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THREE ESSAYS ON REMOTE WORK AND REGIONAL DEVELOPMENT

A Dissertation Presented

by

RYAN DAVID WALLACE

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

September 2019

Regional Planning

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THREE ESSAYS ON REMOTE WORK AND REGIONAL DEVELOPMENT

A Dissertation Presented

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DEDICATION

I dedicate this dissertation to my wife, children, and family for your enduring support.

ACKNOWLEDGMENTS

I would like to thank my advisor throughout graduate school and committee chair, Henry Renski, for his support over my time at UMass. Without his initial encouragement and planting the seeds of becoming a researcher as a master's student, I might never have started and completed this journey. I would like to extend gratitude to the other members of my committee Ina Ganguli, Mark Hamin, and Charles Colgan. In particular, I'd like to thank Mark for his continued guidance, encouragement, and seemingly limitless knowledge of all things planning history, theory, and practice, which have made an enormous contribution to my development as a planning scholar. Thanks to Charlie for giving me the opportunity to serve as Director the EDA University Center at USM.

Social capital doesn't get enough credit in economic development, but community and people make all the difference. My experience at UMass, in the Department of Landscape Architecture and Regional Planning, and living in the happy valley have been some of the most rewarding, challenging, and wonderful years of my life. I am so grateful for the amazing friends, colleagues, and companions I have met there that provided respite along the way – they know who they are. Thanks to the NSF Offshore Wind Energy IGERT for the opportunity, that although did not culminate in a research project, provided an amazing experience and contribution to my scholarship. Thanks to my colleagues at the University of Southern Maine and at UMaine for their encouragement. Special gratitude goes to all of the remote workers that participated in this research and offered invaluable feedback. Without them, this research means nothing.

I would never have made it without the support and love of my family. Thanks to my mother and father for providing me opportunities over the years that helped me get to

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ABSTRACT

THREE ESSAYS ON REMOTE WORK AND REGIONAL DEVELOPMENT

SEPTEMBER 2019

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This dissertation is comprised of three papers that collectively explore the relationship between remote work, or people that work from anywhere, and regional economic development. The first paper measures remote occupational employment in the United States with Census microdata and a shift-share model to decompose the share of occupational growth attributed to remote work. Findings indicate remote work has grown significantly since 2000, with the most pronounced growth in high skill jobs. The second paper uses a mixed-methods design to understand the role of remote work in migration decisions. It concludes that remote work arrangements enable access to employment opportunities that are unavailable locally and supports certain migration. The third paper uses a cross-sectional design and spatial econometrics to investigate the influence of amenities on the concentration of remote workers across a sample of US counties. The findings indicate that amenities, especially recreational and cultural, play a powerful role in explaining variations of remote worker concentrations across counties and that amenities play different roles in the hierarchy of county sizes. The dissertation concludes with a discussion of the implications for place and offers avenues for future inquiry.

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CHAPTER 1

INTRODUCTION

The world of work is changing. Technological change and the rise of the global information economy have had a radical influence on the restructuring of work and occupational skill demands of the workforce. Informationalism as the current economic paradigm in advanced economies, understood as distinct from industrialism, emphasizes the flow of information and generation of knowledge relying on models of flexible production (Castells, 2011; Carnoy, Castells, and Benner, 1997). This has had profound implications for the types of jobs and skills demanded by industry. Employment growth over the last several decades has been concentrated in high-skilled knowledge work and low-skilled services, while middle skilled routine, non-cognitive jobs are being replaced by technological change, such as computerization, automation, and artificial intelligence (Autor, Levy, and Murnane, 2003; Autor and Price, 2013). In conjunction, the internet has dramatically enabled the flow and access of not only information, but also of labor (Autor, 2001). Work in many areas is no longer bound to a particular location or structured arrangement, while worker preferences continue to evolve towards greater flexibility (Carnoy, Castells, and Benner, 1997; Capelli and Keller, 2013; Gallup Inc., 2017).

These trends have also made it possible for many occupations, particularly those that are information and knowledge intensive, to be done entirely remote from a centralized location (Potter, 2003). In effect, work for many jobs can be done from anywhere. US Census data indicate an estimated 8 million Americans, or 5.2 percent of working aged adults, reported working from home in 2017 marking an increase of 90

percent over 2000 levels.[1] For the first time ever in 2017, more Americans reported working from home than those that reported using public transportation in their commute to work.[2] For firms labor pools are increasingly global in nature and organizations are seeking alternative means to access specialized talent in short supply locally and retain high-skilled workers (Blakely 2001; Society for Human Resource Management, 2017).

The growth of remote work, and the evolution of work more broadly, have important implications for the nature of regional and local economies and the development of places. For instance, a number of US states, regions, and local municipalities have undertaken initiatives to encourage and attract remote workers as a community and economic development strategy, especially by marketing and exploiting place-based amenities that may be attractive to remote high-skill knowledge workers and retaining existing residents (e.g., Vermont General Assembly, S.94, Act 197; Whitney, 2015). Some regions have focused on connecting local residents with remote employment opportunities through skill training and as a labor market intermediary (Teleworks, USA). As these examples help demonstrate, strategies to capture the remote workforce has been of particular interest for small and mid-sized cities and rural communities as a way to counter limited employment opportunities for specialized workers, population decline, and an aging workforce (Henderson and Abraham, 2006; Gallardo, 2016; Whitacre and Gallardo, 2014).

Despite the significance, little is known about who works remotely and the types of jobs and services they provide (Autor, 2001), and while there is a rich body of literature on the related topic of telework or telecommuting (e.g. Gurstein, 1996; Handy

[1] United States Census, American Community Survey, Journey to Work.
[2] *Ibid.*

and Mokhtarian, 1995; Mokhtarian, Salomon, and Choo, 2004), there is very limited research that considers the relationship of remote work to place and the movement of remote workers (Gallardo and Whitacre, 2018).

This dissertation is comprised of three essays that contribute new knowledge on the nature, migration, and geography of remote work to the scholarship and practice of regional economic development. Although not rigidly defined, I conceptualize remote workers as people with no geographic requirement to where their work is completed, whether dictated by an employer or by the nature of the occupation or job tasks. Remote workers 'live and work in place' (Erard, 2016) or can work from *anywhere*. This definition includes payroll employees or the self-employed, including independent contractors. Remote self-employed workers are distinct from other home-based businesses in that the nature of their business is not location based, such as a hair salon or local tax preparer. This definition is distinct from other frequencies of telework that may still maintain physically proximity to a central office location and thus has some location dependence to a physical 'place of work'.

Chapter 2 uses data from the US Bureau of Labor Statistics Occupational Information Network (O*Net) and Census microdata from the Integrated Public Use Microdata Series (IPUMS) USA to develop an operational definition of remote employment that I use to document the prevalence and characteristics of remote workers in the US. I then investigate remote employment growth using a shift-share model that identifies the occupations and general skill levels that are growing and declining in remote employment. The findings clearly show a marked increase in remote work employment particularly in salaried and wage employees suggesting that both workers

and firms find utility in more flexible work arrangements. All but a few occupations experienced growth in remote employment since 2000, including middle skill jobs that have been vulnerable to automation, computerization, and outsourcing in recent decades. Overall, remote workers tend to have higher levels of formal education that align with occupational requirements, higher incomes, and age, and when remote workers migrate, they appear to move greater distances than their counterparts.

Chapter 3 uses a mixed-method approach based on surveys and interviews of remote workers in the Portland, Maine region to understand the role of remote work arrangements in migration decisions of remote workers. I find that remote work enables greater locational flexibility when households consider a move, especially to locations that may offer fewer employment opportunities that match the skill sets and expertise of specialized knowledge workers. Remote workers are much more likely to decide on a region or place to locate and use remote work as a means to facilitate the move, especially when local labor market opportunities are lacking. In a vast majority of cases, remote work enables employment and occupational continuity in which workers maintain or access opportunities aligning with skill sets not available in the new location. While there is strong evidence of urban preferences and movements back to the city, findings suggest preferences for large, dense urban areas are not necessarily shared by all. Remote workers reported preferences for natural amenities, proximity to family, and general place affinity. Remote workers also balance wage differentials relative to the local labor market in which remote workers are able to draw wages from a high paying region relative to the new location, thus having the effect of increasing utility.

Chapter 4 uses a cross-sectional design and spatial econometric models to investigate the influence of amenities on the concentration of remote workers across a sample of US counties accounting for county size and Census region. I find that amenities play a powerful role in explaining variations of remote worker concentrations across counties and that amenities play different roles in the hierarchy of county sizes. Cultural amenities are associated with greater shares of remote workers across all county sizes, with the greatest magnitude in large counties that tend to comprise major urban areas. Recreational amenities, on the other hand, are more closely associated with smaller sized-counties that are more typically characteristic of rural regions.

The dissertation concludes with Chapter 5 providing a synthesis of the three core articles and a discussion of the implications for planners and policymakers and directions for future research. Overall, the findings of this dissertation make an incremental, yet significant scholarly contribution of new knowledge to the fields of planning, regional studies, and economic development. The findings should be of interest to both practicing planners and scholars interested in the spatial implications of the changing structure of work with particular relevance for small and mid-sized city regions and rural areas. It is the first body of research that I am aware of that focuses on remote workers, remote occupational employment and skill sets, and the relationship of remote work concentration to places. As such, it is the hope that this small body of research is a starting point for what appears to be an emerging area of inquiry in the future of work and the implications for planning and development.

CHAPTER 2

MEASURING REMOTE WORKER EMPLOYMENT AND OCCUPATIONS

One of the most striking changes of work and labor markets over the past several decades has been the influence of technologies on the skill demands and structure of work and the workforce. Many jobs can now be done remotely, presenting important implications for economic development and planners. Remote workers are less confined geographically to where they live and work and firms are no longer limited to talent availability in local labor pools. This article measures the prevalence and growth in remote occupational employment in the United States by constructing measures of remote work with US Census microdata from the Integrated Public Use Microdata (IPUMS) and employing a shift-share model to decompose the share of occupational growth attributed to remote work. I find that the share of remote workers has grown significantly since 2000, with remote workers that identify as wage and salary employees growing faster than those identified as self-employed. Remote occupational employment has grown in virtually all remote amenable occupations, with the most pronounced growth in high skill jobs. Remote workers have significantly higher levels of educational attainment and income compared to non-remote workers, although at least part of this can be explained by the occupational mix. The paper concludes by offering several areas for future research and implications for regional and urban planners.

2.1. Introduction and Motivation

One of the most striking changes of work and labor markets over the past several decades has been the influence of technologies on the skill demands and structure of work and the workforce (Autor, Levy, and Murnane, 2003). Preferences of workers are shifting towards greater flexibility outside of standardized work arrangements and unified locations (Gallup Inc., 2017). Firms are seeking alternative means to access specialized talent lacking in local labor pools and tools to retain a workforce that is increasingly more mobile in their career paths (Society for Human Resource Management, 2017). As the locus of economic activity in advanced economies has shifted to an emphasis on the generation and flow of knowledge and information, ICTs such as the internet and digital technologies, have had particular consequences for how labor is accessed and the means by which services are delivered (Autor, 2001; Muro, et al., 2017). Work activities for many occupations, particularly those that are information and knowledge intensive, can now be done entirely remote from a centralized location (Potter, 2003); a trend that anecdotally has received a great deal of attention in the popular press and from policymakers (Vermont General Assembly, S.94, Act 197).

From a regional development and labor market perspective, the locational independence of remote workers raises two important considerations. First, remote workers have greater flexibility in making location and migration decisions by 'taking their job with them', and may be more likely to make those decisions based on place-based characteristics rather than access to employment (Wallace, 2019b). This raises the possibility for places to recruit footloose remote worker households to live and work. For instance, the US state of Vermont recently passed legislation to attract and support the

growth of remote work in that state (Vermont General Assembly, S.94, Act 197). At the same time, local initiatives may be implemented to link incumbent residents with economic opportunities located elsewhere, especially rural regions and economically depressed areas as an argument for broadband development (Telework, USA; Gallardo, 2016).

Second, remote work is exemplary of the view that labor pools are not constrained by geography. Firms are seeking alternative means to access specialized talent lacking in local labor pools and tools to retain a workforce that is increasingly more mobile in their career paths (SHRM, 2017). Firms may have opportunities to recruit skilled or specialized workers in short supply locally, by offering remote work opportunities to workers outside the region. Furthermore, the extent to which remote work affects firm location decisions is another important consideration and some firms may cease having a centralized location altogether (Weiler-Reynolds, 2018).[3]

This article conceptually defines remote workers as people with no geographic requirement to where work is completed, whether dictated by an employer or by the nature of the occupation or job tasks. This suggests that remote workers are geographically independent from a physical place of work and may work from *anywhere*. This is distinct from other forms of telework that may still maintain physically proximity to a central office location and thus have some location dependence to a physical 'place of work'. Remote workers complete work activities assigned from a central physical office location and are enabled by information and communication technologies (ICTs). Generally, work is completed from the home, but may also be completed at coworking

[3] https://www.flexjobs.com/blog/post/100-top-companies-with-remote-jobs-in-2018

spaces, coffee shops, or other alternative work spaces. Remote workers may include payroll employees or self-employed, including independent contractors (freelancers). Remote self-employed workers are distinct from other home-based businesses in that the nature of their business is not location based, such as a hair salon, local tax preparer, or IT professional providing services to local businesses and individuals.

Despite the importance little is known about who works remotely and the types of jobs and services they provide (Autor, 2001). Closely related, a number of attempts to measure teleworking have been undertaken in the United States, European countries, and Australia but ultimately suffer from a lack of consistent definition (Mokhtarian, Salomon, & Choo, 2005) or accounting framework (Mokhtarian, 1991; Ellison, 1999), and data availability (Handy & Mokhtarian, 1995; Liu & Kolenda, 2012). Furthermore there have been very few attempts to distinguish remote workers from the broader pool of teleworkers, while understanding the types of occupations and skills, the economic and demographic characteristics, and the geographic differences in the prevalence of remote work (Gallardo & Whitacre, 2018).

In light of these gaps, this paper makes two important contributions to the emerging literature on the changing nature of work related to regional economic development and labor market analysis. First, this paper draws upon data from the US Census American Community Survey (ACS) and Decennial Census (DC) to propose a consistent and replicable methodological framework to measure the prevalence of remote workers over time using readily available public secondary data. The hope is that the framework can be adopted and implemented by both researchers and policy, planning, and development practitioners alike to understand the opportunities and challenges

presented by the changing nature of the workplace. Second, this paper documents and characterizes the types of occupations in which remote work is most prevalent and growing and provides a descriptive analysis of socio-economic characteristics of remote workers in the US.

2.2. Review of Literature

The impact of technology on work is anticipated to be one of the most important developments for society and economic activity in the years ahead (Karoly & Panis, 2004).[4] Global economic pressures and rapidly advancing technologies are helping to restructure the types of jobs and skills in demand, but also the locus of where work is completed (Carnoy et al., 1997; Castells, 2011; Blakely, 2001). Workers are demanding greater workplace flexibility (WEC, 2016; WEF, 2016; SHRM, 2017), while younger generations are placing greater emphasis on work-life balance and flexibility (Ng, Schweitzer, & Lyons, 2010). The occupational structure of work is changing as well, favoring growth of non-routine, cognitive, and knowledge-based work that is less susceptible to automation and substitution by advanced technologies (Autor, Levy, & Murnane, 2003; Autor & Price, 2013). Meanwhile the changing nature of work and reliance on specialized labor are motivating firms to access talent that might not be available in local labor pools (Burke & Ng, 2006; SHRM, 2017).

[4] One of the National Science Foundation's 10 Big Ideas to guide research investments titled "Work at the Human- Technology Frontier: Shaping the Future" is focused on "Understanding how constantly evolving technologies are actively shaping the lives of workers and how people in turn can shape those technologies, especially in the world of work."

2.2.1. Emergence of Telework and Remote Work Flexibility

Remote work is one manifestation of these changes stemming from the concepts of telework or telecommuting. Telework draws its roots from Nilles, Carlson, Gray, and Hanneman (1976) who, long before advanced mobile and digital technologies common today, proposed reorganizing work through connected satellite and home based offices substituting telecommunications technologies for physical commuting. Subsequent futurists postulated the dramatic changes in store for society with the advent of new communications technologies which would lead to society organizing around 'electronic cottages' mixing home and work through dense communications networks (Toffler 1980), eventually leading to the decentralization of human settlement and the 'death of distance' (Cairncross, 2001).

The phenomenon has captured the attention of both practitioners and scholarly researchers alike (Handy & Mokhtarian, 1996) and has been referred to as telecommuting, virtual work, flexible work, distributed work, and remote work (Allen, Golden, & Shockley, 2015). Large bodies of research have developed over the last several decades investigating telework from the perspective of numerous disciplines (Ellison, 1999) including its relationship to transportation (Kim, Choo, & Mokhtarian, 2015; Kim 2016), urban structure (Graham & Marvin, 1996), intra-regional residential location decisions (Muhammad, Ottens, Ettema, & de Jong, 2007), operations management (Mayo, Pastor, Gomez-Meija, & Cruz, 2009), and sociology interested in work-life and family relations (Gurstein, 1996), among others.

