Monthly, 2019-2020, aggregated to COVID-19 waves
Independent Variables			
Variable	**Description**	**Data source**	**Period**
Teleworkability	Share of teleworkable jobs, MSA level	Dingel and Neiman (2020)	Annual, 2018
Restrictions	COVID-19 policy stringency, state level.	Oxford COVID-19 Government Response Tracker, Blavatnik School of Government, University of Oxford.	Daily, 2020; averaged to COVID-19 waves.
COVID 19	Confirmed covid cases per month per 10 000 persons	USA Facts, https://usafacts.org/	Daily, 2020; aggregated to COVID-19 waves.
Population density	Population per square mile (in 10000 persons)	US Census Bureau	Annual, 2019
Population growth	Population growth rate	US Census Bureau	Annual, 2013-2019
Wages growth	Wage growth rate	US Bureau of Labour Statistics	Annual, 2013-2019
Unemployment rate	Unemployment rate	US Bureau of Labour Statistics	Monthly, 2020; averaged to COVID-19 waves.

Related Variety	Variety within major industrial sectors (4-dig NAICS) (Frenken at al., 2007)	Upjohn Institute of Employment research (Bartik et al.,2018)	Annual, 2016
Unrelated Variety	Variety across major industrial sectors (2-dig NAICS) (Frenken at al., 2007)	Upjohn Institute of Employment research (Bartik et al.,2018)	Annual, 2016
Bachelor+	% of adults with a Bachelor degree or higher	US Census Bureau	Annual, 2019

Empirical models

To investigate the link between the share of teleworkable employment in an MSA and labor market resilience as hypothesized in the Conceptual model subsection, we estimate an empirical model presented in Equation 3.

$$Resilience_m^i = \beta_0 + \beta_1 Teleworkability^i + \beta_2 Restrictions^i + \beta_3 Controls^i + e_m^i \qquad (3)$$

where $Resilience_m^i$ stands for the resilience index in MSA i in period m, with period referring to one of the COVID-19 waves (March-June, July-September and October- December 2020). $Teleworkability^i$ stands for the pre-pandemic share of teleworkable employment in an MSA as provided by Dingel & Neiman (2020); the vector $Controls^i$ contains control variables, which are discussed in **Error! Reference source not found.**3. All annual control variables are fixed in the last year (or a multi-year period) for which data are available.[8] Equation (3) is estimated at the level of MSAs for both employment and labor demand and at the MSA-occupation level for labor demand only. In the latter case, resilience is calculated at MSA-occupation (22 occupational groups) level and the model is augmented with occupation-level fixed effects to account for potential occupation-specific differences in the link between teleworkability and resilience in labor demand (corresponding subscripts are omitted for simplicity).

The hypothesized positive link between the share of teleworkable jobs and labor market resilience can be impacted by the restrictions in place. Thus, as a robustness check, we also estimate Equation (4), which adds an interaction term between the share of teleworkable jobs pre-pandemic and the severity of the anti-COVID-19 restrictions. To mitigate the problem

[8] Earlier estimated models included state fixed effects, which we had to omit due to a high collinearity between them and a measure of COVID-19 restrictions. Since the latter variable is of particular importance for the specific research question we are trying to answer, we opted in favour or restrictions. Models that do not include stringency of restrictions but include state fixed effects give qualitatively similar results to the ones reported in this paper.

of multicollinearity, which routinely arises in such regressions, the teleworkability and the severity of restrictions variables were demeaned by subtracting the mean value of the variable. All subscripts and superscripts have the meaning identical to Equation (3).

$$Resilience_m^i = \beta_0 + \beta_1 dmTeleworkability^i + \beta_2 dmRestrictions^i + \beta_3 dmTeleworkability^i * dmRestrictions^i + \beta_4 Controls^i + e_m^i \quad (4)$$

To further investigate the relationship between teleworkability and labor market resilience in the U.S. MSAs, we repeat the analysis by estimating Equations (3) and (4) separately for teleworkable and nonteleworkable occupations (defined at six-digit SOC code level by Dingel & Neiman, 2020) and separately for smaller (up to 500 thousand residents) and larger (above 500 thousand residents) MSAs.

