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# The Role of Institutions in Job Teleworkability Before and After the Covid-19 Pandemic

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## Abstract

The teleworkability of jobs – whether they can and will be performed remotely – has been increasingly contested in the aftermath of the COVID-19 pandemic. To explain which jobs are teleworkable and why, we emphasize the institutional context of a job, including differences among firms, union representation, professional licensing requirements, sector, and employment models. Using a novel dataset of job characteristics extracted from the text of a large sample of online job advertisements from 2010-2021, we examine various explanations for change in the availability of remote job opportunities. Prior to the pandemic, private sector, non-union, and unlicensed jobs lagged federal government, union, and licensed jobs in the growth of telework. Firms are the largest source of variance in remote job offerings relative to other obvious alternatives (technological feasibility, occupation, sector, geography). After March 2020, between-firm differences increased, and institutions influenced the rate of telework adoption.

Keywords: flexible work, technology, institutions, institutional change, remote work.

JEL Codes: J60, J50, J44, J22, O30, R12

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## **Introduction**

Conflicts over job teleworkability – the capacity of a job to be done remotely at high quality – have increased in the aftermath of the COVID-19 pandemic. In the twenty years prior to March 2020, the share of jobs teleworked in the United States increased slowly, and only 8.9 million or 5.7% were worked from home at the time of the pandemic, according to the 2019 one-year estimate from the American Community Survey (2019). In contrast, the Current Population Survey (2022) reported that 48.7 million persons, or 35.4% of all employed persons, worked from home due to COVID-19 in May 2020. Tens of millions of people subsequently lost the opportunity to work remotely as they were recalled to the office, while millions of others gained permanent opportunities to perform their jobs remotely.

Understanding why a job is or is not teleworkable is an opportunity to explore the societal, institutional, and technological forces that can transform workplace structure. Many industrial relations scholars point toward the embedded social and political contexts surrounding a job as sources of change and stability in workplace organization, but there is little understanding of how such institutions affect change in the teleworkability of jobs. To understand the variation in remote work outcomes attributable to the institutional context of a job, we compare and contrast “institutional teleworkability” with efficiency and technology driven explanations that we call “task teleworkability.” We propose that a job’s teleworkability is realized only when institutions surrounding a job enable, or are renegotiated to enable, new modalities of work.

Research addressing which jobs are teleworkable, and how many teleworkable jobs there are, has so far emphasized the role of tasks. As with earlier interest in the outsourcing and offshoring of white-collar jobs and other future of work studies, research studying telework has

examined how new technology enables telework, but only for workers who perform certain tasks – those that can be done remotely at high quality. Under this task approach to teleworkability, technology transforms workplace structure by altering the efficiency with which existing jobs can be done in person or remotely.

Scholars have criticized such “technological determinism” and called for greater attention to the social, political and institutional underpinnings of technological transformation in areas such as job automation (Belloc et al. 2022). Understanding why some jobs are teleworkable requires emphasizing forces beyond the tasks constituting jobs or the efficiency effects of new technologies. Technological advances alone were clearly insufficient to explain the adoption of remote work with the onset of COVID-19.<sup>1</sup> Just as tasks have been used in research to predict whether new technologies mean a job *can* be done remotely, we study how institutions affect whether a job *will* be done remotely.<sup>2</sup> Institutions might facilitate or impede remote work adoption, but large-scale data to describe the role of institutions in the teleworkability of jobs has mostly been unavailable to researchers.

In this paper, we test institutional effects on job teleworkability that include the firm in which a job resides, whether the job is unionized, requires a professional license, or has employee or independent contractor status. We build a novel dataset of variables extracted from a large sample of U.S. online job listings, and create new measurements of job and firm-level

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<sup>1</sup> In the United States, the percent of workers working from home was 5% in the year before COVID per the ACS. Data collection post-COVID by Barrero, Bloom, and Davis (2021) suggest the percent working from home increased to 46% on average from May - December 2020, 34% on average in 2021, and 31% from January-July 2022. Sources: 2019 American Community Survey (ACS) for pre-COVID.

<sup>2</sup> Institutions as used here include the way things are ordinarily done in a given context (“institutionalized practices”) as well as formal laws and rules. As a concept, “institutional teleworkability” is meant to be a broad description of the routines, social context, firm practices, power, politics, rules, and lobbies that shape the organization of work and includes firm to firm idiosyncrasies, ideologies of management. The interests of workers, managers, and owners, and the actions of licensing bodies, trade organizations, unions, and government policy within a given context are some examples of what we mean by the institutional context of a job.

institutional characteristics that affect the organization of work. We also construct a new measure of the extent of remote work opportunities based upon whether job advertisements offer remote work. We build a dataset with this and other features by applying context rules and machine learning trained models to the text of over 290 million job listings from EMSI Burning Glass Technologies covering January 2010 – February 2021. Our analysis of this dataset indicates that institutional differences explain much of the variation in remote work often attributed to technological change.

### **Explaining Recent Changes in Workplace Organization**

The industrial relations literature on workplace change has emphasized that workplace practices are embedded in social and political context, including laws, culture, organizational practices, and historical circumstances (Jacoby 1990). Since the 1980s, scholars interested in workplace trends in the U.S. emphasized growing flexibility in various forms, including the notion of flexible specialization, geographic flexibility (offshoring, remote work), and flexible organization structures (outsourcing, gig work / independent contractors, and the fissured workplace) (Piore and Sabel 1984; Kalleberg 2009; Weil 2014). In part, an emphasis on workplace flexibility was due to the rise of greater global competition, growing instability, and increased economic dynamism. As a result, Vallas (1999) argues that many analysts have replaced contextual social and political analysis with efficiency criteria as core to understanding how workplace practices change.

Theories of industrial relations change often assign a key role to technology. For example, assembly lines and industrial Fordism were key to the development of job control unionism in the United States (Piore and Sabel 1984). By creating new conditions and possibilities,

technology helps to drive workplace outcomes in each historical era; even so, institutional theories emphasize that the structure of work is largely shaped by political and social conditions. For example, job control unionism lasted for 40 years in part due to a cessation of contestation between capital and labor over the New Deal Industrial Relations System (Erickson and Kuruvilla 1998).

Transformations of employment relationships have long been argued to be preceded by advances in technology, including advances in information and communication technology (ICT) in recent decades. The growing flexibility in workplaces has been accompanied by greater geographic mobility for white collar knowledge workers, which ICT may facilitate through lowering mobility frictions that impede new forms of work such as telework, offshoring and outsourcing (Choudhury 2022). ICT enabled new workplace arrangements (on/off premises, inside/outside of the firm, and onsite / offshore of a given national context). In these configurations, one can see the growth of multiple non-traditional work structures including offshoring, outsourcing, remote work, global platform work, and virtual companies (Erickson and Norlander 2022). These new models for structuring work, in turn, each require and embed a distinct social structure – an institutional context, in other words. While robotics and artificial intelligence technologies may require separate attention, “the underlying context for each industry—the core US industrial relations framework—proves consequential” (see, e.g., Litwin et al. 2022).

Institutional theories of change vary across social science disciplines. An informal set of “institutionalized practices” or the automatic routines, assumptions, and tacit understandings that people in a context have often determines behavior until disrupted (Zucker 1977). Institutionalization, while often rational, can produce inefficiencies and is often linked to the

state or regulation (Zucker 1987). Rather than being the best or optimal, institutions and formal organizations mediate pure efficiency logic; bounded rationality and standardized practices are one limit (Simon 1947), and “satisficing” logic is another (Cyert and March 1992); symbolic adoptions of new trends amid continuity in practices are another example drawn from the sociological literature (Meyer and Rowan 1977).

Technology has changed what work *can* be done remotely with high quality and low costs, but a winding institutional path determines what work *will be* done remotely. Institutions will likely both steer the governance of technologically-transformed flexible work systems, and facilitate innovation in workplace practices (De Stefano 2018; Aloisi and De Stefano 2020). Labor institutions that enhance worker voice can complement investments in advanced technologies through better information flow, cooperation between labor and management, and superior work organization (Belloc, Burdin, and Landini 2022). Institutions such as labor unions and professional organizations can reduce supervisor opportunism, and allow groups of employees to express preferences, even diverse preferences, without encountering free-rider problems that inhibit individuals from expressing true preferences for amenities such as telework (Kaufman and Levine 2000). This suggests complementarity between institutions and telework.

As institutional analyses often proceed through case study, observation, or analysis of a small sample, evidence that institutions help to determine the extent of telework may be dismissed for offering mid-range theories lacking generalizability, representing only the epiphenomena of an ongoing efficiency-driven transformation.<sup>3</sup> The common critique for narratives built around such

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<sup>3</sup> Institutional theories can also be contrasted with contingency theories at a firm or industry level. Contingency theories might offer a local explanation for why some firms adopt ICT innovations enabling telework, and why others do not. Form et al. (2017) suggest research should focus on contingencies affecting teleworkability at the establishment level. Nachum and Zaheer (2005) find that firms in low information-intensive industries seek efficiencies offshore, while firms in highly information-intensive industries seek knowledge onsite. Literature building upon such contingencies is often limited by case study and comparative approaches at a small number of firms or industries, leading to findings that cannot always be reconciled.