Empirical evidence on the growth of telework is mixed and statistics have varied widely depending upon the focus of the study, the disciplinary perspective, geography of

focus, and time period of analysis (Mokhtarian et al., 2005). Several studies suggest the uptake of telework has been slow, in some cases insignificant, and has not necessarily proliferated to the extent early proponents claimed (Vilhelmson & Thulin, 2001; Felstead, 2012; Noonan & Glass 2012; Hynes, 2014; Boell, Cecez-Kecmanovic, & Campbell, 2016; Aguilera, Lethiais, Rellet, & Proulhac, 2016). Recent research and media reports suggest the use of telework in general has been increasing over time, and in some cases (Sweden), rates of telework have doubled since 2005 (Mateyka et al., 2012; Tugen, 2014; Vilhelmson & Thulin, 2016). A recent Gallup poll estimated that 43 percent of employees worked remotely at least part of the time in 2016, up from 39 percent in 2012 (Gallup, 2017). Of those, 20 percent reported working remotely 100 percent of the time, up 5 percentage points from 15 percent of all remote workers in 2012 (Gallup, 2017). Based on Gallup's polling estimates, this translates into 8.6 percent of all employees having worked remotely 100 percent of the time in 2016 (author's calculations).

2.2.2. Defining and Counting Remote Work

Several reasons are often provided that explain the differences and disagreements among estimates of telework. First, one of the primary reasons is that remote work and telework do not conform to a well-defined set of characteristics leading to a myriad of inconsistent definitions used across a variety of disciplines that often have a different locus of emphasis (Gurstein, 1996; Bailey & Kurland, 2002; Sullivan, 2003; Garrett & Danziger, 2007). Mohktarian et al. claim that for every study on telework or related concepts, there are as many definitions (Mokhtarian et al., 2005). Part of the problem is that there is no clear consensus on who should be included and counted as a teleworker

(Ellison, 1999; Mokhtarian, 1991). For example, a recent study in France (Aguilera et al., 2016) compared findings to those observed in the United States (Noon & Glass, 2012); however, the former paper exclusively focused on home-based telework, while the latter study explicitly excluded home-based workers (Noonan & Glass, 2012 p.39).

Second, many studies treat teleworkers as a homogenous group failing to differentiate the frequency of telework and the differences and implications that might exist across different groups of teleworkers (Haddon & Brynin, 2005; Sullivan, 2003). Several studies have suggested various typologies and taxonomies of telework to examine various dimensions of the concept (e.g. Gurstein, 1996; Helling & Mokhtarian, 2001; Garrett & Danziger, 2007). More recently researchers have called for the extent of telework frequency (intensity) to be precisely identified in research (Allen et al., 2015).

A third reason for lack of consensus on the prevalence of telework have been challenges in operationalizing the concept because of a lack of consistent data or differences in sampling strategies or methodologies across studies (Mokharian et al., 2005; Pratt, 2000). Pratt (2000) discusses the definitional challenges of telework studies and provides suggestions on designing surveys of home-based work. Mokhtarian et al. (2005) also comment on the definitional challenges of telework research. They discuss a number of data sources used to measure the prevalence of teleworking, highlight the limitations and advantages of each source, and provide a set of considerations for evaluating different data sources for measuring telework. Data sources in the United States range from several US Census programs, including the Decennial Census, the Survey of Income and Program Participation (SIPP), the American Housing Survey (AHS), Current Population Survey (CPS) supplements, and more recently the American

Community Survey (ACS), to market research firms and government reports. Mateyka et al. (2012) compare the estimates of home-based work measurements and discussion of the differences between the ACS and SIPP. The ACS differs in that it allows for a more robust geographic analysis of numerous characteristics spatially and is reported annually. Currently, no statistic from public secondary data sources exist that directly measure remote work or capture the extent of teleworking trends more broadly.

Lastly, the limitations presented by data sources, definitional differences, and heterogeneity of teleworkers has meant research has typically focused on either one region or none at all, and rarely captures the differences of telework across a wide sample of regions. The few exceptions include Gallardo and Whiteacre (2018) who consider the impact of telework on income levels in U.S. Census tracts, and Gould-Ellen and Hempstead (2002) who characterize white-collar telecommuting across different levels of the urban hierarchy. Liu and Kolenda (2012) provide a means to measure contingent work and apply to the state of Georgia. The lack of spatial dimension in telework data and past studies has limited the ability to understand the influence of place and space in the uptake of remote work.

Mokhtarian et al. (2005) suggests that the very complex nature of telework does not lend itself to neat and precise measurement and the definition and operationalization of the concept largely depends on the research questions being asked. Therefore, it is imperative for researchers to define the focus of study within the context of what one is interested in investigating (Mokhtarian et al., 2005). To help define the extent of telework, four dimensions have emerged in the literature generating some consensus; location, time, technology mediation, and employment contractual arrangement (Sullivan,

2003; Garrett & Danziger, 2007), but rarely are they all considered in the same analysis. Location refers to the place which work is carried out in reference to a centralized physical office location. Workers may substitute time in the central office by working off-site, at home, at a client's office, a satellite or field office, or other site. The time dimension refers to the location-time orientation of work and the share of time in which a worker worked entirely away from the office or only part of the time. From its beginning, telework was considered directly reliant on ICTs as a substitute for physical commuting (Nilles, 1975). Although technology is not the only factor in the development of telework, it is often portrayed as a necessary condition (Garrett & Danziger, 2007). Most current definitions require out of office work to be mediated through ICTs or related technology, often precluding a number of occupations. Employment contractual arrangement refers to the relationship between the employing organization and the worker. There has generally been a distinction in the literature among workers that are full-time wage and salary employees (W-2), full and part time contingent workers, and self-employed individuals (including independent contractors and freelancers) that work from home. A very limited number of studies focus exclusively on remote workers as defined in this research being locationally-independent of a place of work.

Previous studies on telework and home-based work have varied on whether they included self-employed workers or whether they were analyzed separately (Handy & Mokhtarian, 1995; Gould-Ellen & Hempstead, 2002; Gallardo & Whitacre, 2018). This study includes both classes of workers in its definition of remote workers, though workers are classified into two broad worker classes in the analysis that follows; wage and salary employees and self-employed workers, which include independent contractors.

While the primary interest of this study is on wage and salary employees, there are other forms of flexible work that are growing (Liu & Kolenda, 2012; Katz & Krueger, 2016), as are the opportunities for home based businesses. The key questions for independent contractors and self-employed persons are whether there is a spatial requirement for where they complete their business or work activities, such as the necessary proximity to local markets and customers.

2.2.3. The Occupations and Characteristics of Remote Workers

Few studies provide a comprehensive characterization of who teleworkers are, what they do, and whom do they do it for (eg. Gurstein, 1996; Haddon & Brynin, 2005; Alizadeh, 2012; GWA , 2017), although a handful of others discuss these characteristics for home-based workers more broadly (Bailey & Kurland, 2002; Moos & Skaburskis, 2007; Mateyka et al., 2012). The very nature of work limits the ability for some occupations to be done remotely. For instance, it is easy to picture a software engineer writing code remotely, but it makes little sense for an electrician to wire a house from a distance. Similarly, as computerization continues to have a dramatic impact on the skill content of jobs placing higher demand on occupations that require nonroutine tasks (Autor et al, 2003; Bound et al., 2013; Autor & Price, 2013), one might expect shifts in the skill content and skill requirements of remote workers towards more knowledge-based work requirements (Alizadeh, 2012). Approximately 50 percent of home workers had a Bachelor's degree or higher compared to just 32 percent for all workers (Mateyka et al., 2012) and recent evidence suggests that high wage, high skilled workers appear to take advantage of flexible workplace as a quality of life benefit at a greater rate than lower skilled, low wage workers (Acosta & Wiatrowski, 2017; Gallup, 2017).

Two studies characterize the occupations of home-based workers that largely demonstrate the uptake of telework across occupations (Moos & Skaburskis, 2007; Mateyka et al., 2012). In a cross-section of three large Canadian cities, Moos & Skaburskis (2007) identify art, culture, and recreation occupations as comprising the largest share of home workers, followed by management occupations, financial, secretarial and administration occupations, social science and government occupations; and natural and applied science occupations. Mateyka et al. (2012) find similar patterns based on the 2010 Decennial Census in which management, business, and financial occupations made up the largest share of home-based work, while jobs in computer, engineering, and sciences had the fastest growth of home-based work uptake between 2000 and 2010. On the contrary, jobs that tend to be location dependent have much lower rates of home-based work, such as healthcare practitioners and construction, installation, and production laborers.

Gender differences in home-based occupations are consistent with past literature that has highlighted the work-life balance aspects of home-based work for women in particular (Hanson & Pratt, 2003), but also for gendered occupational patterns more broadly. Mateyka et al. (2012) report that women are more likely to work at home in administrative and service occupations, while men are much more likely to work from home in managerial and sales occupations. Interestingly, however, a greater share of women in computer, engineering, and science occupations are more likely to work from home than men. At one time self-employed businesses made up the largest share of home-based workers comprising about 58 percent of home-based workers while private wage and salary employees accounted for about 33 percent. Those proportions have

shifted dramatically since 1980, in which private wage and salaried employees comprised close to 60 percent of home-based workers in 2010 (Mateyka et al., 2012).

Various forms of telework and home-based work have been associated with family, lifestyle or life cycle stage preferences and age (Mokhtarian, Bagley, & Salomon, 1998; Shockley & Allen, 2012). Most empirical studies on telework provide demographic summaries of teleworkers which suggest on the whole that teleworkers tend to be slightly older. More specific to remote workers, data from Mateyka et al. (2012) show that workers 45 and over are more likely to work from home (at least part of the time) than younger age cohorts. This appears to remain somewhat consistent over the periods. For instance, Gould-Ellen and Hempstead (2002) reported that almost 61 percent of 'hard-core teleworkers' were aged 40-64 years old. Evidence on the income levels of teleworkers is generally consistent in that teleworkers report relatively higher wages, although the averages may be skewed. For example, Mateyka et al. (2012) report that about 50 percent of home workers earner personal incomes under $25,000 compared to 43 percent for all workers although on the upper end of the income spectrum 11.5 percent of home workers earned $100,000 or more compared to 6.2 percent for all workers.

2.3. Counting Remote Workers

This study constructs employment measures of remote workers by drawing on public use microdata from the Integrated Public Microdata System[5] (IPUMS-USA) (Ruggles,

[5] The IPUMS-USA has been used across a wide range of economic and planning studies and research projects to study occupations (eg. Glaeser, Ponzetto, & Tobio, 2014; Gabe & Able 2016). While it has seen limited use in the past to examine remote work (or telework), the ACS has several advantages over other publicly available data sources. First, the sample size is far larger and more diverse than data used in past studies of telework drawing on a sample of one in every six US households. Second, with over 3 million observations in each annual survey, it is

Genadek, Goeken, Grover, & Sobek, 2017) for the US Census American Community Survey (ACS) and long form Decennial Census. The ACS and Decennial Census report Journey to Work data based on a survey question that asks how the respondent usually got to work last week, for which one of the answers is "worked at home".[6] The sample is limited to the adult population 25 years and older and to those individuals reporting as currently employed. Including all respondents reporting working from home may include workers that are not necessarily remote, as their occupation has an inherent spatial requirement, such as a landscaper or physician. To account for this, the sample of home-based workers is constrained to respondents working from home in occupations that are amenable to remote work.

This paper identifies occupations that are remote amenable (occupational constraint) using an iterative process informed by three criteria: 1. data from the US Bureau of Labor Statistics (BLS) Occupational Information Network (O*Net) on occupational requirements, 2. an occupation's absolute number and relative concentration of home-based work in 2016, and 3. analytical judgement. There is no direct measure in the O*Net of which occupations are more remote amenable than others. Therefore, in the spirit of Autor and Dorn (2013) and Firpo, Fortin, and Lemieux (2011), this paper considers four measures from the O*Net worker requirement measures that include

possible to examine a number of individual and household attributes linked to each response, including the potential to be examined geographically using Public Use Microdata Areas (PUMAs). Third, the fact that estimates are provided annually through using consistent sampling methodology allowing for confidence in comparison of data across years. Additionally, data is provided for single year estimates or combined for larger samples across five-year intervals.

[6] More information can be found at https://www.census.gov/topics/employment/commuting.html and https://www.census.gov/topics/employment/commuting/guidance/home-based-workers.html, both last accessed on August 9, 2019.

"Physical Proximity" (Prox), "Face-to-Face Discussions" (F2F), and "Interactions with Computers" (CPU), which include measures for both importance and level.[7] The O*Net rates occupations on a scale of 1 to 5 for F2F, Prox, and importance of CPU, while rating the level of CPU on a scale of 1 to 7. The values for level and importance of CPU are multiplied to obtain an index for the CPU variable. Occupations with a CPU index above the median value are weighted positively. Similarly, occupations with values for Prox and F2F below the median are weighted favorably as remote work amenable. This is because a lower value for these measures indicates lower face to face discussions and physical proximity are required of the occupation.

O*Net occupational values and concentration of an occupation's employment reporting working from home were used to construct an initial list of occupations perceived to be remote work amenable. The concentration of occupational employment reporting working from home were then considered. Occupations with significantly large numbers or concentration of employment reporting working from home, that may have had less favorable O*Net values, were scrutinized by the author. These included occupations in education and health care, that on average require greater degrees of face-to-face contact or proximity to complete work activities, but have large above average shares of home-based workers.[8] External validation was obtained with remote specific online job posting websites, such as Flexjobs.com, in addition to other media reports and

[7] O*Net data is reported by Standard Occupational Classification Codes (SOCs) which are applied to the ACS occupational codes used in this study using the National Employment Matrix SOC occupation equivalents from the American Community Survey(ACS) (source).

[8] Part of the challenge is the limitations of the occupational classification system itself, which attempts to classify approximately 25,000 reported occupational titles within roughly 500 occupational codes. There is likely to be significant variation in work characteristics within occupational categories themselves.

internet searches. Occupations that are by nature anchored in place and could not be done remotely (ie. carpenters, machine operators, etc.) are excluded. While the O*Net occupational requirements data and share of an occupation working-from-home in 2016 are used as screening criteria, final inclusion of an occupation as remote work amenable falls on the analyst.

This method has the benefit of being more specific in the types of occupations that are included as remote workers rather than broad occupational categories such as "professional services", "management", or "health care" used by other studies to measure telework (Gould-Ellen & Hempstead, 2002; Gallardo & Whitacre, 2018). Though to some degree, this method may be more liberal in the types of occupations to include as remote work amenable and they may capture occupations in which home-based businesses are more prevalent rather than a pure remote work employee (Mokhtarian, 1991; Gallardo and Whitacre, 2018). To account for this, remote workers are differentiated by worker class into two broad categories; self-employed workers and wage and salary employees.

A total of 186 occupations are identified as amenable to remote work out of 499 occupations in the ACS occupation code system. Employment in occupations that are remote-amenable comprised 38.6 percent of all occupational employment in 2016 for the population 25 and older. It is important to note that occupations characterized in the Census are but an abbreviated classification drawn from over 25,000 occupational titles reported on ACS surveys by respondents, and while they provide the best means available to classify and measure occupations, each occupational category may have a wide range of jobs that differ slightly in their focus or application. While many

occupations are subject to gray area on this topic, the definition presented here identifies an occupation as either remote amenable or not. Of all people reporting working from home aged 25 and older in the 2016 ACS, 55 percent are in occupations that meet the remote work definition.

The definition of remote work is applied to IPUMS-USA data for the years 2000 and 2016 to measure the prevalence and growth of remote work employment in the US and to investigate the occupational make-up of remote work.[9] Of the potential remote jobs, an estimated 7.7 percent classify as remote workers in 2016. The top 10 occupations for remote work accounted for 43 percent of total remote employment in 2016 (Table 2.1). The final list of remote work amenable occupations can be found in Appendix A (Table A.2.1.), as well as counts, growth, and other summary characteristics.

Table 2.1: The Top 10 Remote Occupations by Total Employment, 2016

Occupation	Remote Employment	Percentage of all Remote Employment
Miscellaneous managers, including funeral service managers and postmasters and mail superintendents	422,843	10.9%
Management analysts	207,889	5.3%
Sales representatives, wholesale and manufacturing	178,042	4.6%
Computer Scientists and Systems Analysts	166,755	4.3%
Designers	131,511	3.4%
Software developers, applications and systems software	129,810	3.3%
Accountants and auditors	116,895	3.0%
Customer service representatives	111,292	2.9%
Bookkeeping, accounting, and auditing clerks	102,950	2.6%
Sales representatives, services, all other	91,070	2.3%

Source: IPUMS-USA American Community Survey (ACS) 2016 1 yr. est; US Bureau of Labor Statistics (BLS) Occupational Information Network (O*Net); author's calculations.

[9] These years cover two significant periods of economic expansion, contraction, and recovery in the U.S. economy and represent a period of rapid technological evolution in a number of ICT, computer, digital, and mobile technologies.

2.3.1. The Prevalence and Growth of Remote Work in the US

Table 2.2 shows the number and distribution of remote and non-remote (traditional) workers by worker class between 2000 and 2016. Employment growth of remote work is shown in Table 2.3. Relative to the overall employed population 25 and older, remote workers made up a relatively small share of the workforce although the share has increased substantially. The number of remote workers totaled nearly 3,889,000 in 2016 which accounted for approximately 3 percent of all employed workers 25 and over, up from a share of 1.6 percent in 2000. For scale and context, the number of remote workers in 2016 was similar to the population size of the Seattle-Tacoma-Bellevue, Washington MSA or the entire US state of Oklahoma.