Estimation results and discussion

Main analyses

There are several mechanisms at work that can link teleworkability to the two components of the metropolitan labor market resilience as discussed in the Conceptual model section. The link between the share of teleworkable employment and total employment is likely to be positive, while the link to the labor demand can be both positive and negative. Table 4 shows estimation results for the main explanatory variables and three models, resilience index based total employment, total vacancies in an MSA and vacancies in an MSA-occupation pair. Each model is separately estimated by time period. Full estimation results are provided in the online Appendix. The Table shows that indeed there is a positive association between the pre-pandemic share of jobs that can be performed remotely, and labor market resilience approximated by employment. The coefficient is positive and statistically significant in all three time periods. When it comes to vacancies, regardless of the specification, a positive relationship is detected only during the first, and the most profound in terms of labor market collapse, COVID-19 wave. The size of the coefficient shows that an MSA with one more percent of teleworkable jobs tended to have their resilience index higher by 0.02 when based on employment, by 0.05 when based on aggregate MSA-level vacancies and by 0.06 when based on vacancies in MSA-occupation groups during the first wave. Examples of such differences are Chattanooga, TN-GA and Madison, WI for employment; New Bern, NC and

Chicago-Naperville-Elgin, IL-IN-WI for aggregate MSA vacancies as well as Buffalo-Cheektowaga-Niagara Falls, NY and Philadelphia-Camden-Wilmington, PA-NJ-DE-MD.[9]

[9] The first example in each pair is selected around the mean value of resilience.

Table 4. Estimation results for all sample, no interaction

Variables	Employment			Vacancies, Model I			Vacancies, Model II		
	March-June	July-September	October-December	March-June	July-September	October-December	March-June	July-September	October-December
Teleworkability	0.024**	0.024***	0.017**	0.053**	0.007	-0.059	0.058**	0.022	-0.029
	(0.011)	(0.004)	(0.007)	(0.023)	(0.033)	(0.041)	(0.020)	(0.018)	(0.018)
Restrictions	0.005	-0.008***	0.009**	0.038**	0.039**	-0.037	-0.004	0.021**	-0.011
	(0.007)	(0.002)	(0.004)	(0.018)	(0.017)	(0.028)	(0.015)	(0.009)	(0.012)
COVID-19, log	0.063	-0.025	0.031	-0.029	-0.033	-0.521	0.055	-0.088	-0.589***
	(0.039)	(0.027)	(0.061)	(0.095)	(0.184)	(0.443)	(0.079)	(0.099)	(0.171)
Constant	1.586	2.418***	1.928**	-1.558	7.278**	25.510***	4.810**	13.915***	23.191***
	(1.050)	(0.360)	(0.628)	(2.017)	(2.789)	(4.727)	(1.750)	(1.545)	(1.869)
Observations	364	364	364	364	364	364	7841	7853	7886
Adjusted R-squared	0.156	0.567	0.444	0.099	0.172	0.290	0.051	0.059	0.097

Note: *** - significant at the 0.01 level; ** - significant at the 0.05 level, * - significant at the 0.1 level. All models include population density, population growth, wages growth, unemployment rate, unrelated industrial variety, related industrial variety and share of population with Bachelor degree or higher as controls. Robust standard errors in parentheses.

To probe the possible mechanism of the link between teleworkability and labor demand, we estimate the vacancy models separately for teleworkable and nonteleworkable occupations by period (Table 5). The results suggest that the positive association between the share of teleworkable jobs and online job postings reported in Table 4 is through an indirect income mechanism. If teleworkable jobs were less likely to be shed during the pandemic and they, on average, tend to be higher-paid, local demand for goods and services that remote workers generate is likely to translate into more job openings in nonteleworkable occupations keeping everything else constant.