“just-so” stories is that they lack theory, quantitatively testable empirical hypotheses, and data. In the absence of a clear institutional narrative to explain durability and change in workplace structure in the technologically-transformed workplace, scholars have advanced a parsimonious theory of “task teleworkability” to answer the question of what jobs are teleworkable.

### **Task Teleworkability**

The “task approach” to labor market analysis considers the role of skills, tasks, and technological capabilities in offshoring, automation, and the future of work (Autor 2013). By starting with the constituent tasks that are part of a job’s duties, the task approach focuses on “task bundles.” For example, tasks can be routine or non-routine, cognitive or physical, abstract, analytical, managerial, etc. This approach highlights the impact of technological change on work structure, occupations, and labor markets (Acemoglu and Autor 2010). Specifically, technology exerts a teleological effect on workplace organization by augmenting employers’ demand for certain job tasks.

To answer the question of what makes a job teleworkable, scholars using a task approach examine the routine duties of a job, and ask whether the job’s tasks can be performed remotely with high quality (e.g., Bai et al. 2021; Dingel and Neiman 2020; Dey et al. 2020). Before the current interest in telework, Blinder (2006) studied tasks to argue that ICT-enabled changes will shift work to lower cost offshore locations according to the logic of economic efficiency. The “offshorability” and “teleworkability” scales both draw from a task approach, and feature prominently in discussions of the future of work: the number of “offshorable” or “teleworkable” jobs in the economy has so far largely been measured through analysis of occupational tasks and by pursuing the question of whether in principle technology enables a given occupational bundle



of tasks to be done off premises with high quality (e.g., Dingel and Nieman 2020). This literature largely emphasizes the technological possibilities for transformed work, which we refer to hereafter as “task teleworkability.”

Empirical research adopting a task approach often uses data from the Occupational Information Network (O\*NET Online 2022). O\*NET is built from a detailed survey of individuals who belong to a specific occupation. However, it has limitations: a small and non-representative sample of workers in each occupation, the erasure of intra-occupational task heterogeneity, and infrequent updates (Autor 2013).<sup>4</sup> The task teleworkability of a job is an important piece of information that, if perfectly knowable, indicates whether a job “can” be done remotely at high quality. Dingel and Nieman (2021) estimate that 37% of jobs were in principle teleworkable at the time of the pandemic, much more than the actual share of jobs that were done remotely prior to the lockdown.

### **Institutional Teleworkability**

To address the question “what makes a job teleworkable” we emphasize that jobs are embedded in firms, regulated by laws, professions, and union contracts, and their modality is likely to be shaped by social and political forces within the context of a job. Being subject to contextual factors, institutional teleworkability depends in part upon the political will and managerial skill to structure and restructure organizations to enable jobs to be done remotely. Restructuring work involves changes to organizational practice (Gittell 2016; Brynjolffson,

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<sup>4</sup> O\*NET is a Creative Commons licensed resource built largely through surveys completed by workers with a goal of providing detailed standardized descriptions of specific skills, tasks, and knowledge involved in specific occupations at the level of the Standard Occupational Classification (SOC code). See <https://www.onetonline.org/> for information on the resource, and <https://onet.rti.org/> for details on the data collection involved. O\*NET users rely on an average sample size of 26 respondents and a maximum of 76 respondents for a specific measurement and occupation (see Knowledge measurements in the O\*NET 26.2 database found on <https://www.onetcenter.org/database.html#individual-files>).

Rock, and Syverson 2021). In changing practices, workers' expectations and the social contract at work are impacted, which involves politics and bargaining (Erickson and Norlander 2022). Workplace change often occurs slowly through the "layering" of new elements atop old, and suddenly, in punctuated breaks from past practice (Erickson and Kuruvilla 1998; Doellgast and Benassi 2020; Lipsky, Seeber, and Fincher 2003; Thelen 2004; Streeck 2009).

Telework arrangements are often described in workplace "telework policies" or an individual "telework plan," documents that institutionalize the expectations and terms and conditions of telework. Such documents must strike a balance between equity concerns related to peers, security and privacy guidelines, expectations related to performance, surveillance and monitoring of remote worker output, and so on. Institutions that enhance worker voice can enable greater adoption and implementations of technology (Kaufman and Levine 2000; Belloc, Burdin, and Landini 2022). In the aftermath of COVID-19, some firms temporarily offered a remote work option that was never institutionalized, as seen in the quick recall of many workers back to the office once governmental restrictions were withdrawn. Other firms institutionalized remote work options by creating telework policies and plans, changing job descriptions, updating job advertisements, and adjusting their strategy and systems to manage a remote workforce; in other words, a renegotiation of the social contract at work.

Job contexts where institutions structure incentives in favor of telework, or those where workers have greater power, job protections, and where worker voice is incorporated, could affect the teleworkability of jobs. Thus, in addition to a job that can be remote from a task perspective, the context surrounding a job, including specific characteristics of the job and organization, may also be associated with renegotiations of employment practices to enable

remote work. In the remainder of this section, we describe several specific types of institutions that might influence the adoption of remote work.

*Organizational Policies and Politics: Commitment to Telework in Federal Government Policy*

While technology opened the possibility for greater remote work opportunities, the interests of firms' owners, managers, workers, and other actors must align to make remote work possible. For example, it may simply not be in anyone's interest to make a job teleworkable in a given context. Renegotiating contracts and changing workplace practices involves time, opportunity costs, and uncertain benefits. Given satisficing under ordinary circumstances, work structures often do not change. Instead, an alignment of incentives is required to enable telework. Certain industries, such as commercial real estate and municipal governments, have financial interests in ensuring workers return to downtown office buildings that were vacated in the aftermath of COVID-19. In other contexts, incentives might align more favorably with a remote work agenda.

A prominent example of how political interest alignment and policy enactment can further the spread of remote work is apparent in a multi-decade effort to embed telework into federal government employment. Efforts that shape the modern approach to telework in the federal government began in earnest around 1990. In 1989, telework was proposed for disaster preparedness planning; in 1990, legislation covered the cost of telephone lines, and telecommuting equipment for federal teleworkers; in 1993, telework programs for disabled workers began; also in 1993, federal climate change action planning recommended telework; throughout the 1990s, local and state governments in the Washington area encouraged federal workers to telework to reduce traffic and bolster the regional economy; since 1994, federal

agency heads were required to establish family-friendly work arrangements including telework (Wendell 2001). The current model for telework that is backed by legislation emerges from the pilot programs and flexible family-friendly policies first implemented in the 1990s (ibid). Critical decisions in the first decade included revoking Department of Labor and Occupational Safety and Health Administration memoranda that would have made employers liable for workplace safety in the home (ibid). Following these early efforts, the 2010 Telework Enhancement Act established telework as a strategic intervention to achieve greater flexibility in the federal workforce and required each federal agency to establish a telework policy.<sup>5</sup> The act received bipartisan support in the House (291-131) and passed by unanimous consent in the Senate.

Through the 2010 law, the federal government promoted the adoption of remote work to achieve several goals: to reduce energy use and building costs, increase emergency preparedness, recruit and retain workers, and enhance employee performance and productivity. In addition to having many other positive externalities in society, teleworkability is a job quality issue: enabling telework is important for raising job satisfaction, organizational commitment, and enthusiasm, though not without concerns about work intensification (Felstead and Henseke 2017). A multi-year top-down administrative approach to collecting data exists. One result is that management researchers have documented the efficacy of remote work using highly detailed federal agency data (e.g., Choudhury, Foroughi, and Larson 2021).

Local governments can also shape remote work adoption. To curb air pollution, the state of Utah adopted a telework program just prior to COVID. Other states had adopted telework

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<sup>5</sup> The law required each agency to designate a Telework Managing Officer (TMO), create telework agreements with each teleworker, and report on their progress annually to the Office of Personnel Management (OPM). The OPM in turn must report on progress annually to Congress, and maintain a website that serves as a clearinghouse for data and information on telework policy (telework.gov)

practices for state workers, and established information clearinghouses and assistance offices to aid private employers in adopting telework. Through FEMA loans and grants in the aftermath of natural disasters such as hurricanes, and requirements for disaster insurance, local governments and private businesses in disaster-prone areas have also been encouraged or required to develop telework plans as part of their continuity planning against natural disaster.<sup>6</sup> These factors might affect the adoption of telework friendly policies before COVID.