Overall, the number of remote workers more than doubled, growing by 123 percent from 2000 through 2016 and increasing by 2,145,000 million over the period. This compares to traditional non-remote workers which grew by just 19.7 percent over the same period. The rate of growth in remote workers appears to be increasing as well. From 2000 to 2005, the number of remote workers grew by an annual average of 4 percent, while growing by an average of 6 percent over the period 2005 to 2015. While the research has not analyzed every year of ACS data, for the most recent one year period from 2015 to 2016 the number of remote workers increased by almost 11 percent (Table 2.3).

Table 2.2: Remote Work in the United States, 2000-2016

	2000		2005		2010		2015		2016	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Remote worker	1,744,012	1.6	2,095,122	1.8	2,686,706	2.3	3,505,410	2.7	3,888,992	3.0
Self-employed	984,003	0.9	1,135,735	1.0	1,194,938	1.0	1,326,546	1.0	1,420,057	1.1
W-2	760,009	0.7	959,387	0.8	1,491,768	1.3	2,178,864	1.7	2,468,935	1.9
Traditional worker	107,351,205	98.4	112,435,555	98.2	116,558,563	97.7	125,224,663	97.3	126,651,544	97.0
Self-employed	10,974,969	10.1	12,380,569	10.8	11,658,876	9.8	12,094,265	9.4	12,348,137	9.5
W-2	96,376,236	88.3	100,054,986	87.4	104,899,687	88.0	113,130,398	87.9	114,303,407	87.6
Total	109,095,217	100	114,530,677	100	119,245,269	100	128,730,073	100	130,540,536	100

Source: IPUMS-USA Decennial Census (2000) and ACS 2016 1 yr. est; author's calculations.

Table 2.3: Growth in Remote Work in the United States, 2000-2016

	2000-05		2005-10		2010-15		2015-16		2000-16	
	Number	Percent change	Number	Percent change	Number	Percent change	Number	Percent change	Number	Percent change
Remote worker	351,110	20.1	591,584	28.2	818,704	30.5	383,582	10.9	2,144,980	123.0
Self-employed	151,732	15.4	59,203	5.2	131,608	11.0	93,511	7.0	436,054	44.3
W-2	199,378	26.2	532,381	55.5	687,096	46.1	290,071	13.3	1,708,926	224.9
Traditional worker	5,084,350	4.7	4,123,008	3.7	8,666,100	7.4	1,426,881	1.1	19,300,339	18.0
Self-employed	1,405,600	12.8	(721,693)	-5.8	435,389	3.7	253,872	2.1	1,373,168	12.5
W-2	3,678,750	3.8	4,844,701	4.8	8,230,711	7.8	1,173,009	1.0	17,927,171	18.6
Total	5,435,460	5.0	4,714,592	4.1	9,484,804	8.0	1,810,463	1.4	21,445,319	19.7

Source: IPUMS-USA Decennial Census (2000) and ACS 2016 1 yr. est; author's calculations.

One of the most interesting findings from this data is the growth in remote work of wage and salary employees, which accounted for the vast majority of growth in remote work since 2000, as opposed to self-employed remote work. As a share of all remote workers, wage and salary employees made up 44 percent of remote workers in 2000, but jumped to 63 percent of all remote workers in 2016. From 2000 to 2016, the number of wage and salary employees grew by 225 percent increasing by 2,469,000 workers. Comparatively, non-remote wage and salaried workers grew by 18.6 percent over the same period. This offers support to the notion that remote work is a growing work arrangement for companies and employees that is not limited to self-employed businesses. However, these estimates here may be conservative compared to those found by recent surveys by Gallup (2017), which show a significantly higher share of workers are remote 100 percent of the time.

2.4. The Occupations of Remote Work

Recent trends in economic development and planning analysis have focused on occupations as the unit of analysis to better understand the role of human capital in economic change (Markusen, 2004; Thompson and Thompson, 1987; Gabe, 2006). Following this vein, a primary objective of this analysis is to characterize the occupations in which remote work is an increasing option for workers and firms, and to understand how remote work has changed across the occupational structure. This section describes the occupational distribution of remote workers in the United States, including the number, concentration, and growth of remote work across occupations and by class of worker. To this end, this section reports the top occupations that are remote worker intensive, occupations with the largest share of total employment that is remote. A shift-

share model is constructed to decompose the growth components of remote work in an occupation. Lastly, I explore the relative skill demands of the occupations in which remote work is growing based on O*Net Job Zone scores for an occupation. For the purposes of the analysis that follows, I include only occupations with greater than 3,000 remote jobs in 2016, an arbitrary threshold, in order to focus on the most significant remote work occupations.

In terms of the overall number, remote work employment is concentrated in a relatively small number of occupations that contain very large shares of the total remote workforce. Nearly 43 percent of all remote work jobs in 2016 are accounted for by 10 occupations, with the largest number of remote jobs being in managerial, sales, information technology, and other business operation occupations. Similar to occupations with high concentrations of remote work employment, there is a diverse mix of occupations with higher numbers of remote employment, including creative (designers and writers and authors), knowledge-based (computer scientists and systems analysts), business and sales operations (managers and sales representatives), administrative (office clerks), and education and health care (teachers and instructors and registered nurses).[10]

2.4.1. Remote Work Intensive Occupations

Table 2.4 shows the occupations that have the highest concentration of remote employment as a share of total employment in each respective occupation in 2016 and the share of remote employment by worker class (employee and self-employed). Part of the

[10] This information echos other data drawn from online postings of remote jobs by FlexJobs.com, although not necessarily a statistically significant sample. https://www.cnbc.com/2018/03/09/these-are-the-14-most-common- remote-jobs-heres-how-much-they-pay.html.

pattern in Table 2.4 can be explained by differences among remote intensive occupations between class of worker, i.e. self-employed versus wage and salary employees. A higher share of self-employed workers are identified as remote compared to wage and salary employees, which likely include a large number of home-based businesses and independent contract workers. Remote employment accounts for one-third (34 percent) of all self-employed employment in remote amenable occupations, compared to 5.3 percent of wage and salary employees. The most intensive self-employed occupations are in niche jobs with a relatively small numbers of workers.[11] With respect to wage and salary employees, remote intensive occupations have relatively large numbers of employment and are more reflective of the diverse occupations that comprise the larger pool of remote workers. A notable characteristic of the occupations at the top of Table 2.4 is the share of remote work that are self-employed, although this shifts as one moves further down the ranking. Nine out of the top 15 occupations have greater than 50 percent of remote jobs in self-employment, which include writers and authors, artists, and photographers; these are jobs that typically trend towards self-employed. However, 12 out of the bottom 15 jobs on Table 2.4 have a majority share of remote jobs classified as employees and are a rather diverse group of occupations.

[11] Table A2.2 in Appendix A show the top ten most concentrated occupations by worker class, self-employed and wage and salaried.

Table 2.4: Top 20 U.S. Occupations Ranked by Remote Share of Occupational Employment by Worker Class, 2016

Occupation	Total Remote	Occupational Concentration of Remote Employment	Share of Employment: Employee	Share of Employment: Self-employed
Writers and authors	85,051	40.5%	23.1%	76.9%
Travel agents	21,108	31.7%	54.7%	45.3%
Artists and related workers	57,757	30.6%	9.3%	90.7%
Sales engineers	11,020	29.7%	96.3%	3.7%
Photographers	37,770	26.8%	6.4%	93.6%
Management analysts	207,889	26.1%	41.1%	58.9%
News analysts, reporters and correspondents	51,772	22.1%	42.7%	57.3%
Technical writers	11,091	18.8%	73.3%	26.7%
Medical records and health information technicians	27,670	16.5%	96.2%	3.8%
Designers	131,511	16.2%	25.4%	74.6%
Claims adjusters, appraisers, examiners, and investigators	45,022	16.1%	90.2%	9.8%
Sales representatives, services, all other	91,070	15.5%	77.6%	22.4%
Television, video, and motion picture camera operators and editors	7,446	14.9%	17.6%	82.4%
Computer programmers	58,752	14.6%	78.1%	21.9%
Advertising sales agents	22,728	13.9%	62.7%	37.3%
Sales representatives, wholesale and manufacturing	178,042	13.8%	76.7%	23.3%
Miscellaneous media and communication workers	13,003	13.6%	32.8%	67.2%
Architects, except naval	24,263	13.3%	29.5%	70.5%
Securities, commodities, and financial services sales agents	26,865	12.6%	51.1%	48.9%
Other Business Operations Specialists	66,523	12.3%	61.6%	38.4%
Other teachers and instructors	78,964	12.2%	32.5%	67.5%
Computer support specialists	72,052	11.9%	84.9%	15.1%
Reservation and transportation ticket agents and travel clerks	13,415	11.6%	88.9%	11.1%
Computer Scientists and Systems Analysts	166,755	11.5%	72.5%	27.5%
Database administrators	12,158	11.4%	92.7%	7.3%

Source: IPUMS-USA Decennial Census (2000) and ACS 2016 1 yr. est; author's calculations.

Several occupations with the highest concentrations in remote employment are in jobs often associated with the creative economy[12], including writers, authors and related occupations; artists and related workers; photographers; designers; and camera operators and editors, among others. Overall, remote employment in these occupations is largely comprised of self-employed workers including contractors. For example, over 40 percent of employment as writers and authors nationwide are remote, with the 77 percent identifying as self-employed and 23 percent as traditional employees. Likewise, 31

[12] Creative occupation definitions follow those used by Florida (2002) and Wojan and McGranahan (2004).

percent of artists and related workers are remotely employed in which the vast majority (91 percent) identify as self-employed.

Alternatively, there are occupations that have higher shares of remote employment that are predominantly wage and salary employment meaning that organizations have formal salaried employment arrangements with these types of jobs. Several sales and insurance oriented occupations all have higher concentrations of remote employment that are wage and salary. Jobs that might typically be associated with remote work also appear among the most concentrated in remote work, such as computer and information technology, travel agents and representatives and medical records and health information technicians; the latter being an oft cited example of remote work in popular media and jobs boards. Management analysts on their face do not necessarily align with traditional notions of remote work, although the prevalence of managerial jobs follows recent evidence from Bloom and Van Reenan (2007) and Bloom et al (2014) and in popular media reports (Jones, 2018).

2.4.2. Growth in Remote Work Occupations

To understand the trends in remote work over time, I consider growth rates of remote occupational employment and construct a basic shift-share model to decompose the growth of remote work by occupation over the 2000 and 2016 period. Shift-share models are typically used to study regional trends in industry or occupations, but the method has also been employed as a way to isolate change in a subject into various

components of interest. The shift-share model decomposes remote employment growth in three components and takes the following form:

$$r_i^{16} - r_i^{00} = r_i^{00}(US^{16}/US^{00}) + \quad \text{National effect}$$

$$r_i^{00}[(US_i^{16}/US_i^{00}) - (US^{16}/US^{00})] + \quad \text{Occupational effect}$$

$$r_i^{00}[(r_i^{16}/r_i^{00}) - (US_i^{16}/US_i^{00})] \quad \text{Remote competitive effect}$$

where "r" is the number of remote workers, "US" is U.S. benchmark employment, subscript "i" is the occupation, and superscript "16" and "00" refer to start year 2000 and end year 2016. The national effect accounts for the change in occupation "i" if it grew at the same rate as all national employment over the period. The occupational effect accounts for change in occupation "i" remote employment that can be attributed to overall employment change of the occupation whether remote or non-remote. The remote competitive effect isolates the remote employment change in an occupation that cannot be attributed to national overall employment growth or an occupations overall employment growth.

In this case, the remote competitive effect is a more appropriate representation of an occupation's remote employment trends compared to the base employment change. This shift-share analysis allows insight into the role of remote employment in underlying structural changes in the nature and dispersion of work as it relates to skill-biased technological change (Autor, 2001; Autor et al 2003; Autor and Price, 2013). For example, the analysis can identify occupations in which lower skill work is being shifted to remote arrangements while overall occupational employment is shrinking or experiencing stagnant growth. On the other hand, the shift-share model can indicate

higher-skilled occupations that are growing overall and are also seeing expanding remote employment, which might suggest a role for remote work in accessing talent by firms (SHRM, 2016).

I first consider the absolute change of remote employment across occupations between 2000 and 2016. Among the fastest growing remote jobs between 2000 and 2016 are jobs in computer, network, and software related occupations, as well as business operations specialists and customer service representatives.[13] More surprising is remote employment growth in occupations that may typically have less association with remote work. For example, while medical records and health information jobs might be expected to become more remote growing more than 24 times between 2000 and 2016, several other health care related occupations top the list of fastest growing remote employment including registered nurses and medical and health services managers.

Table 2.5 presents a selection of the occupations in which an occupation's overall employment is outpacing national growth, while remote employment growth is outpacing both national and the overall occupation's employment growth; that is both the occupational effect and remote effect are positive and sufficiently large. The diverse array of occupations in Table 2.5 speaks to the rapid diffusion of remote employment and its uptake across industries and higher-skill knowledge domains. For instance, several occupations that are typically representative of insurance and finance, IT and related, education, and health care industries are clustered on this list. The majority if not all of these occupations require higher levels of specialized knowledge, skill, and formal training. In addition to these occupations are other traditional STEM jobs that generally

[13] See Appendix A Table A.2.1 for remote employment growth rates of all occupations.

have higher skill and knowledge requirements, such as engineers and scientists, while customer service representatives and information and record clerks require less formal education and training. One factor driving this emergence of remote high skill jobs may be a function of access to specialized, niche labor that is less ubiquitous across regional labor markets than more common jobs and skill sets. Although beyond the scope of this paper, one hypothesis to test in future research is whether the employers of specialized remote knowledge workers reside in smaller or mid-sized labor markets rather than dense knowledge urban agglomerations where labor matching externalities are high. Firms may use remote work arrangements to access or retain talent that is less abundant in local labor pools, which is reflected in recent polling of firms (SHRM, 2017).

Another noteworthy observation is that while several occupations are commonly aligned with remote work, such as computer and information technology oriented jobs or medical records and health information technicians, previously considered unconventional candidates for remote work have emerged at a fast pace, including several other jobs in health care and education. Fast growth in remote education and health care occupations exemplify the rise of remote service provision in these areas, such as online college courses, instruction, and other education providers, and the emergence of "telehealth" where patients are consulted, diagnosed, and treated remotely for certain conditions, including mental health. Also of interest has been the rapid rise of remote employment in managerial jobs and other business operations specialists. Almost 450,000 managers and management analyst jobs emerged as remote over the 16 year study period.

One of the most interesting findings of the shift-share analysis is the limited number of occupations in which remote employment *declined*. Just eight occupations had a decrease in remote employment between 2000 and 2016, which included telemarketers, tax preparers, medical assistants and other healthcare support occupations, computer operators, artists, financial service sales agents (securities and commodities), economists, and bookkeeping, accounting, and auditing clerks (Table 2.6). Four of these are largely middle skill jobs, with the exception of economists, artists, and medical assistants that are being replaced by technology and automation. For example, telemarketers are being replaced by "robocalls"; tax preparers and bookkeepers are being replaced by do it yourself software such as QuickBooks; and securities sales agents (brokers) are being replaced by online trading platforms such as e-Trade. This raises an important question with respect to the potential or remote work arrangements as a substitute for robots, AI, or other automation.

Table 2.5: Selection of Occupations with Increasing Occupational Effect and Increasing Remote Competitive Effect from Shift-Share Analysis, 2000-2016

	Remote employment change, 2000 to 2016		National growth effect		Occupational growth effect		Remote competitive effect	
Occupation title	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Miscellaneous managers	345,551	447.1%	15,194	19.7%	79,485	102.8%	250,872	324.6%
Software developers, applications and systems software	104,022	403.4%	5,069	19.7%	15,718	61.0%	83,234	322.8%
Customer service representatives	89,614	413.4%	4,261	19.7%	4,809	22.2%	80,543	371.5%
Computer Scientists and Systems Analysts	113,626	213.9%	10,444	19.7%	23,363	44.0%	79,819	150.2%
Computer support specialists	64,408	842.6%	1,503	19.7%	4,981	65.2%	57,924	757.8%
Other Business Operations Specialists	61,248	1161.1%	1,037	19.7%	7,479	141.8%	52,732	999.7%
Computer and information systems managers	57,299	757.7%	1,486	19.7%	5,630	74.4%	50,183	663.6%
Registered nurses	55,468	337.7%	3,229	19.7%	4,791	29.2%	47,448	288.9%
Postsecondary teachers	50,341	361.1%	2,741	19.7%	1,736	12.5%	45,864	329.0%
Management analysts	101,762	95.9%	20,862	19.7%	38,146	35.9%	42,754	40.3%
Financial managers	33,477	184.3%	3,570	19.7%	987	5.4%	28,920	159.2%
Insurance claims and policy processing clerks	30,935	845.4%	719	19.7%	2,537	69.3%	27,679	756.5%
Medical records and health information technicians	26,580	2438.5%	214	19.7%	939	86.2%	25,426	2332.7%
Medical and health services managers	20,160	403.8%	981	19.7%	2,604	52.2%	16,574	332.0%
Education administrators	19,243	198.9%	1,902	19.7%	1,138	11.8%	16,203	167.5%
Miscellaneous engineers, including nuclear engineers	17,761	153.1%	2,280	19.7%	4,975	42.9%	10,506	90.6%
Insurance underwriters	10,461	939.0%	219	19.7%	204	18.3%	10,038	901.1%
Compliance officers	11,675	961.7%	239	19.7%	1,747	143.9%	9,689	798.1%
Database administrators	9,790	413.4%	465	19.7%	711	30.0%	8,613	363.7%
Information and Record Clerks, All Other	8,038	492.2%	321	19.7%	390	23.9%	7,327	448.7%
Meeting and Convention Planners	18,577	948.3%	385	19.7%	11,665	595.4%	6,527	333.2%
Civil engineers	8,814	97.4%	1,778	19.7%	796	8.8%	6,240	69.0%
Medical scientists, and life scientists, all other	6,400	451.3%	279	19.7%	784	55.3%	5,337	376.4%
Other education, training, and library workers	7,624	242.7%	617	19.7%	2,841	90.5%	4,165	132.6%
Miscellaneous mathematical science occupations	4,487	490.9%	180	19.7%	897	98.1%	3,410	373.1%
Operations research analysts	4,175	109.3%	751	19.7%	465	12.2%	2,959	77.4%
Physical scientists, all other	5,659	135.7%	820	19.7%	1,947	46.7%	2,892	69.3%
Diagnostic related technologists and technicians	3,014	309.4%	191	19.7%	384	39.4%	2,439	250.4%
Other Life, Physical, and Social Science Technicians	3,004	128.7%	459	19.7%	577	24.7%	1,968	84.3%
Health practitioner support technologists and technicians	2,479	239.1%	204	19.7%	1,162	112.1%	1,113	107.3%

Source: IPUMS-USA Decennial Census (2000) and ACS 2016 1 yr. est; author's calculations.