Table 5. Estimation results for teleworkable and nonteleworkable occupations, no interaction

Variable	**Teleworkable**			**Nonteleworkable**		
	March-June	**July-September**	**October-December**	**March-June**	**July-September**	**October-December**
Teleworkability	0.055	0.070	-0.016	0.088**	0.037	0.007
	(0.217)	(0.056)	(0.015)	(0.044)	(0.098)	(0.065)
Restrictions	-0.050	0.013	0.007	0.074**	0.065	0.032
	(0.178)	(0.033)	(0.012)	(0.034)	(0.055)	(0.037)
COVID-19, log	0.969	-0.802**	-0.105	-0.067	-0.573	0.470
	(0.921)	(0.288)	(0.165)	(0.166)	(0.608)	(0.707)
Constant	49.786**	30.529***	11.342***	-3.429	27.619**	29.269***
	(18.995)	(4.978)	(1.942)	(3.695)	(8.959)	(7.815)
Observations	364	364	364	364	364	364
Adjusted R-squared	0.076	0.206	0.341	0.102	0.133	0.237

Note: *** - significant at the 0.01 level; ** - significant at the 0.05 level, * - significant at the 0.1 level. All models include population density, population growth, wages growth, unemployment rate, unrelated industrial variety, related industrial variety and share of population with Bachelor degree or higher as controls. Robust standard errors in parentheses.

In the next step of the analysis, we explore potential geographical differences in labor market resilience in U.S. MSAs. Figure 1 suggests that there were differences in labor market performance across smaller and larger MSAs. We follow the grouping of Figure 1 and divide all Metropolitan Statistical Areas into those below 500 thousand residents (Small) and those above (Large). Table 6 presents estimation results and shows that the positive association between teleworkability and labor market resilience is more likely to be detectable in small MSAs. It is true for both the employment and vacancies metrics. There is also some variation over time with the link being statistically significant also for large MSAs during the second COVID-19 wave (July-September 2020). In this period, the relationship between the share of jobs that can be performed remotely and the resilience of employment indicators is positive and statistically significant at the 0.05 level but it is negative for the resilience of job postings. It appears that the negative mechanism hypothesized in the Conceptual model subsection outweighs the positive one. Indeed, the strength of the negative mechanisms would be expected to be greater in regions with more teleworkable jobs, such as larger cities.

The final set of results for the main model is shown in Table 7. Differences in the link between teleworkability and labor market resilience measured by online job vacancies are probed in this specification. The results generally confirm observations from the previous tables. A positive relationship tends to be detectable in the beginning of the pandemic, in small MSAs and it appears stronger for nonteleworkable occupations.

Overall, our analysis supports the idea that concentration of teleworkable jobs in an MSA can enhance the resilience of local labor markets. For employment, teleworkability can offer protection as the activities do not need to be discontinued (and jobs shed) when normal operations from the office become impossible. For vacancies, while we cannot specifically test for it, the results are in line with a hypothesized demand mechanism. The positive link between the share of teleworkable jobs and labor demand during the study period is more consistently observed for nonteleworkable occupations. Since jobs that can be performed remotely, on average, pay higher wages compared to jobs that require physical presence (Brynjolfsson et al., 2020; Dingel & Neiman, 2020) and they were less likely to be shed (Cajner et al., 2020; Cortes and Forsythe, 2020), we conclude that the ability of teleworkable employees to sustain local demand for goods and services likely supported metropolitan labor markets in the beginning of the pandemic. Yet, the regression analysis also shows that teleworkability is not a panacea - it can be unrelated or even negatively related to the resilience of labor demand in teleworkable occupations. Given the evidence that the number of job postings contracted more in teleworkable occupations (**Error! Reference source not found.**2 and Forsythe et al., 2020), this is not unexpected. It may, however, have negative implications for post-pandemic recovery if demand for teleworkable occupations is not picking up (Campello et al., 2020).