Even with a clear objective of promoting remote work and top-down supervision, the Telework Enhancement Act requires each federal government agency to support telework, and ultimately, a job-by-job analysis is required. The availability of remote work is subject to context and political considerations at every level: from a worker and their manager up to union-management negotiations, enabling telework requires a negotiated teleworkability agreement. During the Trump administration, federal employee unions contested efforts to roll back telework arrangements (Rein 2020). Such ongoing negotiations and major re-negotiations are important elements in the restructuring of work. As a major initiative to implement remote work inside a large and complex organization, the drive to institutionalize telework inside federal government agencies suggests that jobs in the federal government should be more likely to be offered as remote jobs than jobs in other organizations before COVID.

#### *New Business Models: Independent Contractor vs. Employee Status*

Another environment where incentives may align to enable telework is in independent contractor relationships. By making it easier to manage and control remote workers, ICT enables

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<sup>6</sup> See, for example, <https://www.ready.gov/business-continuity-plan>. Requirements that firms adopt a business continuity plan including telework can be found in both government relief funding requirements as well as private insurance agreements.

new business models for non-traditional employment that rely on hiring non-employees or independent contractors. Crouch (2018) observes that ICT “facilitates the current trend to self-employment.” ICT can enable greater control from a distance through algorithmic management of workers (Norlander, Jukic, Varma, and Nestorov 2021). For example, globally distributed platform (“gig work”) companies that operate through app or web-based delivery of services have aggressively sought to protect the independent contractor status of their workers, in part, they claim, to preserve the freedom and flexibility of their working arrangements.

Under federal employment law and IRS regulations, a worker must clear a “control test” to be correctly classified as an independent contractor. “Behavioral control” is one of the factors in the IRS test and the Department of Labor considers “the place where work is performed.”<sup>7</sup> For firms that strategically seek to maintain a non-employee workforce of independent contractors, one way to prevent misclassification of employees or avoid jeopardizing independent contractor status of workers is to give up the physical workplace and permit the worker to perform their duties from afar.

This legal context suggests that, in the United States, independent contractor jobs might be more likely to be teleworked than employee jobs. A desire to maintain independent contractor status, or to take advantage of the flexible labor force possible through independent contractor relationships, can lead to more remote, gig-like work opportunities. While technologically-enabled, these business models are also legally constructed. Therefore, having built a business model based upon non-employee labor, firms that advertise more independent contractor jobs should be more likely to offer remote jobs in general.

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<sup>7</sup> IRS Form SS-8 “Determination of Worker Status for Purposes of Federal Employment Taxes and Income Tax Withholding” specifically asks “what location(s) does the worker perform services” under the behavioral control category. Also see DOL Fact-Sheet 13 “Employment Relationship Under the Fair Labor Standards Act (FLSA).”

In the above examples, federal laws are argued to influence which jobs are teleworkable. The following section turns toward organizations that represent workers such as unions, and professional licensing bodies that govern and represent professions and occupations. Such institutions can influence telework in the private and public sectors. For example, the BLS reported in 2021 that jobs in the public sector in the United States are more heavily unionized than the private sector (34.8% vs. 6.3%), and more heavily licensed (39.3% in government, vs. 25% overall).<sup>8</sup> The impact of licensing bodies and unions described below apply equally or even to a greater extent in the public sector than in the private – indeed, early federal government adoption of telework policy was possibly due to not only the alignment of political interests in the House and Senate, but also due to pressure from labor unions and spillover of these practices to non-union federal employees.<sup>9</sup>

#### *Worker Organizations and Telework: Labor Unions, Professional Associations, and Licensing Bodies*

As telework has become a salient aspect of many jobs, the presence of a union is likely to be related to the extent of the adoption of remote work. Labor unions have effects not only for their immediate members but also have substantial spillover effects for non-union workers who are within the same firm, region, and industry (Fortin, Lemieux, and Lloyd 2021). While unions are likely to have an effect, the direction is not clear cut, as unions may seek to facilitate their members' preferences for remote work, but might also have interests in maintaining strong local

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<sup>8</sup> See <https://www.bls.gov/news.release/pdf/union2.pdf> and <https://www.bls.gov/cps/aa2020/cpsaat52.htm>.

<sup>9</sup> Telework agreements in the federal government were negotiated as early as 1996 by the National Treasury Employees Union. Prior to the Telework Enhancement Act, these agreements often spilled over to non-bargaining unit employees, and much of the framework for the Telework Enhancement Act builds upon years of negotiations between the federal government and labor unions (see, e.g. National Academy of Public Administration 2015).

and community ties and direct in-person communication with workers, and in preventing uncompensated time. For example, both the Service Employees International Union and the Communication Workers of America were ambivalent about or opposed to working at home using computers in the late 1980s and early 1990s (Edwards and Field-Hendrey 1996).

Professional associations can lobby the state, and control who does certain work and how it is performed (Freidson 1974). Professional associations and occupational licensing bodies have been highly involved with regulating remote work (Yu and Levy 2010). States have taken various approaches to licensing the remote practice of professions, but in general, licensed occupations tend to be more likely to be able to be done remotely than other jobs, according to an Obama-era White House (2015) report that encouraged licensing bodies to embrace telework. Like other associations that span many employers, associations may enhance inter-firm knowledge sharing about innovative workplace practices (Erickson and Jacoby 2003). The National Conference of State Legislatures (2022) has tracked emergency changes to occupational licensing since COVID-19, and found gathering momentum for universal licensure laws that enable cross-state remote work. Because professions can articulate standards for how remote work can be done and develop protocols and professional norms for adoption of remote work that cut across firms, jobs requiring licenses may be more likely to be offered as remote.

Both professional associations and labor unions have deliberative processes for changing workplace practices that are different than the process for independent contractor, non-union, and unlicensed jobs where sudden change is more possible. While union and licensed jobs may have initial differences from other jobs in terms of remote work opportunity, these jobs are likely to change more slowly as licensing regulations and union contracts require multi-stakeholder negotiations. However, once new regulations or contracts are in place, such changes are less



likely to be affected by external circumstances and are likely to last longer than in unlicensed and non-union jobs.

### **An Exogenous Shock to Work Practices: COVID-19**

Emergency transitions of jobs from in-person to remote work in the first weeks and months of the crisis are not of primary interest here. Instead, we seek to understand which jobs made a switch to remote or hybrid modes after the initial lockdowns, as indicated by changes in the text of job advertisements that set expectations and create psychological contracts with new employees. COVID-19 changed the perceived desirability, efficacy, and capabilities of remote work. COVID-19 also shifted the economic cost/benefit of remote work. As one example, remote meetings became more efficient due to network effects, learning, and the adoption of new social norms. In addition, new remote surveillance technologies were adopted, becoming part of the “bargain” over remote work and shifting power relationships (Aloisi and De Stefano 2022). COVID-19 also changed the composition of jobs in the economy (fewer post-pandemic hospitality jobs, for example). Still, only some jobs became hybrid or remote, and with no dramatic concomitant change in technology between February and April 2020, the pandemic-induced shift can provide some instruction on how tasks and institutions affect the structure and future of work.

### **Task and Institutional Teleworkability Post-Pandemic**

We examine whether and how the pandemic changed the relationships between the task and institutional features of a job and remote job opportunities. Under the technological vision of workplace transformation, institutional teleworkability is largely not a factor in determining

remote work outcomes. Institutional features of the environment are barriers to a broader efficiency-driven transformation shepherded into existence by market forces. In this vision, task teleworkability is a dominant explanation for why remote work is adopted.

Under an extreme version of the argument that technology drives changes in job teleworkability, by early 2020, organizations should have already largely responded to the logics of technology and efficiency and the system would have already been nearing an equilibrium as regards remote work. This suggests that a job's measured task teleworkability would be likely to have no effect or only a small positive effect on the change in the measured number of remote job opportunities with the pandemic.

For example, consider lawyers who worked remotely long before 2020. Although detailed occupational data on telework is unavailable until after the pandemic, just over 30% of managerial / professional employees reported teleworking at least some hours of the week in the early 2000s (Noonan and Glass 2012). The lawyer occupation is task teleworkable per Dingel and Neiman (2021), meaning it should be possible to do the job remotely at high quality. If most lawyers who could work remotely were already doing so before the pandemic, the pandemic would have little impact on the relationship between task teleworkability and the creation of newly teleworkable jobs. Whether they advertised their jobs as remote or not before the pandemic, firms that hire lawyers would not need to update their job advertisements for hiring after the pandemic– the status quo would simply continue. Based on the strong view, task teleworkable jobs like lawyer jobs would already be teleworked, and the pandemic would not change the relationship between task teleworkability and remote job opportunities.

In contrast to the lawyer example, consider largely non-task teleworkable occupations such as those in health care. Only 9 percent of health care occupations are task teleworkable per

Dingel and Neiman (2021). Under the strong task teleworkability view, health care jobs cannot be done remotely at high quality. As a result, few health care jobs are likely to be converted to permanently flexible teleworkable or hybrid jobs after the pandemic, and again based on a strong view of technological progress, we would expect to see that COVID has minimal effect on the relationship between task teleworkability and remote job opportunities after the immediate crisis.