Table 2.6: Shift-Share Analysis of Occupations with Declining Remote Employment, 2000-2016

	Remote employment change, 2000 to 2016		National growth effect		Occupational growth effect		Remote competitive effect	
Occupation title	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Bookkeeping, accounting, and auditing clerks	(7,956)	-7.2%	21,801	19.7%	(51,279)	-46.2%	21,522	19.4%
Securities, commodities, and financial services sales agents	(3,755)	-12.3%	6,019	19.7%	(17,356)	-56.7%	7,582	24.8%
Computer operators	(1,053)	-18.6%	1,111	19.7%	(4,598)	-81.4%	2,434	43.1%
Telemarketers	(4,711)	-48.8%	1,899	19.7%	(7,620)	-78.9%	1,009	10.4%
Economists	(8,988)	-86.6%	2,041	19.7%	(9,932)	-95.7%	(1,097)	-10.6%
Tax preparers	(3,234)	-25.0%	2,540	19.7%	(2,699)	-20.9%	(3,075)	-23.8%
Artists and related workers	(9,496)	-14.1%	13,220	19.7%	(18,391)	-27.3%	(4,326)	-6.4%
Medical Assistants and Other Healthcare Support Occupations	(6,730)	-21.2%	6,244	19.7%	15,345	48.3%	(28,319)	-89.2%

Source: IPUMS-USA Decennial Census (2000) and ACS 2016 1 yr. est; author's calculations.

2.5. Skill Levels of Remote Occupations

The influence of technological change on the nature of work has been the subject of intense focus in the literature with evidence suggesting that routine, lower-skill jobs are being replaced by automation, while the jobs that have grown emphasize non-routine, high-skill cognitive oriented work (Autor et al, 2003; Manning, 2004; Goos and Manning, 2007; Goos et al., 2009). This appears evident from the list of occupations in Table 2.6 that experienced an increase in remote work intensity, although this observation is based largely on the perceived skills associated with each occupational title. While the intent of this paper is not to undertake an in-depth investigation of the job skills of remote workers, it does provide a basic exploratory assessment of the relative skill level of remote occupations drawing on occupational data from the US BLS O*Net Job Zone occupational descriptors. O*Net Job Zones have been used in previous research to measure occupational clusters (Nolan et al., 2011; Chrisinger et al, 2012; Jolley et al., 2019).

Job Zones categorize occupations into one of five groups based on similar levels of education, experience, and training required to complete a job, which are summarized in Table 2.7. Occupations in Job Zone "1" require little or no preparation, including previous experience and may not require a high school diploma or equivalent. Examples of occupations falling in Job Zone 1 include baristas, dishwashers, and various attendant and clerk positions and largely reflect jobs that are non-tradeable, in that they must be completed 'on-site' at the point of service delivery. No occupations identified as remote amenable fall in Job Zone 1. On the other hand, occupations in Job Zone "5" require extensive preparation including prior experience, knowledge, or skills and most

occupations require some level of graduate or advanced training degree. Examples of these jobs include various doctors, researchers, and legal professionals many of which are identified as remote work amenable, such as economists, post-secondary teachers, and other research scientists.

Table 2.7: O*Net Job Zone descriptions

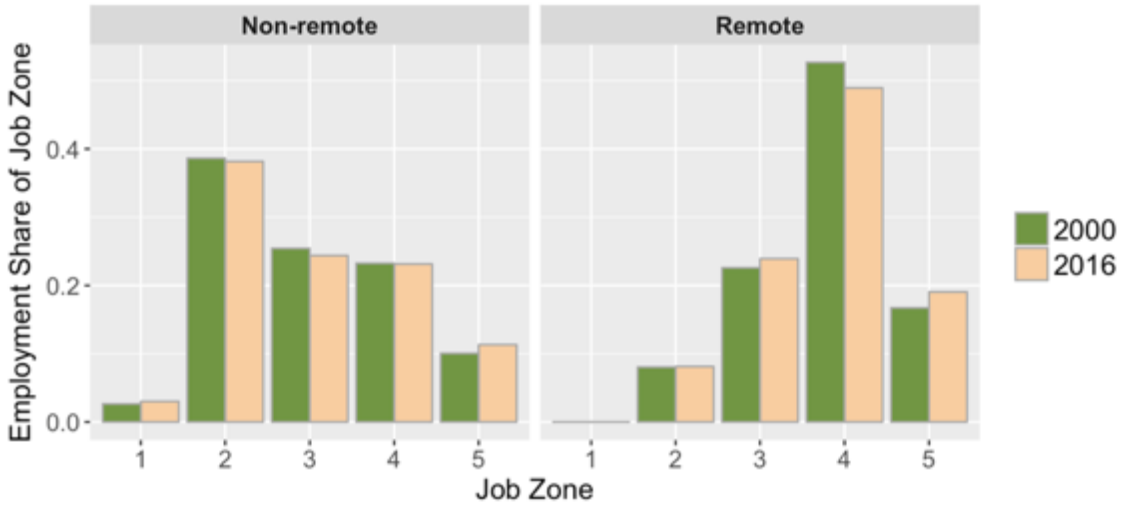
	Job Zone 1	Job Zone 2	Job Zone 3	Job Zone 4	Job Zone 5
Name	Little or No Preparation Needed	Some Preparation Needed	Medium Preparation Needed	Considerable Preparation Needed	Extensive Preparation Needed
Experience	Little or no previous work-related skill, knowledge, or experience is needed for these occupations.	Some previous work-related skill, knowledge, or experience is usually needed.	Previous work-related skill, knowledge, or experience is required for these occupations.	A considerable amount of work-related skill, knowledge, or experience is needed for these occupations.	Extensive skill, knowledge, and experience are needed. Many require more than five years of experience.
Education	Some of these occupations may require a high school diploma or GED certificate.	Usually require a high school diploma.	Most require training in vocational schools, related on-the-job experience, or an associate's degree.	Most require a four-year bachelor's degree, but some do not.	Most of these occupations require graduate school.
Job Training	Employees in these occupations need anywhere from a few days to a few months of training.	Anywhere from a few months to one year of working with experienced employees.	One or two years of training involving both on-the-job experience and informal training with experienced workers.	Several years of work-related experience, on-the-job training, and/or vocational training.	Most assume that the person will already have the required skills, knowledge, work-related experience, and/or training.
Remote Examples	None	Telemarketer, Payroll Clerk, Information Clerk, Cargo Agent	Web Developer, Travel Agent, Medical Records Technician	Purchasing Manager, Budget Analyst, Mechanical Engineer, Insurance Sale Agent	Financial Manager, Mgmt Analyst, Computer Scientist Medical Scientist
Non Remote Examples	Barista, Dishwasher, Landscaper	Child Care Worker, Construction Laborer, Home Health Aide, Cooks, Bartender	Hairdresser, Cosmologist, Police Officer, Crane Operator	Airline Pilot, Real Estate Broker, Primary School Teacher, Legislator	Physician, Surgeon, Veterinarian, Denstist, Clergy

Source: US Bureau of Labor Statistics (BLS) Occupational Information Network (O*Net); author's calculations.

Figure 2.1 shows the distribution of remote workers and non-remote workers by O*Net Job Zone category for the years 2000 and 2016. Compared to non-remote workers, remote work employment in general have higher levels of skill, education, and

training requirements indicated by Job Zones. More than two-thirds of remote jobs are in Job Zones 4 and 5, while just 35 percent of non-remote jobs fall into those skill categories in 2016. Meanwhile over forty percent of non-remote jobs fall into Job Zones 2 and 1, requiring low levels of formal training and experience to perform jobs, compared to just ten percent of remote jobs in those skill categories. Job Zone employment shares have remained relatively level between 2000 and 2016 for both non-remote and remote workers, with the exception of the share of very high skilled workers (Job Zone 5) which increased for both non-remote and remote employment.

Figure 2.1: Employment Share of Remote vs. Non-remote Workers by O*Net Job Zone, 2000 & 2016



Source: Decennial Census (2000) and ACS 2016 1 yr. est; US BLS O*Net; author's calculations.

To better illustrate these trends, I adapt the shift-share model used previously in this paper to decompose the growth of Job Zone remote employment for the years 2000-2016 and also for 2010 to 2016 to consider any significant influence of occupational restructuring following the Greater Recession ending in 2009. Results are shown in Table

2.8. Although the largest increase in employment was in Job Zone 4, remote employment (Job Zone 5) in the high-skill group grew at the fastest rate between 2000 and 2016 at 154 percent. Remote employment growth rates across Job Zones were relatively similar, between 2010 and 2016.

A second interesting observation is a clear trend of skill polarization for all occupations for both periods analyzed. This is apparent after accounting for occupational effect growth rates between 2000 and 2016, which are negative for middle skill Job Zones 2 and 3 at -2.8 percent and -4.8 percent respectively, while Job Zones 1, 4, and 5 experienced positive occupational growth effects with the most pronounced rates in Job Zones 1 and 5. Meanwhile the remote employment effect was positive for all Job Zones after accounting for occupational national growth effects. These trends are also apparent in the post-recessionary period from 2010 to 2016.

When considering remote work effects, this suggests two noteworthy findings. First, while middle skill jobs overall indicated by Job Zone 2 and 3 grew at a slower pace than the nation, a large share of middle skill jobs emerged as remote. An abundance of empirical evidence in the literature demonstrates the skill polarization and hollowing out of the middle of the labor market (Autor, Katz, and Kearney, 2006; Autor and Dorn, 2013). Computerization and automation is often raised as a key driver of these changes and while it is clear that automation is influencing occupational restructuring, its destruction of middle skill jobs has not been nearly as pronounced as is often presumed (Autor, 2015). It is not a stretch to conclude that at least part of the trends in shifting middle skill jobs to remote opportunities fits into this narrative.

Table 2.8: Shift-Share Analysis by Job Zone for periods 2000-16 and 2010-16

Period 2000-2016

Job Zone	Remote employment change, 2000 to 2016		National growth effect		Occupational growth effect		Remote competitive effect	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	-	-	-	19.7%	-	14.3%	-	-
2	175,500	125.3%	27,586	19.7%	(3,945)	-2.8%	179,445	84.5%
3	535,932	136.0%	77,608	19.7%	(19,104)	-4.8%	555,036	88.3%
4	984,363	107.2%	180,940	19.7%	7,961	0.9%	976,402	72.4%
5	449,185	154.1%	57,436	19.7%	47,409	16.3%	401,776	80.9%

Period 2010-2016

Job Zone	Remote employment change, 2010 to 2016		National growth effect		Occupational growth effect		Remote competitive effect	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	-	-	-	9.5%	-	3.9%	-	-
2	103,142	48.6%	20,113	9.5%	(3,895)	-1.8%	107,037	50.4%
3	300,952	47.9%	59,560	9.5%	(9,801)	-1.6%	310,753	49.4%
4	554,049	41.1%	127,731	9.5%	22,845	1.7%	531,204	39.4%
5	244,143	49.2%	47,028	9.5%	28,425	5.7%	215,718	43.4%

Source: Decennial Census (2000) and ACS 2016 1 yr. est; BLS O*Net; author's calculations. Note: For Job Zone 1 no remote employment exists.

A second noteworthy observation is based on remote worker employment growth of high-skilled occupations that outpaces growth rates of the occupational and national effects. Geographic concentration of high-skill workers is a hallmark of today's innovation and knowledge economies where high skill workers cluster with firms in dense agglomerations to benefit from specialized labor and plentiful employment opportunities (Glaeser et. al., 2014). However, not all firms and organizations are located in large urban markets and for firms in small and mid-sized markets with less thick pools of specialized labor are more challenged in finding local talent. For higher skill and specialized occupations that are growing in demand (total employment), firms in smaller markets may be more open to remote arrangements to access this type of skill sets thereby leading to growth in the occupations at the upper end of the skill spectrum, whether to attract and recruit workers or to retain them. Even within large labor markets, remote work carries important implications. Firms located in the city center and subject to high rents may be able to reduce their footprints and real estate costs by employing remote employees, while still maintaining access to the innovative 'milieu' that large agglomerations offer. Recent evidence from a survey of over 1,000 companies confirms that flexible work opportunities that include remote work are a critical tool in attracting and retaining skilled workers (SHRM, 2017).

2.6. Characteristics of Remote Workers

In addition to counting remote employment and occupations, a secondary goal of this research is to gain a rudimentary understanding of the characteristics of the remote worker population. To achieve this, a descriptive analysis along an array of common measures was conducted that considers differences in common demographic and

economic characteristics between remote and non-remote workers by worker class using the IPUMS-USA 2016 one-year ACS estimates. Although not a comprehensive investigation, these characteristics provide a useful descriptive first look at any differences between remote and non-remote employees that may inform future inquiry and multivariate regression analysis. This section considers age, gender, personal income, educational attainment, and migration rates which are summarized in Table 2.9. All statistics are significant at the $p< |0.0001|$ confidence level.

2.6.1. Age and Gender

Remote workers skew older compared to non-remote workers, consistent with past findings that identified telework and home workers as typically older than the general population (Mateyka, et al, 2012; Moos and Skaburskis, 2007; Gould-Ellen and Hempstead, 2002). For instance, 59.7 percent of remote workers were 45 or older in 2016 compared to 49.9 for the non-remote worker employed population. Both the remote and non-remote groups aged between 2000 and 2016, although the remote population aged slower than the non-remote population. However, the share of remote workers is growing faster as a mode of work for younger age cohorts. As a share of the employed population 25 to 34, remote workers increased by 88 percent between 2000 and 2016, while that increase was 105 percent for the population 35 to 44. There do not appear to be any significant differences between self-employed and wage and salary workers across age cohorts among remote and non-remote workers.

Table 2.9: Summary of Socio-economic Characteristics of Remote Workers (employed population age 25 and older)

	2000						2016					
	Remote			Non-Remote			Remote			Non-Remote		
Category	**SE**	**W-2**	**Total**	**SE**	**W-2**	**Total**	**SE**	**W-2**	**Total**	**SE**	**W-2**	**Total**
Number (thousands)	984	760	1,744	10,975	96,376	107,351	1,420	2,469	3,889	12,348	114,303	126,652
Gender												
Female	49.9	56.1	52.6	31.7	47.7	46.0	47.8	53.3	51.3	35.7	47.9	46.7
Male	50.1	43.9	47.4	68.3	52.3	54.0	52.2	46.7	48.7	64.3	52.1	53.3
Age Cohort Share												
Age 25-34	12.3	21.4	16.3	15.4	28.0	26.7	11.7	18.3	15.9	13.0	27.5	26.1
Age 35-44	27.2	31.7	29.1	30.2	31.9	31.7	20.3	26.7	24.4	21.4	24.4	24.1
Age 45-54	29.1	25.0	27.3	29.1	25.4	25.8	24.8	26.8	26.1	27.6	24.3	24.7
Age 55-64	18.8	14.0	16.7	17.2	11.4	12.0	25.3	20.6	22.3	25.2	18.4	19.1
Age 65+	12.6	7.9	10.6	8.1	3.3	3.8	17.8	7.6	11.3	12.8	5.4	6.1
Personal income												
Median	$42,356	$56,259	$48,786	$42,300	$42,300	$42,300	$43,000	$72,000	$60,211	$36,400	$41,600	$40,900
Mean	$73,778	$76,451	$74,943	$77,233	$55,574	$57,788	$71,591	$88,290	$82,192	$69,008	$57,226	$58,374
Education												
Less than HS	2.0	2.6	2.3	13.0	11.5	11.7	1.7	1.1	1.3	11.5	8.4	8.7
HS or equiv	10.3	13.1	11.5	27.1	26.8	26.8	10.1	8.2	8.9	25.3	24.0	24.2
Some college, no deg	22.0	23.0	22.5	23.1	23.4	23.3	18.7	17.5	18.0	20.8	21.0	21.0
Associates	6.8	7.7	7.2	6.0	8.1	7.9	7.1	8.8	8.2	7.7	9.8	9.5
Bachelors	35.9	35.9	35.9	17.2	19.3	19.1	37.9	40.7	39.7	20.4	22.8	22.6
Masters or higher	22.9	17.6	20.6	13.7	10.9	11.2	24.5	23.6	24.0	14.3	14.0	14.0

Source: Decennial Census (2000) and ACS 1 yr. est; author's calculations. Note: Incomes in 2016 dollars. Note: Statistics for Remote Workers are tested against Non-Remote Workers across variables within each period using two-tailed t-tests for means and proportions. Statistics are all significant below the 0.0001 confidence level.