Table 6. Estimation results for all sample by size, no interaction

	Employment						Vacancies, Model II					
	March-June		**July-September**		**October-December**		**March-June**		**July-September**		**October-December**	
	Small	**Large**	**Small**	**Large**	**Small**	**Large**	**Small**	**Large**	**Small**	**Large**	**Small**	**Large**
Teleworkability	0.030**	-0.001	0.023***	0.028**	0.015*	0.018	0.077***	0.015	0.069**	-0.112***	-0.032	-0.037
	(0.012)	(0.022)	(0.005)	(0.009)	(0.008)	(0.012)	(0.023)	(0.042)	(0.021)	(0.032)	(0.022)	(0.035)
Restrictions	-0.001	0.024**	-0.009**	-0.007	0.005	0.015**	0.000	-0.028	0.021*	0.027**	-0.006	-0.007
	(0.008)	(0.012)	(0.003)	(0.004)	(0.004)	(0.006)	(0.018)	(0.023)	(0.012)	(0.012)	(0.015)	(0.016)
COVID-19, log	0.062	0.037	-0.027	-0.041	0.003	0.120	0.062	0.259	-0.031	-0.132	-0.651***	-0.240
	(0.043)	(0.095)	(0.030)	(0.048)	(0.070)	(0.117)	(0.088)	(0.160)	(0.108)	(0.191)	(0.194)	(0.292)
Constant	2.536*	0.081	2.834***	2.352	2.816***	0.155	0.500	12.926**	7.465***	27.155***	25.670***	20.394***
	(1.379)	(2.211)	(0.480)	(1.530)	(0.826)	(1.828)	(2.408)	(4.665)	(2.256)	(3.611)	(2.658)	(4.002)
Observations	264	100	264	100	264	100	5643	2198	5653	2200	5686	2200
Adjusted R-squared	0.145	0.296	0.531	0.656	0.410	0.580	0.074	0.025	0.064	0.154	0.091	0.113

Note: *** - significant at the 0.01 level; ** - significant at the 0.05 level, * - significant at the 0.1 level. All models include population density, population growth, wages growth, unemployment rate, unrelated industrial variety, related industrial variety and share of population with Bachelor degree or higher as controls. Robust standard errors in parenthese

Table 7. Estimation for teleworkable and nonteleworkable occupations, by size, no interaction

Variable	Teleworkable						Nonteleworkable					
	March-June		**July-September**		**October-December**		**March-June**		**July-September**		**October-December**	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Teleworkability	0.124	-0.303	0.122*	-0.119	-0.020	-0.020	0.132**	-0.054	0.095	-0.100	0.006	-0.017
	(0.271)	(0.296)	(0.065)	(0.095)	(0.019)	(0.021)	(0.054)	(0.077)	(0.122)	(0.204)	(0.077)	(0.114)
Restrictions	0.055	-0.326	0.023	-0.015	0.008	-0.010	0.090*	0.021	0.067	0.083	0.050	-0.021
	(0.228)	(0.242)	(0.043)	(0.044)	(0.015)	(0.010)	(0.046)	(0.043)	(0.070)	(0.078)	(0.049)	(0.050)
COVID-19, log	0.904	1.891	-0.881**	0.136	-0.124	-0.144	-0.147	0.515	-0.613	-0.652	0.641	-0.477
	(1.063)	(1.141)	(0.320)	(0.712)	(0.192)	(0.167)	(0.179)	(0.330)	(0.679)	(1.156)	(0.813)	(0.905)
Constant	4.344	173.421**	23.831***	47.859***	12.872***	10.020**	-10.616**	7.941	29.225**	20.630	34.311**	20.956
	(26.079)	(53.178)	(7.015)	(13.625)	(2.709)	(3.572)	(5.266)	(8.247)	(12.549)	(24.176)	(10.986)	(17.132)
Observations	264	100	264	100	264	100	264	100	264	100	264	100
Adjusted R-squared	0.076	0.208	0.156	0.212	0.245	0.296	0.136	0.055	0.129	0.108	0.182	0.272

Note: *** - significant at the 0.01 level; ** - significant at the 0.05 level, * - significant at the 0.1 level. All models include population density, population growth, wages growth, unemployment rate, unrelated industrial variety, related industrial variety and share of population with Bachelor degree or higher as controls. Robust standard errors in parentheses