An intermediate view between technological and institutional perspectives would accept that the task-based potential of remote work had mostly not been realized prior to the pandemic, and that the system could be nowhere near an equilibrium as regards remote work in early 2020 due to institutional barriers. This view might acknowledge that satisficing behavior, institutional inertia, lack of managerial know how, political will, enabling policy, lobbying pressures, social norms, and business models can all act as barriers to technological and efficiency-driven changes in the organization of work. If the pandemic had a large positive effect on the relationship between task teleworkability and remote work opportunities, this would suggest that the potential extent of remote work is still largely determined by technology affecting the task teleworkability of jobs, but that such task teleworkability was largely not realized before the pandemic due to institutional barriers that the pandemic erased (at least momentarily). Essentially, if a larger portion of task teleworkable jobs (lawyer jobs) than non-task teleworkable jobs (health care jobs) are offered remotely post-pandemic, this would indicate that many task teleworkable jobs were not institutionally teleworkable pre-pandemic, and we would see a strong positive relationship between task teleworkability and remote jobs after March 2020.

In a third view, institutions have a significant and complementary role in transforming work organization and determining which jobs are teleworkable. A health care worker might plausibly do their job remotely at high quality. However, transitioning such jobs to a remote

work model involves work redesign, which involves bargaining and politics. The political maneuvering and bargaining necessary to change workplace practices would likely occur either through institutions such as labor unions and professional associations or are themselves institutionally embedded. Although obvious to institutionalists, an example of embedded bargaining is the act of a group of workers voicing a request for a remote work arrangement: a group of non-union unorganized workers who do not belong to a professional organization still operate under the umbrella of rights that are protected under Section 7 of the National Labor Relations Act. In contrast, individual workers who lack a collective voice to request new forms of work organization operate in a background environment governed by the employment-at-will doctrine (Milliken, Schipani, Bishara, and Prado 2015).

Whether or not a particular job is teleworkable or not might then depend upon many factors beyond the tasks of the *ex ante* job. For example, the firm a person works for, and the interests of the owners and managers of that firm, and their ability to manage a remote workforce. For health care jobs, licensing, quality, patient satisfaction, reimbursement processes, and other key stakeholder concerns will influence the outcome. If institutional teleworkability has a large role in determining which jobs are remote, then task teleworkability will have less influence on a whether a job opportunity is listed as remote both before and after the pandemic.

Institutional teleworkability assumes large between-firm differences in policy and the political will necessary to make jobs remote. Firms with the will and capability to enact institutional teleworkability for their potentially task teleworkable jobs pre-pandemic are unlikely to be affected by the pandemic. Federal government agencies, for example, had 10 years before the pandemic to conduct job analysis and report annually to Congress on how many teleworkable jobs they have. Contexts in which professional associations and unions were

powerful actors pre-pandemic are also likely to have a negative post-pandemic effect relative to settings where management discretion reigns free, as the pandemic did not fundamentally change the process or pace by which these institutions renegotiate workplace practices.

### **Data and Methods**

To evaluate the alternative explanations for job teleworkability described in the above exploratory hypotheses, we constructed a novel dataset of remote work opportunities and institutional characteristics using information contained in Burning Glass' corpus of job advertisement text from 2010-2021. This measure represents changes in the flow of written (albeit often informal) contracts: by making a promise about the role prior to a job application from a candidate, the job listing is an important antecedent to psychological and social contracts at work (Rousseau 2001).

To construct the data, we first extract a random sample of keywords and chunks of text from the full text corpus, create and validate "context rules" to classify the text, and construct a training dataset for machine learning via the extrapolation of context rules. A machine learning niche classification model for each variable is trained. For example, a remote work model flags any job posting within the corpus containing text that indicates that the job can be done remotely.

### **Measures**

A significant limitation (or strength) of job ad data in this context is that it provides a measure of the flow of new jobs into the labor market. In contrast to representative survey data, it does not allow us to estimate the total number of workers or jobs that are teleworked. Job ad data also does not allow us to capture all new remote work opportunities, only written

advertisements. Some jobs may be teleworkable but not advertise it, while others may advertise location flexibility but not be truly teleworkable. While selection may be a concern, this data does allow us to say for the near universe of job ads in the U.S. how many new ads each month advertise a remote work possibility.

Each of the following measures is a 0/1 binary indicator variable built at the job level:

*Remote Job Opportunity*. A job with the opportunity to work remotely, including both full-time and hybrid remote job opportunities equals 1, otherwise 0. This is the dependent variable in all analyses. This includes jobs that may require site visits, but contain language that offers workers the flexibility to work outside of a traditional work site (and not in an office or factory) when not required to be on location.

*Task Teleworkability (TaskTeleworkable)*. A job in a teleworkable occupation per Dingel and Nieman (2021) equals 1, otherwise 0.

*Federal Government (Gov)*. A job for a federal government agency covered by the Telework Enhancement Act equals 1, otherwise 0.

*Independent Contractor (IndContractor)*. A 1099 independent contractor job equals 1, otherwise 0.

*Professional License Required (License)*. A job requiring a professional license or formal apprenticeship equals 1, otherwise 0.

*Union Presence (Union)*. A job within a collective bargaining unit or a job that involves negotiating and working with unions (labor relations jobs, e.g.) equals 1, otherwise 0.

*Affected by the Covid-19 Pandemic (COVID)*. A job posted after March 15, 2020 equals 1, otherwise 0.

## **Methods for Building Measures**

We pay close attention to measurement reliability. With over 290 million job advertisements, machine learning tools are essential, but require training data, tuning, and validation. No training data existed, and no off-the-shelf classification of which jobs are remote in the Burning Glass data existed prior to our work.

Table 1 provides additional information from the process we developed to achieve a highly accurate result. To construct each variable listed in column 1, the 6 words before and after every appearance of a “keyword” (in column 2) were extracted from the text corpus of job advertisements. Research assistants and the first author hand-coded a sample of the most frequently occurring 13-word “text chunks” containing keywords. Based upon the hand-coded sample, “context rules” that conform to the hand-coded sample allow the construction of a training dataset extrapolated based upon specific instructions (“context rules”) about what language indicates a remote job. Comparing known “true positives” and known “true negatives” from hand-coding to a training dataset, we can be confident that the training dataset represents at least the number of observations in column 3 correctly. Once a strategic sample of the training dataset, which is extrapolated based upon context rules, provides a perfect match with the hand-coded data, we use the training dataset to train a machine learning model that predicts, e.g., if a given job is remote. We tested logistic regression, naïve Bayes, and random forest models, and found that random forests perform best.

Table 1 column 4 presents the size of a sample of machine learning results used to assess accuracy. This sample size varies for each variable, as each variable occurs with different frequency, and while initially drawn from a random sample, it is not random, but intended to oversample “positive” cases to ensure accurate identification of each variable. The percent of

known true positives in column 5 is based upon exact matches between hand-coded data and the machine learning sample. We are confident that *at least* that percentage of the resulting sample is accurate based upon the prior hand-coding. Finally, to assess the accuracy of the machine learning model, we report in column 6 the harmonic mean of precision and recall (or  $F_1$ -score) based upon a comparison between the machine learning output and the training dataset. With a maximum score of 1 when precision and recall are perfect, and 0 when either precision or recall is zero, the  $F_1$  scores obtained suggest a high level of accuracy and recall between the training dataset and results.

**[[Table 1 Near Here]]**

### **Descriptive Statistics**

Table 2 reports summary statistics at the job and firm-level. Figures 1-3 summarize several key facts that emerge from the data construction. First, we find that COVID-19 led to a large increase in remote job opportunities in the job market. The solid black line in Figure 1 shows that job advertisements that offer remote work arrangements were typically less than 3% of all job advertisements in the decade prior to the pandemic, and spiked to 11.7% in the months following the onset of the COVID-19 pandemic in March 2020. Second, Figure 1 also indicates that the share of task teleworkable jobs offered as remote opportunities were stable at around 3% prior to the pandemic, then peaked at 14.9% after the onset of the pandemic. Around 1% of jobs in non-task teleworkable occupations were offered as remote job opportunities prior to the pandemic and peaked at 9.7% but remained below the level for task-teleworkable jobs.

**[[Table 2 near here]]**

**[[Figure 1 near here]]**



Third, considering two years surrounding March 2020, Figure 2 indicates that federal government and unionized jobs were more likely to be offered as remote prior to the pandemic. Jobs in the federal government and jobs that are governed by union contracts did not experience a sudden change with the pandemic as regards remote opportunities, and in fact the percent of remote job opportunities fell among government jobs. If anything, the pandemic seems to have brought a convergence, with government and unionized jobs looking more like all jobs in terms of the share that were offered as remote.

**[[Figure 2 near here]]**

Figure 3 displays the F ratio or F statistic, the between group variance divided by the within group variance, for various possible groupings of the data. Figure 3 compares the F statistic in each month for alternative groupings of the data we can construct, such as teleworkable vs. non-teleworkable jobs, occupation, industry, county, sector, and whether the job is in a union setting. Figure 3 shows that among these groupings, only between firm variance exceeds the critical threshold of 1, where there is more variation in remote work between the group than within.