A greater share of remote workers identify as female compared to non-remote workers with 51.3 percent of remote workers in 2016 being female compared to 46.7 of the employed workforce of non-remote workers. Of all employed females 25 and over in 2016, 3.3 percent are classified as remote workers compared to 2.7 percent of all employed male workers. This follows past evidence that argues remote work is a flexible work arrangement for females who provide child care (Hansen & Pratt, 1995; Oberhauser, 1995). The gender composition of remote workers appears relatively unchanged since 2000 in which females comprised 52.6 percent of all remote workers, with just a slight shift towards a greater share of classifying as male. However, the number of male remote workers grew faster than the number of female remote workers between 2000 and 2016.

2.6.2. Educational Attainment

Lending validity to the occupational requirements of remote occupations, the remote worker population possess significantly higher levels of skill and formal education compared to the non-remote worker employed population. Almost 64 percent of remote workers have a Bachelor's degree or higher compared to 36.6 percent for non-remote workers, while just 10.2 percent of remote workers had a high school degree or less compared to 32.9 percent for the non-remote worker population. As might be expected given the respective underlying data, this characteristic is similar to those found by Mateyka et al. (2012). Part of this difference is likely accounted for by the types of skills and formal educational requirements of occupations that are remote versus non-remote. Educational attainment levels have been steadily increasing for the entire population since 2000 and a similar trend has occurred for the remote work population.

Between 2000 and 2016, the total remote worker population with a Bachelor's degree or higher increased by 7.2 percentage points to 63.7 percent in 2016 from 56.5 in 2000, while for those with a high school degree or less dropped by 3.6 percentage points down from 13.8 in 2000.

2.6.3. Personal Income

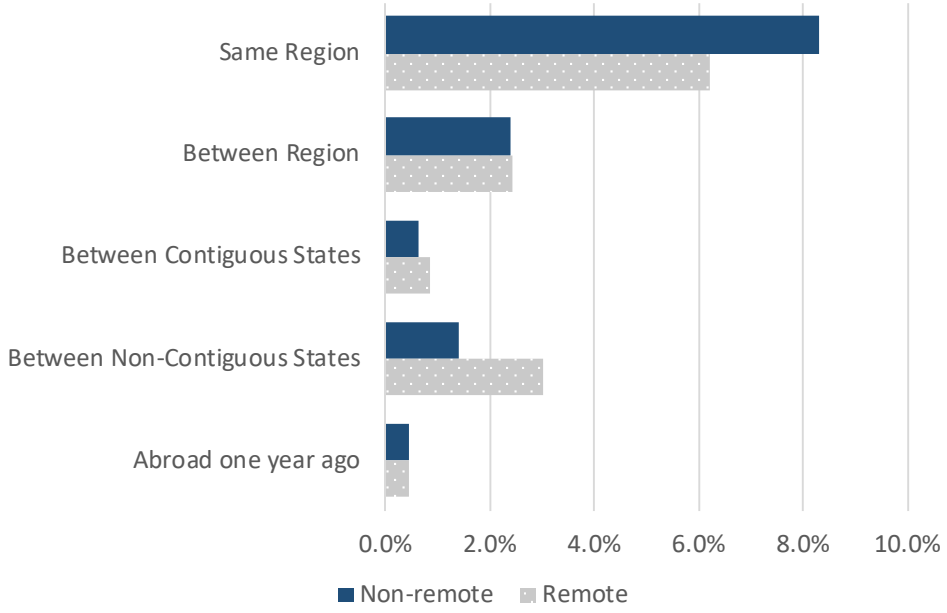
It follows from older age populations and higher levels of skills and formal education that remote workers earn higher incomes than their non-remote counterparts. The median personal income of remote workers was almost $20,000 higher for remote workers compared to non-remote workers in 2016. The gaps between remote and non-remote personal income has grown wider; the difference in median personal income in 2000 was just $6,400 (in 2016 $) between the two groups. Real personal income growth in remote workers was largely driven by wage and salaried workers whose real median incomes increased by $15,700, from $56,259 in 2000 to $72,000 in 2016. Remote self-employed income increase by just $644 over the same period. Real personal income actually declined for non-remote workers by $1,400 between 2000 and 2016. As with educational attainment, these differences and increases may largely be explained by occupational differences in remote versus non-remote workers. IT skills have been shown to increase the wages of workers (Goss and Phillips, 2012).

2.6.4. Migration

Finally, this paper considers the rates of migration of remote workers as an indicator of the potential for spatial mobility, given the potential geographic implications of remote workers on place. Looking at migration rates across categories, the data

suggests that a slightly larger proportion of non-remoter workers (13.4 percent moved in the last year compared to remote workers (13 percent), but of the share of people that moved, a significantly higher share of remote workers moved outside of home region[14] while one-third of remote workers that moved made the move to another state (Figure 2.2). There is a statistically significant difference compared to the 19 percent of non-remote workers. Remote workers are more likely to move greater distances such as between non-contiguous states, than non-remote workers. This may be due to the fact that higher skill and educated workers are more likely to migrate over greater distances (Greenwood, 2014). Further testing needs to be done to determine the role of remote work in migration. However, this provides a first look at migration patterns of remote workers and provides a basis for constructing testable hypothesis in future research.

Figure 2.2: Migration Rates of Remote Workers by Migration Class, 2016



Source: ACS 2016 1 yr. est; author's calculations.

[14] Region is defined as Public Use Microdata Area (PUMA), the lowest level of geographic region provided in the IPUMS data.

2.7. Conclusions and Future Research

This research paper measures and documents the growth of remote occupational employment in the US between 2000 and 2016 using publicly available secondary data. Distinct from past research on the broader phenomenon of telework, this paper attempts to overcome some of the measurement and definitional challenges inherent in past work and places the focus on workers that are entirely remote and the unique spatial implications for place, regional and local economies, and labor markets these types of workers may present. A second key contribution of this paper provides an exploratory and descriptive analysis of the demographic characteristics of remote workers that help inform empirical inquiry and the work of policymakers and planners.

The findings clearly show a marked increase in remote work employment particularly in salaried and wage employees suggesting that both workers and firms find utility in more flexible work arrangements. The types of jobs that remote workers do are not limited to IT or customer service representatives but permeate across a wider array of the occupational landscape to include registered nurses, teachers, and high-skilled knowledge workers. Remote employment grew across most skill levels and occurred in business operations and knowledge-based occupations. Remote workers tend to have higher levels of formal education that align with occupational requirements, higher incomes, and age, and when remote workers migrate, they appear to move greater distances than their counterparts. But the extent to which these characteristics are correlated rather than caused by remote work arrangements remain areas for fruitful investigation in the future. Practitioners may find this information and method useful for profiling their local remote population or developing better informed strategies for

targeting and attracting remote workers. A wide variety of additional ACS data exists that can be directly linked to this method for classifying remote workers, including housing and family based variables, although these areas are outside the scope of this present paper.

There are two important limitations to acknowledge of this method that analysts and researchers should be aware of when implementing. One limitation of using ACS occupational codes is the fact that the relatively small number of occupational categories represent a rather large number of occupations that must be categorized in some way by assigning to one of the ACS occupational codes. Census estimates are derived from over 25,000 job titles provided in Census survey responses, some of which closely align while others may be more of a stretch. In this respect, the occupational constraints used in this framework may accidentally exclude workers that are truly remote, but because of job title nuances may have been assigned to an occupational category that was determined to not be remote work amenable. For instance, a physician or other health care professional may work remotely providing diagnostics from a home office and may be either self-employed or a salary and wage employee, but physicians on the whole are deemed to not be an occupation that is amenable to remote work employment on a widespread scale.

A second limitation, as with many concepts in social science, the data available is not necessarily intended for this use and thus does not directly structured to directly addressed the questions asked in this paper. Census ACS Transportation to Work data does not verify whether a respondent works entirely at home, 100 percent of the time. Likewise, it does not allow the analyst to differentiate remote workers that may utilize a local co-working space, that may still ‘commute’ to a coffee shop, or other non-employer

place to complete work. From this standpoint, the estimates of remote work presented here may be conservative and may in fact undercount the actual number of remote workers that are employed. Aside from the potential underestimate of the number of remote workers, this method should provide a relatively accurate picture of the occupational and demographic trends in remote work, which by nature of the survey repetition likely controls for any interpretation bias of the Transportation to Work Census question.

From a policy and planning perspective, the extent to which a strategy that links local workers with remote employment opportunities rests on understanding the occupations and skill demands of remote jobs and to what degree do remote workers actually live in remote areas. However, there is an open question as to whether remote work is a key to revitalizing depressed rural area by linking incumbent residents with jobs virtually. Part of the question pertains to the skill composition of remote jobs opportunities. Routine, tradeable jobs are being replaced by automation, computerization, and in some cases offshored at lower wages. There is also a question on the extent to which companies are using remote work to cut costs for lower skill, routine jobs, or whether remote work is used primarily as a means to attract and retain specialized and highly skilled workers. Based on the findings in this paper on the growth of remote employment in middle skill jobs, it begs the question to what extent is remote employment a substitute for automation or computerization.

This paper offers several additional areas for future research. First, the analysis has largely focused on the occupational dimension alone. A natural progression would be to investigate which industries have experienced growth in remote work and more

specifically, how occupational staffing patterns of remote workers differ by industry. For instance, do some industries employ more remote software developers than other industries? An adapted shift-share model to incorporate industry employment growth could extent the analysis in this article to further decompose the growth effect of remote work and illuminate what industries may be using remote work to outsource certain jobs, or whether certain industries are more likely to tap high-skilled workers through remote means. In conjunction with this, a deeper investigation into the specific skills and knowledge requirements of remote workers using O*Net data could help shed further light on how remote work relates to the changing occupational structure or work. Lastly, the analysis in this paper is focused on the US as a whole. Given the spatial nature of economic activity, investigating the extent to which remote workers in similar occupations cluster or concentrate in certain regions would address another importance knowledge gap.

The framework in this article provides an initial starting point for investigating these questions, despite the limitations of the underlying data. In the future, an ideal set of estimates, whether derived or incorporated into Census based surveys or from another federal or state agency, would specifically identify whether a respondent is a remote worker and the extent to which remote work is primarily undertaken at home or from another non-home location. It would additionally be ideal to understand the location or at least distance from the central office location wage and salary workers report. This would allow researchers to better differentiate how ‘remote’ a respondent is and the spatial relations between the remote worker and the ‘source’ of work or employer. On the other hand, surveys of employers would allow researchers to better understand the importance

of remote work by firms and organizations, which would also enable research into how remote work influences firm location and labor market decisions. Likewise, it will be important to continue inquiry on the questions underpinning this research as the nature of work and the workplace continue evolving.

CHAPTER 3

THE CHARACTERISTICS AND MIGRATION DECISIONS OF REMOTE WORKERS: A FOCUS ON MAINE

Interest by planners and policymakers in the economic development potential of remote work in small cities and rural regions has been growing. Yet, there is relatively little scholarship that provides insights into the benefits and characteristics of remote workers and the factors that attract them to a place. This paper uses primary data collected from web-based surveys and semi-structured interviews of remote workers in the US state of Maine to explore their characteristics, the factors that motivate location decisions, and the role of remote work in those decisions. I find that remote workers have greater locational flexibility and balance location decisions on a number of personal, professional, and place-based factors that include strong personal connections to a place. Remote workers appear to have higher levels of skill and education compared to the broader population and leverage remote work arrangements to access employment opportunities that may be unavailable or lacking in the labor market of their residential location.

3.1. Introduction

Advancements in information and communication technologies (ICTs) have had profound impacts on the nature of work and the location of the workplace (Carnoy, Castells, and Benner, 1997; Blakely, 2001). In 2017, more Americans reported working from home than those commuting by public transportation, while the number of American employees working remotely has risen by 225 percent between 2000 and 2016 (Wallace, 2019). Although teleworking has long been on the radar of the planning discipline to addressed transportation and environmental issues, more recently planners and policy makers have taken interest in the potential to attract remote workers as a community and economic development strategy with particular relevance for small and mid-sized city regions and rural areas (VT Gen Assem. S.94, Act 197; Whitney, 2015; Gallardo, 2016).

This article conceptually defines remote workers as people with no geographic requirement to where work is completed, whether dictated by an employer or by the nature of the occupation or job tasks. Remote workers 'work in place' (Erard, 2016) and absent proximity requirements they can live and work anywhere which may be based on lifestyle preferences, lifecycle stage, or other personal factors. While there is a rich body of literature on the related topic of telework or telecommuting (eg. Gurstein, 1996; Handy and Mokhtarian, 1995; Mokhtarian, Salomon, and Choo, 2004), this scholarship does not address the implications of the footloose nature of remote workers or the question of *who works remotely* and the relationship to placemaking and economic development.

This research begins filling these knowledge gaps by attempting to answer two questions: *What are the characteristics of remote workers? What role does the option to*

work remotely play in household migration? The underlying hypothesis of this research is that free of the locational constraints of a central workplace, workers will base migration and location decisions on other lifestyle and life-cycle factors, such as attractive place-based attributes (quality of place), cost of living, and proximity to family, friends, and social networks, among others. This information will assist planners in developing programs that support remote work in their community or region.

I use an exploratory mixed-methods research design that includes a web-based self-selection survey followed by a series of semi-structured interviews with remote workers to answer the research questions. The survey sample is comprised primarily of remote workers in the US state of Maine; a largely rural state known for its attractive natural amenities with a growing mid-sized city region in its southern part. A small share of the survey sample is from remote workers located across the US. I find that remote workers have a relatively greater degree of locational flexibility and balance migration decisions on a number of personal, professional, and place-based factors. These include strong personal connections to place and proximity to social networks. Remote workers are high-skilled, earn higher incomes, and leverage remote opportunities to match skill sets with preferential job opportunities that are lacking in local labor markets. Findings also suggest, however, that remote work may serve as a transitional work arrangement until a local opportunity arises for some. Remote workers typically take their jobs with them as they relocate to a new place of residence. These findings suggest a role for planners and economic developers to leverage quality of place and amenities to attract residents while also supporting the greater uptake of remote work opportunities for incumbent workers. Yet, planners and policymakers must also consider the impact of

such things as wage differentials of remote workers and prevailing local prices, primarily in housing markets and wage rates paid by local firms.

3.2. Remote Work and Migration

One of the most striking changes of work and labor markets over the past several decades has been the influence of technologies on the skill demands and structure of work and the workforce (Autor, Levy, and Murnane, 2003). Employment in routine middle skill jobs have been on the decline replaced by computerization or the outsource of work to markets with cheaper labor costs while jobs emphasizing high-skill cognitive and analytical skills have grown (Autor, Katz, and Kearney, 2006; Autor and Price, 2013). As the locus of economic activity in the US and advanced economies has shifted to an emphasis on the generation and flows of information and knowledge, information and communication technologies (ICTs) such as the internet and the digital, have had particular consequences for how labor is accessed and the means by which services are delivered (Autor, 2001; Muro, Liu, Whiton, & Kulkarni, 2017). These changes have helped to contribute to an increase in more flexible modes of work arrangements and the places where work is completed (Liu and Kolenda, 2012; Capelli and Keller, 2013; WEF, 2016: Katz and Krueger, 2016). Workers are demanding greater flexibility outside of standardized work arrangements and unified locations (Gallup Inc., 2017). Firms are seeking alternative means to access specialized talent lacking in local labor pools and tools to retain a workforce that is increasingly more mobile in career paths (SHRM, 2017).

The rapid emergence of remote employment since 2000 is one example of these changes (Wallace, 2019). Remote work is often used synonymously with the terms

telework and telecommute, which have interested transportation planners for decades (Niles et al, 1976) and has spawned a diverse body of scholarship (Mokhtarian et al, 2004; Muhammad, Ottens, Ettema, & de Jong, 2007; Kim, 2016). Research on telework has been hampered by lack of consistent definitions, challenges with measurement, and lack of sufficient data to study the topic (Handy and Mokhtarian, 1995; Mokhtarian et al, 2004).[15] Research on telework has also lagged relative to the rapid advance of enabling technologies and organizational restructuring that are having real impacts on communities, economies, and labor markets. I make an important distinction between the teleworker that occasionally telecommutes and the worker that is purely remote; that is, teleworks on a full-time basis. This study is entirely focused on the latter.