In terms of control variables, it is worth highlighting that the spread of COVID-19 (measured by the daily average number of cases per 10000 residents) is not statistically significant in almost all specifications, a result that also Forsythe et al. (2020) and Tsvetkova et al. (2020) observe. Curiously, the severity of restrictions tends to be positively related to the resilience of metropolitan labor markets. This might reflect the fact that introducing and following the restrictions in the U.S. tended to be linked more to political inclinations of governors, mayors and the population at large than to the gravity of the health situation. On average, if better-performing places were more likely to introduce restrictions, which on the surface would seem plausible, the coefficient would pick up this situation. We also find that both related and unrelated industrial variety tended to have a persistent negative association with labor market resilience. While previous literature mostly found a positive effect of related variety on regional economic resilience (Cainelli et al., 2018; Xiao et al., 2017), in our focus on the very short-term, related variety appears to exacerbate the demand shock by potential contagion effect across related industries (Acemoglu et al., 2013). More educated MSAs tended to have lower labor market resilience during the studied period – likely a reflection that larger cities, where the average level of educational attainment is higher, were hit harder in the beginning of the pandemic. Population density was negatively linked to the resilience of the metropolitan labor markets measured by employment but positively to the resilience measured by vacancies. This could offer an additional indirect support to the hypothesized income mechanisms behind the link between teleworkability and labor demand. Other significant coefficients are in line with expectations. MSAs with greater levels of unemployment performed worse, while faster growing cities tended to have more resilient labor markets.

Additional analyses

A series of additional analyses were performed to explore the sensitivity of the reported results to alternative specifications.[10] Table 8 reports results for a full sample model, which additionally includes an interaction between the share of teleworkable employment and the anti-COVID-19 restrictions (the full estimation results, as well as interaction models for all other specifications, are reported in the online Appendix). The main results in Table 8 are in

[10] In addition to the reported results, all models (except for employment) were re-estimated omitting medical occupations. The results remain virtually identical to the ones reported in the paper (available upon request from the authors).

line with the ones reported previously. For labor demand resilience, however, the table reveals the likely presence of the interaction effects. In MSAs with more severe restrictions, the positive association between teleworkability and job postings tends to be of smaller magnitude, at least in the beginning of the pandemic.

Table 8. Estimation results for all sample, interaction model

Variable	Employment			Vacancies, Model I			Vacancies, Model II		
	March-June	July-September	October-December	March-June	July-September	October-December	March-June	July-September	October-December
Teleworkability demeaned	0.028**	0.024***	0.020**	0.087***	0.021	-0.035	0.079***	0.043**	-0.005
	(0.013)	(0.004)	(0.008)	(0.026)	(0.033)	(0.046)	(0.022)	(0.018)	(0.020)
Restrictions demeaned	0.005	-0.008***	0.009**	0.045**	0.042**	-0.040	-0.002	0.024**	-0.013
	(0.007)	(0.002)	(0.004)	(0.019)	(0.017)	(0.029)	(0.015)	(0.009)	(0.012)
Teleworkability demeaned# Restrictions demeaned	-0.001	0.000	0.001	-0.006**	-0.010**	0.005	-0.004**	-0.012***	0.005***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)
COVID-19, log	0.063	-0.026	0.032	-0.022	-0.000	-0.510	0.051	-0.049	-0.569***
	(0.039)	(0.026)	(0.060)	(0.095)	(0.189)	(0.435)	(0.079)	(0.099)	(0.171)
Constant	2.762**	2.664***	2.935***	3.507*	10.974***	20.621***	7.223***	17.153***	20.735***
	(1.068)	(0.389)	(0.647)	(1.928)	(3.021)	(4.529)	(1.721)	(1.664)	(1.842)
Observations	364	364	364	364	364	364	7841	7853	7886
Occupation FE	No	No	No	No	No	No	Yes	Yes	Yes
Adjusted R-squared	0.164	0.566	0.444	0.108	0.195	0.291	0.051	0.065	0.099

Note: *** - significant at the 0.01 level; ** - significant at the 0.05 level, * - significant at the 0.1 level. All models include population density, population growth, wages growth, unemployment rate, unrelated industrial variety, related industrial variety and share of population with Bachelor degree or higher as controls. Robust standard errors in parentheses.