**[[Figure 3 near here]]**

### **Job-Level Covariates: Analyzing Task and Institutional Teleworkability**

Our baseline model is a multivariate ordinary least squares regression for a two-year period (March 2019 – February 2021) around the onset of the pandemic in March 2020, and includes both task and institutional job-level variables, as well as an indicator variable for the post-COVID time period:

$$1) WFH_{it} = \beta_0 + \beta_1 TaskTeleworkable_{it} + B_2 Gov_{it} + \beta_3 IndContractor_{it} + \beta_4 Union_{it} + \beta_5 License_{it} + B_6 COVID_t \varepsilon_{it}$$

Where  $i$  indicates a job and  $t$  indicates the month in which the job is advertised.

To test how the shock of COVID changes the role of institutions and tasks in determining teleworkability, model 2 is a two-way fixed effects model. Because COVID impacted all jobs, and jobs cannot be randomly assigned to be task teleworkable, in the federal government, or to have union representation, for example, the interpretation is not causal as in a canonical differences-in-differences model. Instead, COVID is an exogenous shock to the stable relationships between job-level institutional and task teleworkability of a job and remote job opportunities in job advertisements, and offers evidence on how COVID affected these relationships. The institutional and task teleworkability variables are still potentially endogenous, and the coefficients are the average effect of, for example, a job being within a union before and after COVID on the likelihood of the job being offered as remote:

$$2) WFH_{it} = \beta_0 + \beta_1 TaskTeleworkable_{it} + \beta_2 Gov_{it} + \beta_3 IndContractor_{it} + B_4 Union_{it} + \beta_5 License_{it} + B_6 COVID_t + * \beta_7 COVID_t * TaskTeleworkable_{it} + \beta_8 COVID_t * Gov_{it} + \beta_9 COVID_t * IndContractor_{it} + \beta_{10} COVID_t * Union_{it} + \beta_{11} COVID_t * License_{it} + \gamma FE + \varepsilon_{it}$$

where  $\beta_2$ -  $\beta_5$  correspond to the pre-COVID effect of institutional and task teleworkability, and  $\beta_6$ -  $\beta_{11}$  are the post-COVID effects of the institutional and task teleworkability variables. The  $\gamma$

term reflects that additional model specifications include a vector of month, occupation, sector, and firm fixed effects.

### **Firm-Level Covariates: Analyzing Employer Characteristics**

Figure 3 suggests that firm-level effects are a meaningful source of variation in job-level teleworkability. The above models cannot illustrate which firm characteristics are associated with remote job opportunities, however. We estimate additional models that do not include firm fixed effects, but rather include non time-varying institutional characteristics at each firm.

We build a firm-level average for each independent variable, creating an index of each institutional variable at the firm-level. Bai, et al. (2021) perform a similar calculation to create a task teleworkability index for firms. We calculate an average value for each independent variable at each firm  $f$  over the January 2010- February 2021 time-period from the job-level task and institutional characteristics. We use the full time-period to capture the stable characteristics of a firm, as opposed to those that might have been unduly affected by COVID-19, or other changes in the environment. These 10-year firm-level averages provide insight into the non-time-varying institutional characteristics of firms: the mean level of union, license, task teleworkable, and independent contractor jobs in a firm. We then regress these firm-level means on whether each job listing is a remote job opportunity.

We construct several additional firm-level variables as controls. *FirmSize* is the log of the sum of the number of job advertisements that each firm posts for the 2010-2021 duration.

*Regional* is an indicator variable that denotes whether a firm hires in more than 5 and less than 20 states, and *National* indicates that a firm hires for positions in more than 20 states.

Panel B of Table 2 reports descriptive statistics for these variables. Observations missing the identity of the firm are dropped. In the regression equation and results, these variables are normalized and scaled such that coefficients can be interpreted as the effect on remote job opportunities of moving from a firm at the mean to a firm one standard deviation above the mean. For job  $i$  at time  $t$ , we estimate how characteristics of firm  $f$  affects remote job offerings:

$$\begin{aligned}
3) \text{ } WFH_{it} = & \beta_0 + \beta_1 FirmTaskTeleworkability_f + \beta_2 FirmIndContractor_f + \\
& \beta_3 FirmUnion_f + \beta_4 FirmLicense_f + \beta_5 Regional_f + \beta_6 National_f + \\
& \beta_7 \text{Log}(FirmSize_f) + \beta_8 COVID_t + \beta_9 COVID_t * FirmTaskTeleworkability_f + \\
& \beta_{10} COVID_t * FirmIndContractor_f + \beta_{11} COVID_t * FirmUnion_f + \beta_{12} COVID_t * \\
& FirmLicense_f + \beta_{13} COVID_t * Regional_f + \beta_{14} COVID_t * National_f + \\
& \beta_{15} COVID_t * \text{Log}(FirmSize_f) + \gamma FE + MonthFE + \varepsilon_{it}
\end{aligned}$$

Where  $\beta_1 - \beta_7$  correspond to the pre-COVID effect of firm-level characteristics, and  $\beta_8 - \beta_{15}$  are the post-COVID effects. Here, the  $\gamma$  term reflects that additional specifications include a vector of occupation, sector, and state fixed effects, where the state fixed effects use the modal state a firm hires in over the 2010-2021 time period. In all estimations, heteroskedasticity-robust standard errors are reported.

## Results

Table 3 corresponds to the models 1 and 2 above that use job-level task and institutional characteristics. Conditional on institutional and task teleworkability variables in column 1, jobs advertised after March 2020 (COVID-19) were 9.6% more likely to be offered as remote. Overall, Table 3 indicates that institutions and task teleworkability are positively associated with

remote job opportunities. These results seem to be robust across specifications and controls for time, occupation, sector, and firm in columns 2-7 corresponding with model 2 above.

Conditional on firm fixed effects in column 5, jobs in task teleworkable occupations were 1.6% more likely to be offered as remote before the pandemic. Conditional on month and occupation fixed effects in column 4, jobs in the federal government were 24.7% more likely to be offered as remote before the pandemic. Examining the model in column 7 that includes a full set of fixed effects for firm, month, occupation, and sector, pre-pandemic independent contractor jobs were 2.7% more likely to be offered as remote, union jobs were 7.9% more likely to be offered as remote, and licensed jobs were 2.7% more likely to be offered as remote. According to the results of the full model in column 7, the pandemic diminished the positive impact of licensing, unionization and government status on the likelihood of a job being offered as remote. In contrast, a job that was in a task teleworkable occupation was 1.6% more likely to be offered as remote post-pandemic than it was pre-pandemic and a job with independent contractor status was 0.6% more likely to be offered as remote post-pandemic than it was pre-pandemic. Finally, we note the large increase in R-squared with the inclusion firm fixed effects (in columns 5 and 7), which, along with Figure 3, indicates that significant variation occurs across firms.

**[[Table 3 near here]]**

Table 4 presents results that correspond to model 3 above and examines how firm-level characteristics affect the likelihood of jobs being offered as remote. Overall, these results suggest that institutional characteristics identified at the firm level influence the availability of remote jobs. The second through sixth columns, with varying fixed effects controls and interactions, indicate that jobs in firms with above average levels of workers in task teleworkable occupations, independent contractor jobs, professionally-licensed jobs, and unions were more likely to be

offered as remote before the pandemic. Examining the model in column 6 that includes a full set of fixed effects (month, state, sector and occupation): before the pandemic, jobs in one standard deviation above average task teleworkable firms were 0.3% more likely to be offered as remote, jobs in above average independent contractor firms were 0.5% more likely to be offered as remote, jobs in above average unionized firms were 0.4% more likely to be offered as remote, and jobs in above average firms requiring licenses were 1.1% more likely to be offered as remote. Jobs in national firms were 7.2% more likely to be offered as remote, and jobs in regional firms were 3.5% more likely to be offered as remote pre-pandemic. In most specifications, larger firms were less likely to offer jobs as remote, but this varies with the differing utilizations of fixed effects.

After the pandemic, a job in a firm with a one standard deviation above average percent of task teleworkable jobs was 0.3% more likely to be offered as remote relative to pre-pandemic. A job in a firm that had a one standard deviation above average percent of independent contractors was 1.6% more likely to be offered as remote relative to the pre-pandemic effect (column 6). The pandemic diminished the positive impact of firm-level unionization and firm-level licensing on the likelihood of a job being offered as remote. Compared to national and regional firms, jobs in local firms post-pandemic were more likely to be offered as remote relative to before the pandemic. Larger firms were less likely to offer jobs as remote after the pandemic.

**[[Table 4 near here]]**

We next discuss the results for each independent variable hypothesized to have a role in explaining remote job opportunities separately, along with corresponding firm-level

implications. We emphasize potential descriptions of the world with which these results are consistent.