Not all occupations and work activities *can* be completed from a distance because not all jobs are tradeable, in the sense that they can be completed off-site. For example, a barista, landscaper, or surgeon typically must be on site to perform core work activities, while web developers, medical coders, or computer scientists have core work activities that allow them to work remotely. Although past researchers have referred to telework as largely white-collar knowledge work (Gould-Ellen and Hempstead, 2002), Wallace (2019) identifies a set of occupations that are 'remote work amenable' meaning that while the workers themselves may not be remote, typically work activities for a particular occupation can be completed remotely. Remote occupations emphasize cognitive rather than manual tasks, though do include jobs that have been defined as routine (Autor, Levy, and Murnane, 2003) in addition to nonroutine analytical jobs, while excluding most low-

[15] Across the literatures on telework, it is often unclear exactly what studies and estimates of telework include purely remote workers as I have defined in this research and those that may exclude them. For instance, Noonan and Glass (2012, p.39) exclude home-based workers from their study of teleworkers altogether.

skill personal service jobs that have been at the other end of the growth pole (Autor and Dorn, 2013).

3.2.1. Remote Work in a Model of Household Location and Migration

In the neoclassical perspectives of residential location tradeoff theory (Alonso, 1968; Fujita, 1989) and interregional migration theory (Mincer, 1978; Greenwood, 1985; Mueser and Graves, 1995), location decisions are largely a consideration of economic opportunity (jobs and wages), housing availability and accessibility, and access to place based amenities. Within these models, jobs are assumed to be anchored in place and wages are assumed to be derived in the home region at prevailing price levels (Hunt, 1993), while place based amenities are accounted for in regional wage rates and housing prices (Roback, 1982; Greenwood and Hunt, 1989). As such, migration and location patterns are largely constrained by proximity to an employer's location, or in the case of a small business by the local market served. Inserting remote work into these models suggests the colocation of home and work is no longer bound by geography, since the remote worker is able to access work from *anywhere*. The location decision may now not only emphasize, but be solely based on locational amenities or other non-employment place-based factors alone rather than tied to the job-wage accessibility requirement. In effect, this alters the spatial constraints of the location selection process from a set of choices in one region to a set of choices in any number of regions unrestricted by employment. This suggests that the mobility of remote workers may increase, though it does not suggest remote workers will necessarily move more frequently.

Remote worker households can gain utility by exploiting wage and price differentials by drawing wages in a high paying region (such as a lawyer in Washington,

DC) and locating in a region where wages are significantly lower for the same occupation (such as Portland, ME), yet still offer the household a preferred bundle of locational amenities (Hunt, 1993; Booth, 1999). Remote work may also facilitate the migration of a dual earner household in which economic opportunities for both income earners may be limited (Rabe, 2011). In a location such as Portland, Maine, with limited diversity of high-skilled industries, the likelihood that the "trailing" partner's career can be accommodated locally is lower compared to regions with large and dense labor opportunities, like Boston, Massachusetts.

On the contrary, remote work may have the effect of *reducing* the likelihood of relocation. For instance, in rural regions with limited employment opportunities, residents may access employment through remote means rather than being forced to migrate to a region where employment opportunities exist. This is one premise behind rural broadband development initiatives in the US (Smith, 2017). Recent evidence suggests that broadband may in fact reduce migration, although findings are not explicitly linked to remote work (Cooke and Shuttleworth, 2018).

There is growing interest in the potential for remote work to promote economic development in rural areas and small cities that have struggled with population decline and lackluster economic growth in the innovation based economy that favors concentration of economic activity characteristic of large urban areas (Glaeser et al, 2001). There is very little understanding, however, of how remote workers may interact and disrupt local economies and labor markets, particularly as they relate to small cities and rural areas. For planners and economic developers to develop targeted economic development strategies around remote opportunities, it is important to have an

understanding of the characteristics of remote workers and the factors that influence household movements. Likewise, there are important implications for how firms access specialized talent and pursue expansion opportunities, as well as promote worker attraction and retention. This may be of limited consequence for dense labor markets or major metropolitan agglomerations; however, there are significant implications for smaller and mid-sized communities and rural regions (Simpson et al, 2003; Gallardo, 2016).

3.3. Research Design

This research uses a mixed-methods design (Creswell, 2009) in which data were collected and analyzed in two distinct phases – a web-based survey of remote workers based primarily in the US state of Maine followed by a series of semi-structured interviews with remote workers located both in Maine and elsewhere in the US. Survey questions focused on three components that align with the study research questions: individual and occupational characteristics, connections to place, and household and location decisions. Several questions also allowed respondents to offer comment or clarification for their answer. Text from these responses were mined and used in the analysis as well, and in many places allowed corroborating evidence to statements made in the interviews. Data from the survey analysis was used to identify areas for a more in-depth exploration in the interview component. The data from both phases were then interpreted in tandem and integrated simultaneously with data receiving equal weighting in order to achieve complementarity.[16]

[16] The survey protocol and interview protocol are located in Appendix B for reference.

Surveys were administered in June and July of 2016 using web-based self-selection recruitment; both of which have become popular methods due to their cost advantages and ease of designing and accessing difficult to reach populations (Fowler, Jr 2013; Fricker, 2008). Surveys were designed and administered using SNAP software following a review of the literature, informational interviews with experts, and a pilot survey conducted on a small sample of remote workers. Surveys were distributed through a variety of mediums to identify and reach "hidden populations" (Salganik and Heckathorn, 2004), including emails lists, print and social media outlets, remote work related groups, and co-working spaces in Maine.

Survey responses were closely screened to verify that respondents fit our conceptual definition of remote worker. The fundamental condition of my definition of remote worker is that a worker is independent of a physical location and complete regular and standard work activities remotely 100 percent of the time. Remote workers also substitute physical presence for an office, market, or customer, with ICTs. I consider three types of workers that include payroll employees, independent contractors (freelancers), and self-employed workers. The key condition for whether independent contractors and self-employed persons were included in my final sample is whether there is a spatial requirement for where they complete their business or work activities.

Survey responses were also screened for completeness. In some instances, respondents did not complete every question. However, a subject was included in our sample if the vast majority of questions were answered. A total of 358 remote workers were included in my final sample. Because of the nature of the sampling strategy and the fact that networks extend beyond geographic borders, survey responses were received

from across the United States. Sixty-six percent of respondents are in the Portland-South Portland Metropolitan Statistical Area (MSA) located in the southern part of the state and contains nearly half of the state's population (Table 3.1). Another 20 percent are located in the rest of Maine, while the remaining 14 percent of survey respondents are dispersed across the United States.[17] The majority of respondents identified as salaried employees (W-2), while almost a quarter reported being an independent contractor, and just 10 percent as a business owner. The median age of survey respondents was 43 and 54 percent were female which are comparable to 46 median age and 51.3 percent female in Wallace (2019).

Table 3.1: Worker Class and Geography of Remote Worker Survey Respondents

Category	Percent
Worker Class	
Salaried employee	67.8%
Ind. contractor or freelancer	22.7%
Business owner	9.5%
Geographic Distribution	
Porltand City	30.2%
Portland-South Portland MSA	66.5%
Maine	86.6%
Outside of Maine	13.4%
Urban Areas	75.1%
Rural	24.9%

Source: Survey of Remote Workers; Author's calculations

To obtain more contextual and explanatory detail, I conducted a number of semi-structured interviews in the summer of 2017 using a nested sample (Onwuegbuzie and

[17] Responses were received from remote workers in a total of 25 states (including Maine) and included postal codes in both urban and rural areas of states that included WA, ID, CA, CO, SD, TX, WI, MN, OK, FL, OH, NY, GA, PA, WV, VA, NC, SC, NJ, CT, MA, VT, and NH.

Collins, 2007) of recruits responding to the survey. Approximately 70 percent of survey respondents provided email addresses to participate in future studies, from which I recruited and interviewed 12.[18] Interviews were approximately an hour in length, completed both in person and virtually, and included questions directed at learning greater detail about the subject's remote work situation, how it emerged in relation to household location decisions, career pathways, and connection to place building on evidence gleaned from the survey results and from the literature. Interviews were coded and analyzed using and integrated with outcomes of the quantitative component to expand on findings from surveys. Findings from the survey analysis and interview coding were interpreted in parallel, giving equal weight to both methods to inform findings.

Mixed-methods designs are well suited for the present research allowing the researcher to leverage the strengths of each type of method (Creswell 2009, Tashakkori and Teddlie, 2003) and have gained in both popularity and acceptance in recent years as methodologies and procedures for inquiry have been established in the literature (Creswell, Plano, and Clark, 2007). Qualitative designs are often suited for problems that have little by way of past research in order to develop an understanding of what exactly the phenomenon entails, particularly when the important variables to examine are not yet known. Quantitative methods are easier to implement, allow larger samples, and provide more precise measures of numerical data (Creswell, 2009).

The design is preferred to other mixed method designs in this case, compared to a concurrent triangulation for instance, because of the exploratory investigative nature of this paper's objectives and the sampling challenges with an unknown population.

[18] Email addresses were collected and stored separately from responses to maintain confidentiality.

However, there are several limitations of this design and data that should be considered when interpreting the findings.

First, the full population of remote workers is not known. As a result, the sample lacks random selection and may result in selection bias towards remote workers that are associated or attached to the groups and organizations used to advertise and distribute the survey (Baker et al, 2013). There is also geographical bias and there is limited opportunity with the present sample to investigate whether remote workers in this region are similar to remote workers in other states such as California or Colorado. As a result, the findings of this study should be viewed as representative of remote workers in Maine and may not necessarily be generalized outside of Maine. Despite these limitations, the sample provides a rich exploratory dataset allowing for significant insights into the socio-economic characteristics of remote workers and the factors that influence their location and migration decisions. Given Maine's composition of rural and small and mid-sized urban geographies and high natural amenities, it serves as an ideal case for gaining insight into the prospects for these types of places to attract remote worker migrants. Furthermore, the findings of this research provide fruitful lines of inquiry for further investigation that will be able to construct valid sample frames and apply inferential statistics.

3.4. Remote Workers and What They Do

Overall, remote workers are high-skilled and work in occupations and industries that are commonly associated with the driving forces of economic activity in the modern information economy (Glaeser and Mare, 2001) and that align with previous data on remote employment (Wallace, 2019). Over 80 percent of survey respondents report

having a bachelor's degree or higher, while almost 40 percent have an advanced degree, including a master's, professional or doctoral degree, while just 2 percent of respondents report high school as their highest level of educational attainment (Table 3.2). This is also true of remote workers interviewed, a majority of which hold a Master's or advanced professional degree. By comparison, in Maine the percent of the population aged 25 or older with a Bachelor's degree or higher was 29 percent, while the share with an advanced degree was reported at 10.5 percent (ACS 2016 5-yr est).[19] In the US, 30.2 percent of the population 25 and older reported a Bachelor's degree or higher while 11.5 percent reported having an advanced degree.

Table 3.2 shows the occupational groupings and industry sectors of survey respondents.[20] Forty-two percent report working in either computer, mathematical, and information related occupations, or in arts, design, entertainment, sports, and media. However, a variety of other occupational categories and industries are represented, including health and social services. Our interviewees report working in occupations including "Educational Content Creator", "Software Engineer", "Director of Research", "Mechanical Engineer", "Corporate Consulting Counsel", "Medical Researcher/Epidemiologist", and "Child Welfare Specialist".

[19] As another point of comparison to where 2/3's of survey respondents reside, in the Portland-South Portland, ME MSA 39 percent of adults 25 or older possessed a Bachelor's degree or higher and 14 percent possessed an advanced degree in 2016.
[20] Occupation and industry categories correspond with 2 digit SOC groupings and NAICS sectors.

Table 3.2: Educational Attainment, Occupations, and Industries of Remote Worker Respondents

Educational Attainment	Survey Sample	Maine	United States
Less than high school	0.0%	7.7%	12.0%
High school or equivalent	2.2%	30.9%	27.1%
Some college or Associate's degree or similar	16.0%	29.3%	28.9%
Bachelor's degree or similar	43.0%	19.9%	19.7%
Graduate or professional degree	38.8%	12.1%	12.3%

Occupational Category	Survey Sample	Maine	United States
Computer, Mathematical, or Information Related	28.8%	2.1%	3.0%
Arts, Design, Entertainment, Sports, and Media	13.1%	1.9%	2.0%
Management	11.5%	10.2%	10.3%
Sales and Related	10.6%	10.4%	10.5%
Business and Financial Operations	10.1%	4.1%	4.9%
Education, Training, and Library	8.7%	6.8%	5.9%
Life, Physical, or Social Science	5.3%	0.8%	0.9%
Architecture and Engineering	4.5%	1.6%	1.8%
Legal	3.4%	0.7%	1.1%
Office and Administrative Support	2.2%	12.6%	12.8%
Healthcare Practitioners and Technical	2.0%	6.6%	6.0%

Industry Category	Survey Sample	Maine	United States
Information and Computer Related	38.2%	2%	2%
Professional, Scientific, and Technical Services	26.2%	9%	11%
Educational services, and health care and social assistance	12.5%	28%	23%
Finance and insurance, and real estate and rental and leasing	8.8%	6%	7%
Tourism, Arts, Entertainment, and Recreation	4.6%	9%	10%
Public Administration / Government	2.8%	4%	5%
Wholesale or Retail Trade	2.8%	15%	14%
Natural Resource Based	2.6%	2%	2%
Manufacturing, Transportation, and Warehousing	1.4%	12%	15%

Source: US Census, American Community Survey 1 year estimates 2016; author data and calculations. Note: Educational Attainment and Occupational Category Survey Sample estimates based on n=358; Industry Category n=351.

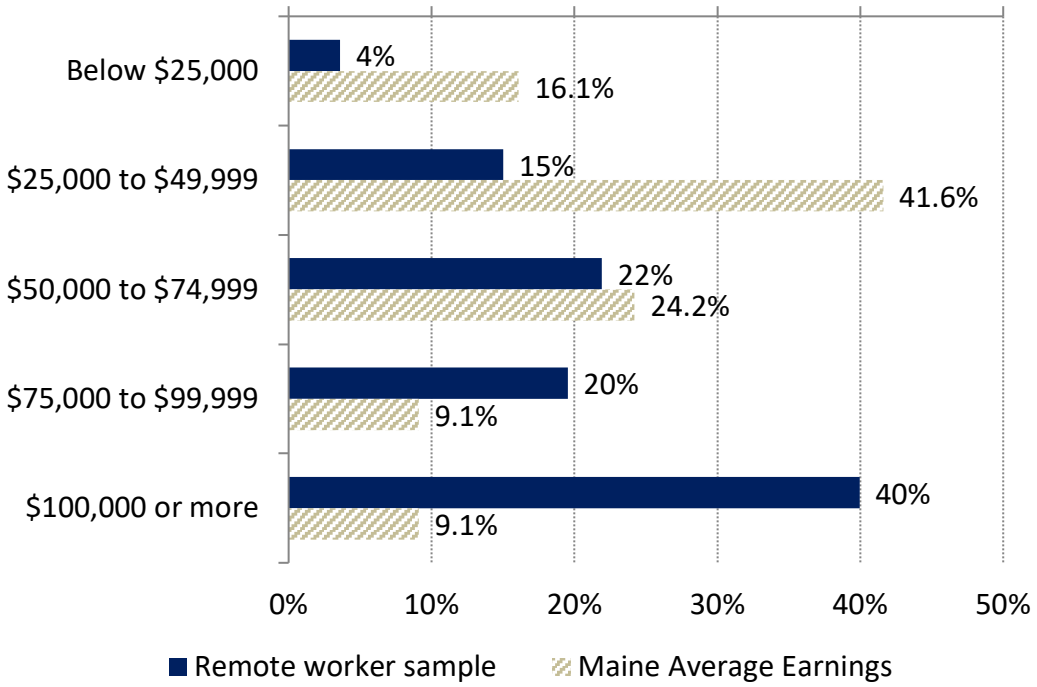
A clearer association can be found in the industries in which remote workers work. Sixty-nine percent of remote workers report working in broadly defined science, technology, engineering, arts, and math (STEAM) industry sectors, with almost 40 percent working in computer and information related and another 26 percent working in

professional, scientific, and technical services (Table 3.2). Conversely, there are news reports of lower-skilled remote jobs being offered by large firms, such as recent news that Amazon is hiring 10,000 remote customer service workers. About one-third of workers with computer, mathematical, and information related occupations in our sample had less than a bachelor's degree. This suggests that while a vast majority of remote workers possess high levels of educational attainment, there is also a cohort of remote workers that are engaged in jobs with lower levels of skill requirement. This supports findings in Wallace (2019) in which 38 percent of US remote workers had less than a four year degree while remote employment grew in jobs with middle skill requirements.

It follows that high-skilled workers command higher incomes. Figure 3.1 shows the distribution of *earnings* reported by survey respondents. Over half the respondents report annual earnings greater than $75,000, with nearly 40 percent earning in excess of $100,000. One question arising from this data and from other anecdotal evidence is to what degree are there wage differentials between what remote workers earn and relative incomes of where remote workers live. Figure 3.1 also shows the comparative distribution of earnings of the Maine working age population, where the vast majority of survey respondents are located. There are significant differences in the distributions at the lower and upper ends. Only 16 percent of the Maine population earned above $75,000 in 2016, compared to upwards of 60 percent of remote workers. Differences in earnings are also notably different across occupational categories. For instance, the average annual wage for computer and mathematical occupations in Maine was $72,920, where more than 80 percent of remote workers reported earnings over $75,000.[21]

[21] Occupational data from the Maine Department of Labor Center for Workforce Research and Information for 2016.