2. Conclusions

Teleworking is heralded as a potential key to labor market resilience during pandemics caused by a contagious disease. For less central regions and smaller cities, teleworking can offer hope for additional growth, both in terms of population and economic performance. The attention to the regional economic effects of teleworking so far seems stronger in policy discussion that in the academic one. Policy makers seem attuned to the idea of advancing economic prospects of their regions through teleworking. As the modalities of work are changing, teleworking indeed might offer an additional lever, especially to the amenity-rich places. Yet, the expectations of the positive effects should rely on the results of empirical research, which is able to inform corresponding policy design. This paper is a contribution to building the knowledge base on the link between teleworking and regional economic outcomes. In particular, it investigates the relationship between the pre-pandemic share of jobs that can be performed remotely and labor market resilience in the U.S. MSAs during 2020, the year when the pandemic started.

Our knowledge on the link between teleworking and economic performance is naturally limited. Mass adoption of remote work is a very recent phenomenon triggered by the COVID-19 pandemic and the many restrictions imposed by the governments to curb its spread. Research on the past crises, while providing many useful insights into the factors related to regional economic resilience, are only partially able guide us now, as the ongoing crisis has different origins.

We find a spatially uneven pattern of labor market resilience across MSAs and that the pre-crisis concentration of teleworkable jobs may partly explain this pattern. Our analysis documents a generally positive link between the teleworkability of a local economy and its labor market resilience during the COVID-19 pandemic when it comes to employment. The positive link between teleworkability and labor demand resilience, on the other hand, is dependent on several other factors. First, it is observable mostly during the first wave of the pandemic, when the labor markets were hit unexpectedly and most profoundly. In the subsequent periods, the link mostly disappears. Second, it appears that smaller cities were able to benefit from the teleworkability of their economies as the relationship is usually statistically insignificant in larger cities. Finally, positive and statistically significant coefficients emerge more often in the models focusing on the nonteleworkable occupations. This implies that the overall positive link between teleworkability and labor market resilience (at least in the labor demand part) seems to stem from the indirect income effects where generally higher wages of remote workers could have supported local labor markets.

The results of this paper bring up several considerations important for regional policy. First, as the paper does not establish a causal relationship, additional analyses are needed to better understand the *effects* of teleworking on labor markets in regions. The effects will likely vary in different types of places and a more precise knowledge of how and where teleworkability can contribute to economic performance is needed to design more efficient policies. Our analysis already offers insight in this vein – we document a consistent positive link between teleworkability and labor market resilience measured by both employment and labor demand in smaller cities. Second, although we are unable to probe the mechanisms behind the observed relationship for employment, the evidence from labor demand seem to suggest that income effects do exist. In other words, the presence of (usually higher paid) remote workers in an economy is associated with greater demand for nonteleworkable occupations.

If regions choose to pursue teleworking as a part of their economic development strategy, the following would be of importance for the success. A comprehensive coverage of a reliable and high-quality IT infrastructure becomes a must. Regions can strengthen conditions for teleworking by investing in IT infrastructure, providing support for remote work to firms and employees as necessary and by investing in digital education and skills (OECD, 2020b). Telework is not only an effective tool to continue business operation during a pandemic but can also act as an emergency response in the case of extreme weather events or other scenarios where commuting would not be considered safe. Moreover, teleworking is likely here to stay (OECD, 2020a). Bartik et al. (2020) uncover that more than one-third of U.S. firms, which switched to telework during COVID-19, believe that telework will remain common at their company even after the pandemic. Telework may also provide several public benefits such as enhanced aggregate productivity, geographical dispersion of employment and reduced carbon emissions if fewer commutes would be necessary (Clancy, 2020). Thus, regional policies which enhance teleworkability can prepare regions to be more resilient in front of a variety of potential crisis as well as support economic development in general.

The analysis in this paper can be further extended and improved as more data become available. The first goal would be to establish causality and to investigate the heterogeneity of the effects depending on the specific regional conditions. Another important improvement would be to use a more comprehensive and up to date measures of teleworkability and labor market indicators, which can include, in addition to vacancies and employment, firings and other types of separations, unemployment, labor market participation rates among other relevant metrics. Lastly, the widespread adoption and continued use of telework will likely have comprehensive repercussions on the distribution of economic activity within and across geographies (Clancy, 2020; Delventhal et al., 2021) which requires additional attention to this quite new phenomenon in order for regions and cities to be able to maximize the opportunities opened by these processes and mitigate the possible risks.

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