### **Task Teleworkability**

Jobs in task teleworkable occupations were more likely to be offered as remote both before and after the pandemic. Alone, however, task teleworkability weakly predicts remote job opportunities, which suggests that occupational scales of teleworkability may miss substantial variation in what jobs can be done remotely (Table 3). Table 3 also provides some support for the technological vision of workplace transformation, insofar as task teleworkable jobs were only 1.5-2.5% more likely to be offered as remote after the pandemic relative to before the pandemic, which is consistent with the view that substantial technological possibilities had already been realized.

### **Government**

Federal government jobs were significantly more likely to have remote opportunities prior to the pandemic (Figure 2, Table 3). However, remote job listings in the federal government demonstrate little to no reaction to the pandemic, in contrast to the sudden increase elsewhere. This is suggestive of different institutional logics: the government has a logic (supported by laws) that determine a process for what jobs can be listed remote – telework agreements must be in place. This involves slower and more complex processes for deliberation, a process which began a decade before the pandemic with the passage of the Telework Enhancement Act.

Government processes for workplace transformation contrast with much of the rest of the economy, where management has more discretion, especially in non-union environments. These results are also consistent with the possibility that, given the high rate of remote work in government jobs prior to the pandemic, there were fewer easy opportunities to turn in-person jobs to remote. It is also possible that in-person government workplaces were more likely to shut down during the pandemic or slow their in-person hiring.

### **Independent contractor**

Independent contractor jobs were more likely to be remote opportunities prior to the pandemic. Unlike the union and license variables, this association accelerated with the pandemic (Table 3). Jobs in firms with large portions of independent contractors were more likely to be offered as remote before the pandemic, and this gap expanded post-pandemic (Figure 4, Table 4). One possibility this suggests is that business models and the mix of firms in the environment shape the outcome, influencing which organizations can shift their business models quickly, manage a remote workforce, and have long-run incentives to offer remote work. Firms that utilize independent contractors have non-traditional work environments in their mix of operations already, so perhaps they can more easily shift to remote work. As with the results for firms that employ many workers in task teleworkable occupations, the results are also consistent with the concept of learning how to manage and operate a business including a non-employee, remote workforce. Perhaps it is easier to move to remote if a mindset and embedded knowledge about non-traditional work arrangements already exists.

**[[Figure 4 near here]]**



## **Unions**

Unionized jobs were significantly more likely to have remote opportunities prior to the pandemic (Figure 2, Table 3). The relatively high rate of remote opportunities among unionized jobs prior to the pandemic suggests that when workers have some power and voice, they seek to formalize work from home arrangements. Like government jobs, union jobs also did not respond markedly to the pandemic. One possible explanation for this pattern is that union contracts change slowly. Negotiations of various forms over which jobs would go remote would likely have taken place both pre- and post- pandemic. In contrast to non-union jobs, work modality is not a pure management decision in unionized settings; the process of negotiating social contracts is perhaps slower, more formalized, and more responsive to internal needs and less responsive to sudden external change.

## **Professional Licenses**

Jobs that required professional licenses were more likely to be remote opportunities before the pandemic, but this effect diminished post-pandemic (Table 3). This is consistent with the view that firms with a lot of professionally licensed workers are more likely to be subject to legal restrictions on how work is performed. Prominent examples are in health care post-pandemic. The negotiation that needs to take place is large and complex and not subject to sudden changes in external environment: insurance rates need renegotiation, laws may need to be changed to reimburse health care provided remotely, etc. That renegotiation plays out over a longer time period, involves influence and lobbying, and government actions. Jobs in firms with large portions of professionally licensed jobs were more likely to be offered as remote pre-pandemic, but this pattern reversed post-pandemic (Table 4). Overall, the story for unions and

licenses seems to credibly involve incremental progress pre-pandemic and barriers that slowed rapid change post-pandemic.

### **Task and Institutional Teleworkability Interactions**

Interactions between task and institutional teleworkability suggest that many jobs in non-task teleworkable occupations can be done remotely in specific contexts. Figures 5 through 8 illustrate some of these interactions. For the critical two-year period surrounding March 2020, Figure 5 illustrates the percent of remote job offerings for lawyers (a task teleworkable occupation) inside and outside of federal government employment (an institution that embraced telework). Figure 5 indicates that federal government lawyer jobs were much more likely to be offered as remote before and after the pandemic relative to lawyer jobs in other sectors. In non-governmental sectors, there was a brief spike in new remote job opportunities for lawyers, but this returned to pre-pandemic levels in less than one year. The sustained divergence in new remote job opportunities between lawyers in the government and other sectors suggests the power that institutions hold to influence teleworkability above and beyond task, technology, and efficiency.

**[[Figure 5 near here]]**

Figure 6 illustrates that new remote job opportunities for health care workers (many in non-task teleworkable occupations) in the federal government were higher than in the private sector before the pandemic, although this gap was narrowing. One explanation is that the Trump administration had sought to restrict the use of telework (Rein 2020). Another possible explanation is that learning occurred in the federal government about which health care jobs

actually are task teleworkable. In non-government sectors, remote job opportunities for health care jobs increased post-pandemic, and converged with federal government percentages.

**[[Figure 6 near here]]**

Figures 7 and 8 illustrate that whether a new job in a non-task teleworkable occupation is offered remotely is affected by the context in which it resides. Figure 7 indicates that 4-5% of job listings for non-task teleworkable occupations in firms with a one standard deviation above average percent of existing jobs in task teleworkable occupations indicated remote work before the pandemic, and that this increased to over 15% post-pandemic. Listings for non-task teleworkable jobs in firms with an average share of existing task teleworkable occupations were less likely to involve remote work. Figure 8 shows that 10-20% of new listings for jobs in non-task teleworkable occupations in the federal government involved remote work pre-pandemic. In contrast, job listings involving remote work for non-task teleworkable jobs in all sectors were around 1% pre-pandemic (Figure 1).

**[[Figure 7 near here]]**

**[[Figure 8 near here]]**

### **Conclusion and Directions for Future Study**

We compare and contrast technological and institutional views regarding changing work organization and analyze them with large-scale data in the setting of remote work job listings. We measure changes in the flow of remote jobs in the labor market, and find evidence that institutions have played a significant role in the availability of remote job opportunities both before and after the COVID-19 pandemic, with an especially large effect of the government

sector. The findings are consistent with the view that institutions have an important effect on the adoption of these flexible work arrangements, above and beyond technological feasibility.

Institutional features that enable the adoption of new technologies and transform workplaces merit further research and discussion. The contribution of institutions to the teleworkability of jobs that this paper demonstrates could be an important subject for studies of how the workplace is changing more generally. Future work might examine the institutional contexts associated with other ICT-enabled non-traditional work arrangements such as outsourcing, offshoring, and gig work.

The data constructed from the text of job advertisements in the present paper opens new avenues for research on job characteristics and workplace practices. Such longitudinal data on remote work opportunities at the level of a specific job inside a specific firm, occupation, industry, and geographical labor market creates opportunities to investigate previously difficult to study contextual factors that shape the workplace. While scholars have previously used job ad data to construct measures of employer market concentration among others, our institutional and remote work measures are new, bespoke measures of job characteristics. Just as these were used to explore the contextual determinants of remote job opportunities, future research can follow similar methods to construct measures of many more features of the context in which a job is situated in order to investigate other aspects of workplace organization.

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## Tables

TABLE 1: MEASUREMENT RELIABILITY

1. Variable	2. Keyword(s)	3. Hand - coded Confirmed Training Data	4. ML Sample Size	5. % of ML Sample Known to be True Positives	6. F <sub>1</sub> Score
Remote Job	“home”, “remote”, “telecommut”, “telework”, “virtual”, “videoconferenc”, “internet”, “anywhere”	2,901	15,297	92.1%	97.6%
Independent Contractor	“contract”	1,287	8,771	98.4%	99.4%
Professional License Required	“licens”, “credential”, “certifi”, “apprentice”	11,107	15,665	74.5%	89.0%
Union Presence	“collective”, “bargain”, “contract”, “union”	5,357	14,254	67.4%	87.4%

*Notes:* Column 5 presents a lower bound for accuracy and improves as more of the “positive” cases picked up by machine learning are verified by hand-coders.