Figure 3.1: Earnings Distributions of Remote Worker Survey Respondents



Source: US Census American Community Survey 2016 one-year estimates

There are three important implications. First, while remote workers on the whole have higher levels of formal educational attainment, the data suggests that remote work is not purely for high skilled knowledge workers. There are occupations that can be done remotely that do not require high levels of educational attainment and therefore remote employment opportunities can be found for a variety of workers. Interestingly, the bulk of jobs for remote workers with lower levels of educational attainment fall in the computer, mathematics, and information occupational category. This finding largely supports those from Wallace (2019). A second implication is that there may be different reasons and conditions under which organizations utilize remote workers. Large firms may use remote low-skill, low-wage jobs to save costs, such as customer service

representatives or medical coders. On the other hand, small and mid-sized firms may use remote work to access specialized workers, while new ventures will seek the best talent available through remote means. Lastly, remote workers draw much higher wages than are found in the local labor market. As regional wages and prices are closely interrelated, this suggests remote workers are able to leverage differentials above and beyond the capitalization of amenities into local wages and prices (Knapp and Gravest, 1989). However, the extent to which higher wages alter local markets and prices, especially housing, is a notable consideration.

3.5. Remote Work and Place Attraction

Understanding what factors attract and connect remote workers to place is fundamental to helping planners and economic developer design strategies to attract and retain the growing remote workforce. There are two questions asked in relation to this: what are the connections of remote workers and their households to their current location and, what factors were important in their initial decision to locate where they are?

3.5.1. Connections to Current Locations

Regarding the first question, remote worker households who participated in this survey have strong personal connections to their present locations. Figure 3.2 shows survey responses by remote workers when asked to indicate whether they or their spouse had any of the listed connections to current location. Respondents could answer multiple categories. The vast majority of respondents (87 percent) indicated that either they or a partner/spouse had at least one of these connections to their current place of residence. Just 13 percent reported no previous connection to place for themselves or partner/spouse

across any connection category. The most common connection was proximity to family. Almost 3 in 4 respondents (74 percent) reported proximity to family as a connection to current geographic location, whether their own or that of their spouse/partner's. Several survey respondents and interviewees explicitly identified family as a defining *motivation* for locating in current place of residence. Consider the following responses from research subjects:

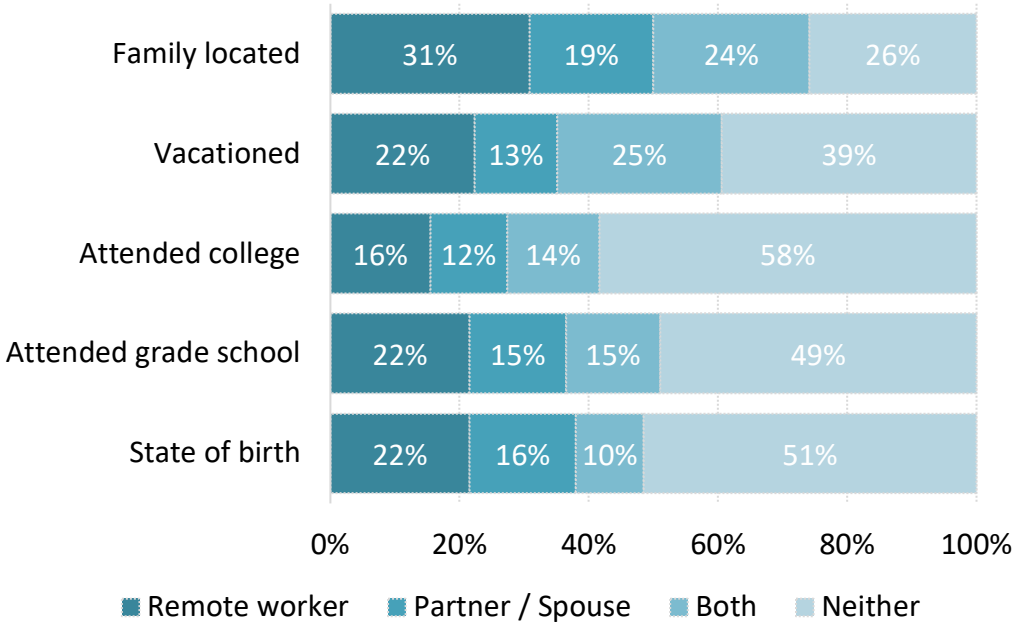
> "Family was as defining feature of our move." (Survey response)

> "My husband's family retired and moved here. So we wanted to be closer to them, but neither of us lived in the area before moving here. My sister-in-law and her family, both are remote workers by the way, also recently moved to the town over from us for the same reason. So now we have a lot of family nearby." (Interview response)

About half of respondents indicated they or their partner had lived near their current location previously, either having grown up or attended grade school there. Although to a lesser extent, attending college was reported as a connection for two out of five respondents. These connections and in conjunction with family are understood to be a big draw as explained by one survey respondent.

> "Grew up in southern Maine, left for work and school, wanted to come home and be closer to family." (Survey response)

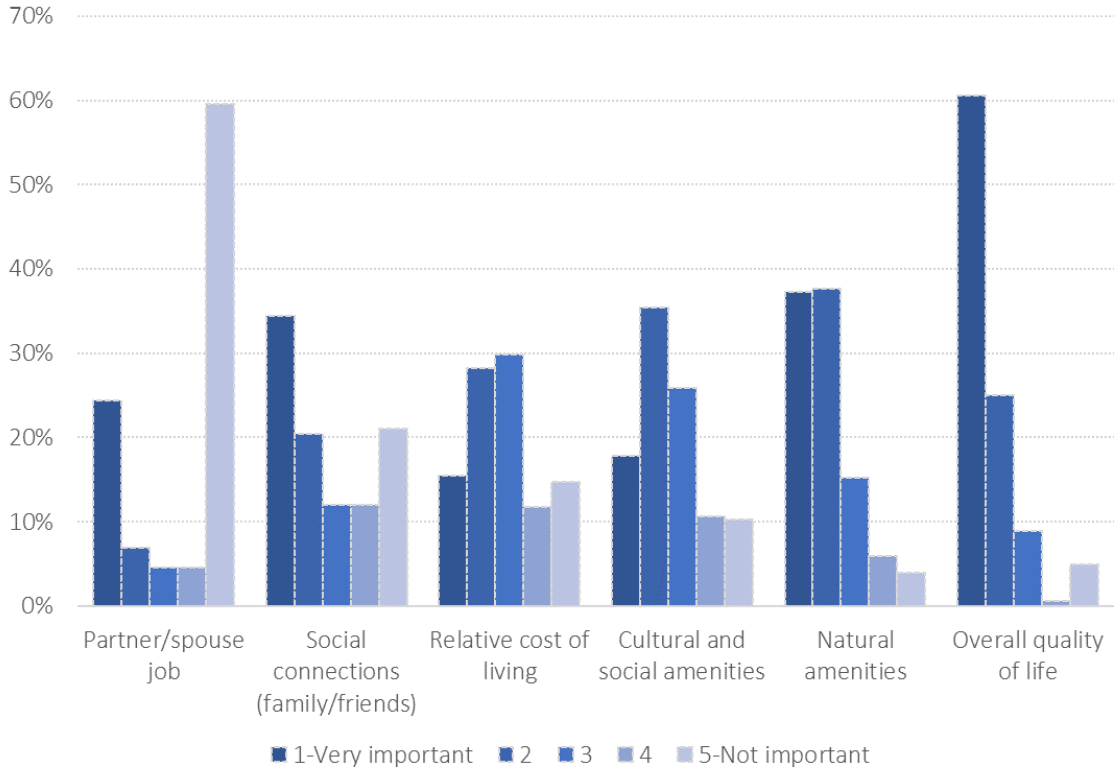
Figure 3.2: Personal Connections to Current Location of Survey Respondents



3.5.2. Importance of Factors in Location Decisions

Survey respondents were asked to rank the importance of several factors as they relate to location decisions. Figure 3.3 shows the responses based on a 5-point rating scale in which 1 indicates very important and 5 indicates not important. Eighty-six percent of respondents reported that quality of life was very important or highly important in deciding to live in their current location. Quality of place is generally considered as contributing to quality of life and tends to have a bigger role in smaller and mid-size regions (Kelly et al, 2016) and is often measured through the presence of amenities. Three out of four respondents reported natural amenities, and more than half reported cultural and social amenities were all very important in decisions to reside in their current location.

Figure 3.3: Importance of Location Decision Factors of Survey Respondents



Remote workers may also move for other economic reasons, including spouse's job. The idea of a 'trailing spouse' has often been used when discussing household moves. Of those that reported no previous connection, 1 in 4 reported the employment/ job opportunity for spouse/partner were very important to their location decision. One survey respondent illustrated this notion clearly adding,

> "We had zero connections to Maine. We moved 100% because of my husband's job." (Survey response)

However, the data does not allow us to determine whether any one factor was the sole or primary reason for most respondents, and instead should also be considered along with other reasons for locating.

3.6. Remote Work and Location Decisions

A crux of this research is to understand how remote work influences the location decisions of remote workers and their households. Residential location and migration theory suggest that absent the locational constraints related to employment, remote workers may be more flexible in their mobility and are able to weight location decisions on place based amenities and attributes, unconstrained by proximity to a central work location. The findings of this research suggest remote workers and their households show high degrees of interregional mobility, in that they have made a significant relocation to a new region in the past, as opposed to moving *within* a region. Almost 90 percent of survey respondents reported that they lived in a different state previously, while just 13 percent have always lived in their current state. As a general point of comparison, in 2010 an estimated 59 percent of Americans lived in their state of birth, while the remaining 27 percent were born outside their state of residence (US Census, 2010 American Community Survey).

3.6.1. Remote Work Emergence, Occupational Matching, and Locational Flexibility

There are two ways in which a remote work opportunity emerges. First, workers will start a job that is already classified as remote and never set foot in a physical location. This often occurs through traditional job search means in which an applicant responds to a job posting, primarily online, that provides an option to work remotely or that is explicitly recruiting remote employees, or as applicants they are connected to remote opportunities through professional networks. These scenarios were the case for 28 percent of interview subjects. A majority of these cases emerged from short-term contract jobs that later evolved into a full-time employment position.

The second, and more common, scenario is one in which an existing 'brick and mortar' job turned remote as a result of negotiation with an existing employer. Two-thirds of survey respondents reported not having worked remotely in their job previous to locating in their current place. Typically, this arrangement emerged in conjunction with a job search process in which the respondent was seeking employment opportunities in their future location as indicated by interview participants. The remote option was not necessarily the first inclination of respondents. In many cases, respondents would have *preferred* finding employment that was non-remote.

> "I worked in an office for 3 years. We were sick of Boston and she was finishing up her nursing program and looking for a job… So, I went to my direct boss and said basically I'm going to do this [move to Maine] but I don't want to stop working here. I'm on a good pathway, I like working here, I like working with our team. And his response was like, I don't mind if you do this… I had some leverage and I felt I was a good employee and good at my job and you know, it's hard to train someone. So I don't think they wanted to lose me." (Interview subject)

These findings suggest that remote work is a means to match skill sets and occupational aspirations that may not exist in the local labor market to which the household is intending to move. The findings also suggest that remote workers likely have higher levels of intangible human capital and may command higher wages as a result.

3.6.2. Career Advancement as a Remote Worker

Career advancement is viewed as a challenge for remote workers, following findings of other studies (Bloom, Liang, Roberts, and Ying, 2015). Virtually all interview respondents expressed concerns about advancing in their career through the current

remote work situation. This is primarily a result of two factors. First, remote workers feel disconnected from their organization outside of their immediate team or co-workers. The lack of visibility hinders opportunities to network and build relations that would allow upward mobility within the organization.

> "Most challenging was not being visible. Opportunities are not as presentable beyond my job and team." (Interview response)

Second, upward mobility within the organization may be hindered by how amenable higher-level occupations are to remote work. For instance, the next logical job in a career progression may be in management, an occupation not well-suited to remote work.

> "People are very rarely looking for remote workers in senior positions." (Interview response)

> "I did advance 1 or 2 times, but it was pretty clear there is a ceiling." (Interview response)

The implications are that remote workers may seek other employment opportunities, likely at a regional brick and mortar. This provides opportunities for local firms to recruit high-skilled workers with specialized skill sets. However, a trade-off expressed by several interview subjects is that there is a perception of a lack of employment opportunities that align with job desires and skill sets of remote workers.

Likewise, if the wage differential is sufficiently large, there is or maybe a disincentive to seek employment with a local organization.

> "I would have to retrain to find a job here." (Interview response)

> "I was unhappy with my current remote work arrangement. I considered and actually looked for a job that appealed in Portland, but in the end there was not a good match. So I ended up finding another remote job through my networks." (Interview response)

3.6.3. Advantages of Wage Differentials

Remote work allows for inter-regional wage differentials to be capitalized on, under certain conditions. In the case of this sample, remote workers reported significant pay gap between the pay of the respondent's current occupation with those in the local labor market. For instance, over half of interview respondents indicated the home office of their employer is located in major metropolitan areas, including Washington, DC, Boston, New York, or San Jose (Silicon Valley); places in which wages and prices are significantly higher than national averages and many small and mid-sized regions. In one extreme case, the wage differentials were nearly three times the local rate of pay. One respondent who is a legal professional and works as an independent contractor for a law firm in a major US metropolitan area stated,

> "There's definitely an advantage in smaller markets. The pay is better. I'm working less and making more than I would at a traditional firm here in Portland. For 2016 I worked a full year as an independent contractor and I made three times what I would have made compared to what I would make as an Associate at a Portland law firm. As an anecdote, I can tell you I had moved and been here for six months and went and talked to a law firm that I really liked here about a position. And they told me what the salary would be. And they asked how much I made, and they all went [pause]… You should think about that. I'm probably making more than a lot of partners at the local firm." (Interview response)

Applying interregional migration theory, this suggests workers are able to capture increased utility, in some cases significantly, if a wage differential exists between residential location and location of employment.

3.7. Implications for Economic Development Planning in Small Cities and Rural Areas

> "As an electronics engineer in an area that doesn't appear to offer much in the way of electronics engineering work, working in place is a wonderful way for me to continue doing the work that I love in an area that I love and that accommodates both my wife and I." (Survey response)

Interest in the economic development potential of remote work has been growing. Yet to date, there has been little written about the location preferences and characteristics of remote workers that enable policymakers, planners, and economic developers to better develop and target strategies to leverage remote work as an economic development strategy. This research has attempted to help fill knowledge gaps by drawing on data collected from remote workers through semi-structured interviews and a web-based survey.

This research suggests that remote workers possess higher levels of formal educational attainment and work in industries and occupations that are commonly associated with the knowledge economy. Remote workers earn significantly higher incomes, suggesting they are able to take advantage of regional wage and price differentials. Although remote work may not be the causal force behind household location choice, it enables greater locational flexibility when households consider a move, especially to locations that may offer fewer employment opportunities that match the skill sets and expertise of specialized knowledge workers. While there is strong

evidence of urban preferences and movements back to the city, findings from this study suggest preferences for large urban areas are not necessarily shared by all. Remote workers reported preferences for natural amenities, proximity to family, and general place affinity.

Remote workers are much more likely to decide on a region or place to locate and use remote work as a means to facilitate the move, especially when local labor market opportunities are lacking. In a vast majority of cases in the sample, remote work enables employment and occupational continuity in which workers maintain or access opportunities aligning with skill sets not available in the new location. Remote workers also balance wage differentials relative to the local labor market, in which remote workers are able to draw wages from a high paying region relative to the new location, thus having the effect of increasing utility. Over time this may have the effect of eroding the urban wage premium.

These findings suggest several considerations for policymakers and planners. First, remote workers drawing high wages from outside the home region with large differentials relative to local wages may inflate local prices for housing. Anecdotally, this issue has been raised in policy circles in some small city regions (e.g. Portland, Maine) in which a growing concentration of remote workers from outside the region have located. Public officials must consider to what extent the location of remote workers receiving high wage differentials influence local prices, particularly related to housing markets and local wages. If local firms are to recruit remote workers to transition from a remote to local employment, they will need to compete with wage rates paid in a different region. In some cases this may mean competing with prevailing wage rates in large metropolitan

areas. However, empirical evidence on the impact of remote worker wage differentials on local prices is still absent.

On the other hand, wage differentials may be one powerful point of leverage if the goal is to attract remote workers to a region. Policymakers in rural, small and mid-sized cities may target remote workers in large cities where prices are higher by highlighting the increased utility gains a remote worker could capture by relocating to the lower cost region while still drawing earnings remotely from the higher wage region. Specifically, attraction strategies that leverage existing social connections to the planner's region can be designed. As an example, planners seeking to attract remote workers to Maine may target diaspora living in the Boston Metropolitan region, highlighting the relatively lower housing prices and appealing to emotional affinities for 'home'. Traditional print advertising and social media outreach through existing networks may be one component of this place marketing strategy. On the other hand, using remote work as a retention strategy may also be appealing for places struggling with out-migration and limited economy opportunities. Though this type of strategy may be more difficult to implement.

A second implication is that much like firms that sell products or services outside of a region, remote workers can be viewed as 'exporting services' and thus importing dollars into the local economy that, in turn, go through additional rounds of local spending supporting additional economic activity. From this perspective, attracting remote workers can have a positive impact on local economies through multiplier effects. The most logical role for planners and policymakers seeking to attract remote workers is to focus on making sure critical infrastructure is available, such as reliable broadband access which remote workers reported as being essential for daily work activities. Ninety-

four percent of survey respondents in this study reported using ICTs between 80 and 100 percent of the time to complete work activities, while less than 2 percent reported ICTs as not important in work activities. Likewise, building soft supporting infrastructure for remote work, including networking opportunities, public spaces to work, and branding as a remote work friendly place may also be important.