TABLE 2 – DESCRIPTIVE STATISTICS

*Panel A – Job Level Statistics (2019 – 2021)*

Job-Level Statistics	N	Mean	St. Dev.	Min	Max
Remote Jobs	60,303,905	0.07	0.25	0	1
Task Teleworkable Jobs	60,303,905	0.45	0.50	0	1
Federal Government Job	60,303,905	0.01	0.08	0	1
Independent Contractor Jobs	60,303,905	0.04	0.20	0	1
Union Jobs	60,303,905	0.01	0.10	0	1
Licensed Jobs	60,303,905	0.24	0.43	0	1

*Panel B – Firm Level Statistics (2019-2021)*

Statistics	N	Mean	St. Dev.	Min	Max
Firm Average Task Teleworkable	55,722,451	0.47	0.28	0.00	1.00
Firm Average Ind Contractor	55,722,451	0.04	0.10	0.00	1.00
Firm Average Union Workforce	55,722,451	0.04	0.10	0.00	1.00
Firm Average Licenses Required	55,722,451	0.22	0.24	0.00	1.00
Regional Firm	55,717,734	0.16	0.28	0.00	1.00
National Firm	55,717,734	0.32	0.43	0.00	1.00
Log(Firm Size)	60,303,905	9.73	5.26	0.00	18.13

*Note: Panel B reports descriptive statistics for firm-level characteristics for firms that advertised positions from March 2019- February 2021. The firm averages are drawn from the entire January 2010- February 2021 time period to capture stable firm characteristics, rather than those affected by COVID or other circumstances. Several million observations with missing firm information are dropped in Panel B.*

TABLE 3 - JOB LEVEL DETERMINANTS OF REMOTE JOB POSTINGS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Task Teleworkable Job	3.45*** (0.01)	2.41*** (0.01)	1.16*** (0.01)		1.55*** (0.01)		
Federal Government Job	19.46*** (0.07)	24.51*** (0.10)		24.67*** (0.10)			
Independent Contractor Job	6.07*** (0.02)	5.24*** (0.02)	4.74*** (0.02)	4.61*** (0.02)	2.78*** (0.02)	4.24*** (0.02)	2.72*** (0.02)
Union Job	4.09*** (0.04)	5.95*** (0.05)	6.40*** (0.05)	5.62*** (0.05)	8.22*** (0.05)	5.94*** (0.05)	7.94*** (0.05)
Licensed Job	0.56*** (0.01)	0.96*** (0.01)	1.85*** (0.01)	1.85*** (0.01)	2.19*** (0.01)	2.07*** (0.01)	2.66*** (0.01)
Post-COVID Job	9.63*** (0.01)						
COVID X Task Teleworkable Job		2.48*** (0.01)	2.46*** (0.01)	2.29*** (0.01)	1.51*** (0.01)	2.27*** (0.01)	1.57*** (0.01)
COVID X Gov. Jobs		-10.99*** (0.15)	-11.01*** (0.15)	-9.73*** (0.15)	-6.46*** (0.13)	-9.76*** (0.04)	-6.58*** (0.04)
COVID X Ind. Con. Jobs		2.17*** (0.04)	2.14*** (0.04)	2.44*** (0.04)	0.52*** (0.04)	2.40*** (0.04)	0.63*** (0.04)
COVID X Union Jobs		-4.53*** (0.08)	-4.60*** (0.08)	-4.42*** (0.08)	-4.32*** (0.08)	-4.49*** (0.08)	-4.22*** (0.08)
COVID X Licensed Jobs		-0.96*** (0.02)	-1.08*** (0.02)	-1.07*** (0.02)	-1.96*** (0.01)	-1.14*** (0.02)	-1.94*** (0.01)
Num. obs.	60,303,905	60,303,905	60,303,905	60,303,905	60,303,905	60,303,905	60,303,905
R <sup>2</sup> (full model)	0.05	0.05	0.06	0.07	0.27	0.08	0.28
Month Fes		24	24	24	24	24	24
Sector Fes			22			22	22
Occupation Fes				728		728	728
Firm Fes					406,980		406,980

Note: \*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$ . Standard Errors are heteroskedasticity robust. Fixed effects are indicated at the bottom of the table.

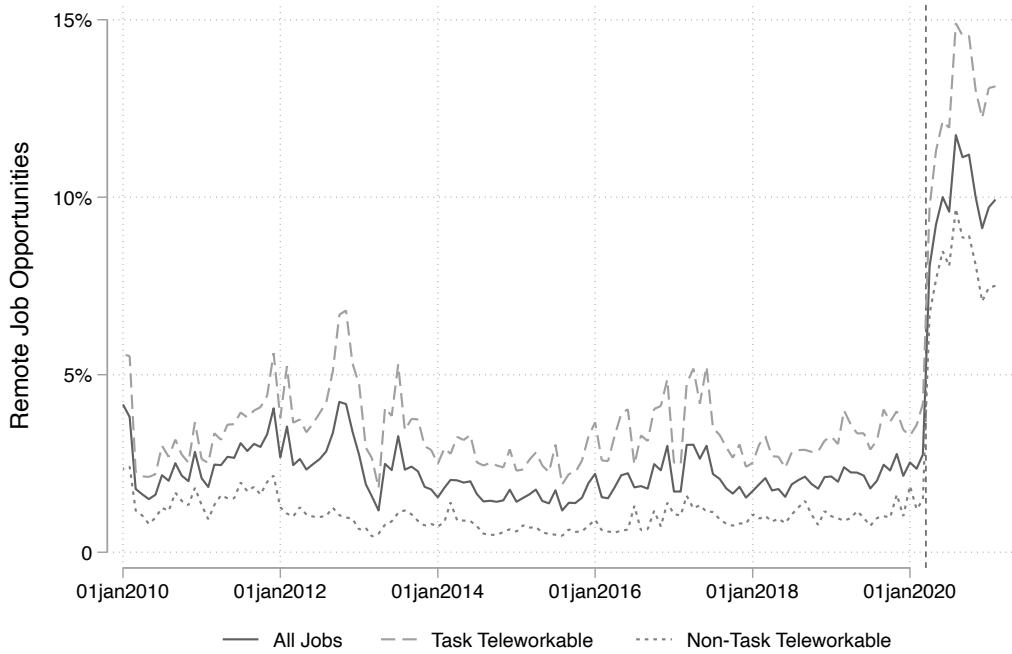
TABLE 4 – FIRM LEVEL DETERMINANTS OF REMOTE JOB POSTINGS

	(1)	(2)	(3)	(4)	(5)	(6)
Firm Task	1.60***	1.49***	1.49***	0.83***	0.83***	0.34***
Teleworkability	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Firm Ind. Contractors	1.87***	1.15***	1.00***	0.88***	0.80***	0.54***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Firm Union	0.52***	0.82***	0.87***	0.50***	0.80***	0.43***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Firm Licenses	-0.04***	0.37***	0.55***	1.13***	0.55***	1.07***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Regional Firm	-4.79	-0.01	1.04***	3.32***	0.05***	3.53***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
National Firm	-0.31	2.35***	4.01***	7.11***	2.07***	7.15***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Log(Firm Size)	-0.48	0.05***	-0.27***	-0.96***	0.08***	-0.90***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Post-COVID Job	7.86***					
	(0.01)					
COVID X Firm Task		0.44***	0.42***	0.45***	0.30***	0.33***
Teleworkability		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
COVID X Firm Ind		1.58***	1.51***	1.58***	1.66***	1.57***
Contractors		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
COVID X Firm		-0.70***	-0.70***	-0.73***	-0.68***	-0.74***
Union		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
COVID X Firm		-0.93***	-0.97***	-1.03***	-1.03***	-1.09***
License		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
COVID X Regional		-10.42***	-10.43***	-10.33***	-10.31***	-10.33***
Firm		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
COVID X National		-5.69***	-5.78***	-5.42***	-5.85***	-5.61***
Firm		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
COVID X Log(Firm		-1.16***	-1.15***	-1.11***	-1.14***	-1.10***
Size)		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Num. obs.	55,717,734	55,717,734	55,708,983	55,559,157	55,717,734	55,552,355
R <sup>2</sup> (full model)	0.05	0.07	0.07	0.09	0.09	0.11
Month FEs		24	24	24	24	24
State FEs			70			70
Sector FEs				4837		4837
Occupation FEs					728	728

Note: \*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$ . Standard Errors are heteroskedasticity robust. Fixed effects are indicated at the bottom of the table.

**Figures**

**FIGURE 1 – SHARE OF REMOTE JOB OPPORTUNITIES FOR ALL, TASK TELEWORKABLE, AND NON-TASK TELEWORKABLE JOBS: 2010-2021**



**FIGURE 2 – SHARE OF REMOTE JOB OPPORTUNITIES FOR ALL, GOVERNMENT, AND UNION JOBS: 2019-2021**

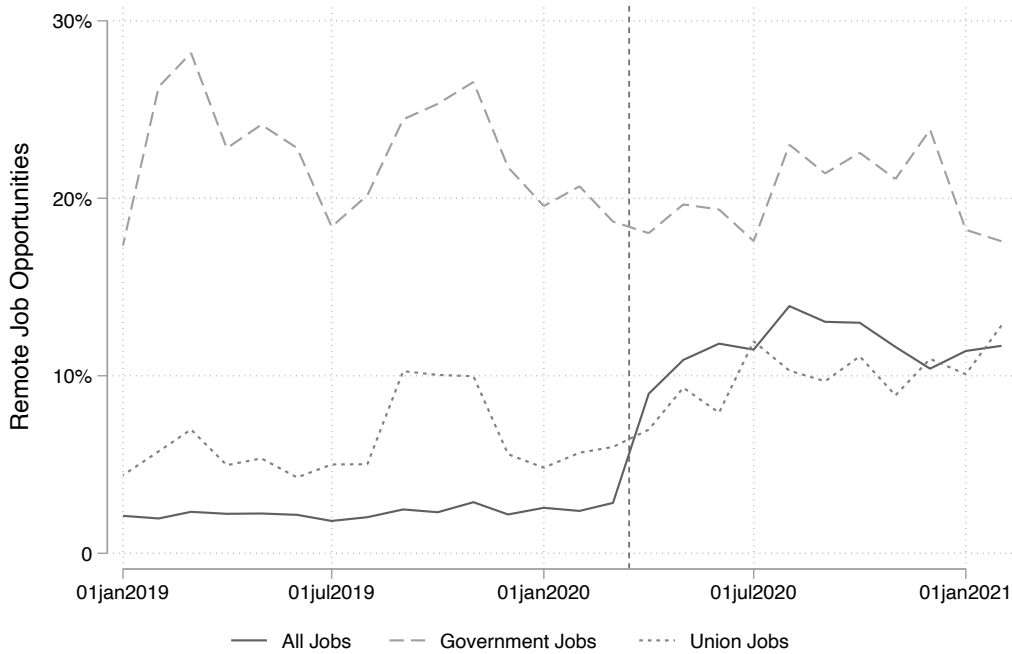




FIGURE 3 – F STATISTIC (BETWEEN GROUP / WITHIN GROUP VARIANCE): 2019-2021

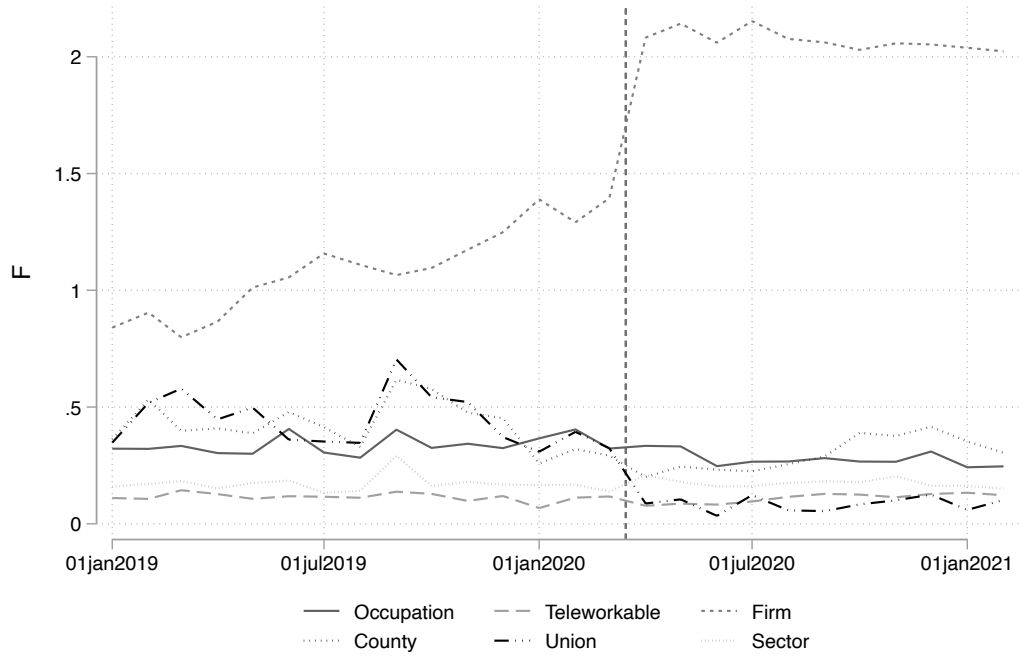
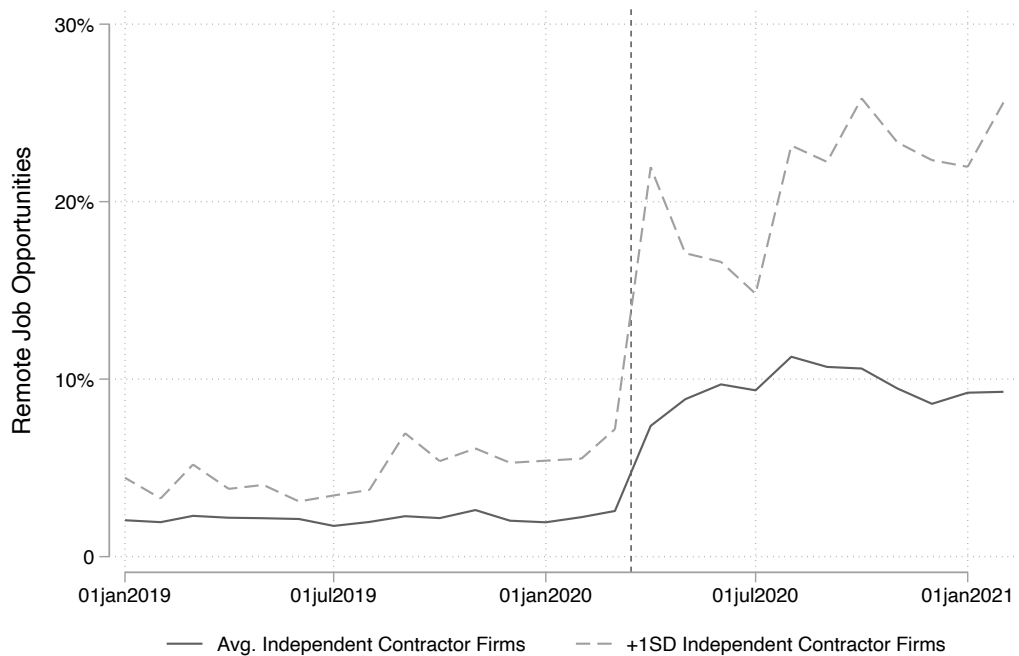


FIGURE 4 - SHARE OF REMOTE JOB OPPORTUNITIES IN HIGH INDEPENDENT CONTRACTOR FIRMS: 2019-2021



Note: Figure 4 drops one pre-pandemic outlier (0.17) in January 2020.

FIGURE 5 – SHARE OF REMOTE JOB OPPORTUNITIES FOR LAWYERS IN FEDERAL GOVERNMENT AND ALL OTHER SECTORS: 2019-2021

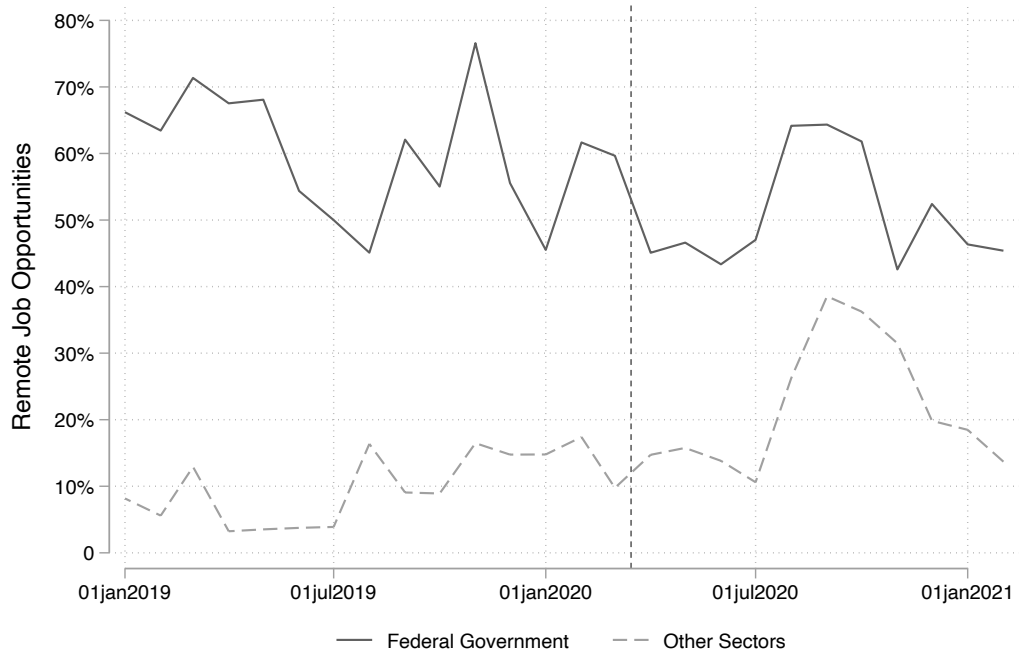


FIGURE 6 – SHARE OF REMOTE JOB OPPORTUNITIES FOR HEALTH CARE JOBS IN FEDERAL GOVERNMENT AND ALL OTHER SECTORS: 2019-2021