Third, career advancement is a challenge for remote workers and a vast majority of remote workers interviewed expressed a desire to find their next job locally. Economic developers may find untapped skilled local labor in remote workers and may be able to entice matching with local innovative firms that struggle from similar limitations in less dense labor markets, especially in small and mid-sized regions. Economic developers and planners should focus on building networking opportunities that match remote workers and specialized skills with local firms. On the other hand, planners and policymakers should not expect to lure remote workers simply because they are more footloose. This is particularly the case if a significant wage differential exists as well as mismatched end skills of the worker and those that are in demand by regional organizations. The economic implications of remote workers with higher levels of income and educational attainment in rural areas, where wages are typically lower, are likely to be even more pronounced. On the other hand, policymakers have expressed interest in the role remote work opportunities could play for displaced workers in economically depressed regions. While the focus of the present paper is on policy implications for the attraction of remote workers, it remains unclear the extent to which rural regions can leverage remote opportunities for displaced workers given what we now know about remote worker characteristics, especially the concentration on computer and information based

occupations that are not aligned with skill sets of many rural workforces, such as coal country and the pulp and paper manufacturing sector in central Maine. Skill mismatch and broadband accessibility are all critical barriers to linking with remote opportunities in these settings.

This research was intentionally designed as exploratory, given the lack of knowledge and inquiry into the topic and focused on the case of remote workers in Maine. Although a small portion of our sample extends to other parts of the country, the results are characteristic of mid-sized city regions and rural areas. The extent that these results are reflective of other regions is a question to be answered in future research. Still, the results of this paper uncovered a number of interesting questions for future research related to remote workers, location and migration, and implications for places that have been discussed elsewhere in this paper.

CHAPTER 4

THE GEOGRAPHY OF REMOTE WORK: DIFFERENCES ACROSS US REGIONS

Remote work has grown rapidly over the last decade and a half, emblematic of the evolving changes in the nature of work and the workplace. US regions and states have begun experimenting with strategies to attract remote workers based on the notion that they may be more footloose in their location and migration decisions because they are not constrained by proximity to a central employment location, yet little empirical evidence exists on the relationship of remote work and geography. This paper investigates the influence of amenities on the concentration of remote workers across a sample of US counties by employing a series of cross-sectional spatial econometric models. I find that amenities play a powerful role in explaining variations of remote worker concentrations across counties and that amenities play different roles in the hierarchy of county sizes. Cultural amenities are associated with greater shares of remote workers across all county sizes, with the greatest magnitude in large counties which tend to comprise major urban areas. Recreational amenities, on the other hand, are more closely associated with smaller sized-counties that are more typically characteristic of rural regions. These findings, although consistent with related literature, provide important insights into the relationship of remote work to place-based characteristics to both planners and scholars interested in the spatial implications of the changing structure of work.

4.1. Introduction and Motivation

The spaces and places of work are changing. A tangible example of these changes is the surge in the prevalence of remote work over the past decade and a half. One recent study estimates that the number of American wage and salary employees working remotely has risen by 225 percent between 2000 and 2016, while self-employed, home-based remote workers grew by 44 percent (Wallace, 2019a). More broadly, US Census estimates indicate the number of Americans working from home increased by 90 percent between 2000 and 2017 to an estimated 8 million Americans, or 5.2 percent of working aged adults.[22] The growth in remote work is largely a result of a shifting occupational structure that emphasizes the production of information, knowledge, and services and the emergence of information and communication technologies (ICTs), coinciding with demands for greater workplace flexibility and increased virtual mobility by workers (Carnoy et al, 1997; Castells, 2011; Blakely, 2001; Ng, E. S., Schweitzer, L., & Lyons, S. T. 2010; McDonald, 2015; Gallup, 2017). Likewise, firms are increasingly recognizing the importance of workplace flexibility as a tool for recruitment and retention of skilled workers (Society for Human Resource Management, 2017).

A number of US states, regions, and local municipalities have undertaken initiatives to encourage and attract remote workers as a community and economic development strategy, especially by marketing and exploiting place-based amenities that may be attractive to remote high-skill knowledge workers and retaining existing residents (e.g., VT Gen Assem. S.94, Act 197; Whitney, 2015).[23] For instance, in 2018 Vermont

[22] US Census, American Community Survey (2017) one year est., Decennial Census (2000), Journey to Work.
[23] https://www.janetmills.com/issues/economy

passed legislation that among other targeted policy supports, offers tax credits to remote workers that relocate to the state. The newly elected governor of Maine has made supporting remote workers in the state an element of the new administration's economic prosperity plan[24]. As these examples help demonstrate, strategies to capture the remote workforce has been of particular interest for small and mid-sized cities and rural communities as a way to counter limited employment opportunities for specialized workers, population decline, and/or an aging workforce (Henderson and Abraham, 2006; Gallardo, 2016; Whitacre and Gallardo, 2014). This perception largely stems from the notion that remote workers do not have to locate within commuting proximity to a place of employment, since, by definition, remote workers have locational flexibility with respect to a workplace, and may instead emphasize access to amenities or other place-based factor in making location or migration decisions.

This paper investigates differences in the concentration of remote work populations across US counties as possibly explained by place-based amenities and other locational attributes. Based on the notion that remote workers have greater locational flexibility, I expect to find greater concentrations of remote workers in amenity rich places, in locations with strong social and familial ties, and in regions where employment matching opportunities are more limited or less diverse. Furthermore, I expect differences in the role of amenities in regions of different size and degree of rural versus urban intensity.

I define remote workers as people that work in place (Erard, 2015) and have no geographic requirement for where work is completed, which may be dictated by an

[24] *Ibid.*

employer, customer base, or characteristic of the job (Wallace, 2019a; Wallace, 2019b). By this definition, remote workers are a distinct type of teleworker in that they telework on a full-time basis rather than part-time as many teleworkers do. While I include both self-employed and wage and salary workers in my sample, it is important to recognize there may be differences related to locational requirements for work that exist between worker classes. For example, the self-employed remote worker may be more likely to serve local markets and be required to visit with customers or clients frequently.

In a similar vein, the ability to complete day to day activities remotely is limited by the nature of some jobs. For instance, most production, construction, or extraction oriented jobs typically require being on-site to complete, although technology is rapidly expanding the types of jobs that can be completed remotely. I do not consider these types of jobs to be remote work, despite often being run as a home-based full-time business. Remote workers, in particular, have been found to be concentrated in occupations with high skill, knowledge, and educational requirements compared to non-remote workers (Wallace, 2019a). Therefore, this paper focuses on the share of home-based workers in professional, technical, and scientific services as a measure of remote work to test the explanatory power of a number of independent variables across two groupings of US counties based on county population and by US Census Region.

This paper makes several important contributions to the emerging literature on remote work. This is the first paper, that I am aware of, that considers differences in the inter-regional distribution of remote workers in the United States and the relationship of remote worker concentrations to place-based attributes. Past studies on telework typically focus on *intra*-regional location patterns and targeted towards audiences interested in

transportation planning and urban sprawl (Mokhtarian, Salomon, and Choo, 2005). There is far less emphasis on *inter*-regional spatial patterns of remote workers and the economic development implications for places of different sizes with different amenity stocks (Wallace, 2019b).

I find that amenities play a powerful role in explaining variations of remote worker concentrations across counties and that amenities play different roles in the hierarchy of county sizes. Cultural amenities are associated with greater shares of remote workers across all county sizes, with the greatest magnitude in large counties that tend to comprise major city regions. Recreational amenities, on the other hand, are more closely associated with smaller sized-counties that are more typically characteristic of rural regions. Broadband enabling technology is also highly significant across all county sizes, while remote workers also appear to take advantage of regional wage differentials – higher shares of remote workers are found in counties with larger differences in the median wages of remote workers compared to the median wage of the county. These findings provide important insights into the relationship of remote work to place-based characteristics and suggest that policymakers targeting remote workers should focus on the amenity strengths are their region, while recognizing the importance of broadband infrastructure in growing a remote worker base.

4.2. Literature Review

This section provides a brief review of the telework literature and provides a basis for why one might expect to find higher levels of remote workers in places with higher levels of preferential attributes, such as natural and cultural amenities, broadband accessibility, and more limited economic opportunity. It briefly reviews traditional

neoclassical location and migration theories, the role of amenities in shaping location decisions, and factors influencing remote work uptake as it relates to potential location and migration factors. Although this paper does not specifically model migration or location decisions, the literature provides a crucial lens for understanding the link between people and place.

4.2.1. The Emergence of Remote Work

Remote work is not necessarily a new concept, rather it is synonymous with the more commonly referred to concepts "telework" or "telecommuting". Remote work is emblematic of what was envisioned by early proponents of the death of distance in which work was completely decentralized and people lived and worked from home (Toffler, 1980; Cairncross, 1998). Since the concept was first defined in the 1970's, telework has been primarily viewed as a policy means to address transportation issues by reducing congestion and greenhouse gas emissions (Nilles, Carlson, Gray, and Hanneman, 1976; Mokhtarian, 1991). Abundant literatures have developed over the last several decades expanding to a diverse range of disciplines (Ellison, 1999). In particular, sociologists have been interested in the implications of telework on individuals, households, gender roles, families, and quality of life (Hansen and Pratt, 1995; Oberhauser, 1995; Sullivan and Lewis, 2001).

Telework research has been hampered by definitional inconsistencies, differences in disciplinary perspectives, data limitations, and general measurement challenges (Mokhtarian et al, 2005). In most instances, studies define teleworkers as a homogenous group and fail to differentiate the full-time remote worker from other intensities of telework, such as the more typical part-time teleworker (Wallace, 2019a). This has

important implications because the part-time teleworker still physically commutes to an office location when not telecommuting, thus subject to locational proximity to an employer or customer base. Research on telework from an economic development perspective has also been absent, with only recent efforts to understand the role of broadband and telework on income levels (Gallardo and Whitacre, 2018).

There are constraints on the types of occupations that can be done remotely (Belanger, 1999), although the spectrum of remote amenable jobs and skill requirements are changing towards higher-skilled workers (Wallace, 2019a) and increased digital requirements of all types of occupations (Muro, Liu, Whiton, and Kulkarni, 2017). Researchers have referred to remote work as largely information- or knowledge-based (Gould-Ellen and Hempstead, 2002). Most definitions include ICT substitution for a physical commute as a key feature of telework (Mokhtarian et al, 2005; Garrett and Danziger, 2007), which suggests limitations for jobs which are non-tradable, in the sense that they are locationally bound. Researchers have recently used methods to account for occupational constraints in the measurement of remote work. For instance, Wallace (2019a) used data from the US Bureau of Labor Statistics Occupational Information Network (O*Net) to identify occupations that are amenable to remote work.

4.2.2. Location, Migration, and Amenities

Neoclassical interregional migration theory (Mincer, 1978; Greenwood, 1985; Mueser and Graves, 1995) and residential location theory (Alonso, 1968) are a useful starting point to understand why higher concentrations of remote workers might be expected in amenity rich regions. Both are rooted in a utility maximizing framework. Neoclassical migration theory is split into two competing views between an equilibrium

perspective (Graves, 1980) and a disequilibrium perspective (Hunt, 1993). The equilibrium perspective views place-based amenities as capitalized for in regional wage rates and housing prices (i.e. compensating differentials) leaving utility constant across space (Greenwood and Hunt, 1989). From this perspective, migration is explained by changes in the demand and/or supply of amenities, and the factors that lead to those changes, such as increasing real income or changes in relative prices (Knapp and Gravest, 1989). The disequilibrium perspective understands migration decisions to be based on utility gains from regional differences in economic opportunities, such as moving from a low-wage to a high-wage region. Hence regional wages are a fundamental driver of migration in the disequilibrium perspective and amenities play little role. On the other hand, residential location theory views household decisions as based on a set of tradeoffs between accessibility to employment (i.e. commute to work), access to housing, and access to environmental amenities—subject to budget and time constraints (Fujita, 1989).

A fundamental assumption of these theories is that wages, and by effect employment, are location specific. People live in the same region of their employment. Under the residential trade-off theory, employment access is viewed as a physical commute distance, while under the disequilibrium and equilibrium migration theories wages are tied to local prices (Greenwood, 1985; Fujita, 1989). From the perspective of the remote worker, work can be completed from any location and wages can be sourced from another region. It follows then, that understanding remote work from the neoclassical perspectives presents several implications. First, from a residential trade-off theory perspective, remote employment access is hypothetically not a constraint and does not factor into the model. Second, from a disequilibrium migration perspective, utility

may be gained by locating in regions with lower relative wage compensation for the same job if drawing wages from a higher paying region. Lastly, under the equilibrium migration theory, real incomes and relative prices may be effectively increased in comparison to another region that makes migration an attractive option for the remote worker. To illustrate, consider the example of an attorney based in the high compensating region of Washington, D.C. working remotely in Portland, Maine—an area where attorney salaries are significantly lower but where natural and environmental amenities are higher and preferential. The attorney may choose to work remotely in Portland, Maine thereby increasing utility because of significantly higher wages from Washington, D.C. and access to greater stocks of natural and environmental amenities or other attractive attributes in Portland.

Interregional migration is also a challenge to the dual earner household that must consider the employment access of both income earners (Costa and Khan, 2000; Chen and Rosenthal, 2008). This is particularly problematic for dual high-skill, specialized workers in smaller and less diverse regions with limited labor market opportunities. Remote work may help facilitate the migration of dual earner households in such scenarios (Rabe, 2011; Wallace, 2019b). In a location such as Portland, Maine, with limited diversity of high-skilled industries, the likelihood that the "trailing" partner's career can be accommodated locally is lower compared to regions with large and dense labor opportunities, like Boston, Massachusetts (Simon, 2018). On the contrary, remote work may have the effect of *reducing* the likelihood of relocation. For instance, in rural regions with limited employment opportunities, residents may access employment through remote means rather than being forced to migrate to a region where employment

opportunities exist or minimize 'brain drain'. This is one premise behind rural broadband development initiatives in the US (Gallardo, 2016; Smith, 2017).

Research on the geographic distribution of remote workers in the US and the role of locational attributes has been largely absent in the literature, particularly from a regional development perspective. Previous research has attempted to understand the impact of the broader concept of telework on residential location patterns and the urban form (Tayyaran, Khan, and Anderson, 2003; Mokhtarian et al, 2004; Kim, Mokhtarian, and Ahn, 2012; Zhu 2013; Kim 2016a; 2016b). The causal relationship between telecommuting and relocation has been difficult to establish (Ory and Mokhtarian 2006). While there is substantial evidence that teleworkers tend to live further from employment centers (Mokhtarian et al, 2004; Kim et al, 2012), there is much more limited evidence that telework encourages residential relocation to outlying areas. Some studies present evidence that home-based workers, especially knowledge workers, may be encouraged to remain in the urban core to access clients and urban amenities (e.g. Ellen and Hempstead, 2002; Moos and Skaburskis, 2012). Regardless, most researchers anticipate net dispersion effects from telework as adoption increases (Helling and Mokhtarian, 2001).

The role of amenities as pull factors in migration and regional development has been a focus for researchers (Knapp and Gravest, 1989). Research has focused the role of natural amenities in attraction and migration between rural and urban places (Chi and Marcouiller, 2013), across US counties (Rupasingha and Goetz, 2004), and whether natural amenities in rural places can be a centerpiece for attraction strategies (Green, Deller, and Marcouiller, 2005; Kim, Marcouiller, and Deller, 2005; McGranahan, 1999), especially regions with plentiful recreation opportunities (Booth, 1999; Lawson, 2019).

Within this discussion is whether people emphasize job access or access to amenities in determining where to locate (Ferguson, Ali, Olfert, and Partridge, 2007). Focus has been on workers with high stocks of human capital - a population shown to be more mobile or move longer distances than the general population (Moretti, 2012). Researchers have investigated whether high-skill workers favor access to employment or access to amenities (Whisler, Waldorf, Mulligan, and Plane, 2008; Brown and Scott, 2012) and whether high-skill jobs follow rich amenity regions (Dorfman, Partridge, and Galloway, 2011).

The large and diverse pool of urban amenities present in large city regions are also assumed to be an important draw for high-skill and fuel the growth of agglomerations (Glaeser, Kolko, and Saiz, 2001). Cultural and social amenities are deemed important in attracting high-skilled workers perhaps best exemplified by the creative class hypothesis promoted by Florida (2002). Although creative class theory has typically focused on the role of cultural amenities in stimulating economic development in large cities, researchers have considered the role of the creative class for rural regions as well (McGranahan and Wojan, 2007).

Household and personal relationships are also an important component of migration and location decisions including familial ties (Mulder and Malmberg, 2014), and social connections, and embeddedness (Kan, 2007). Another large body of literature views migration to occur at various stages of the lifecycle that change with significant life events based on age and family composition (Rossi 1955; Clark and Onaka, 1983; Walters, 2002). The influential role of natural amenities in migration decisions of

retirees, particularly to warmer climates, has also been well documented (Reeder, 1998; Poudyal, Hodges, & Cordell, 2008).

The previous discussion has briefly touched on the factors that various literatures have found important to the movement and location of people across geographies. The underlying proposition of this study is that if workers (and households) are truly mobile and footloose in terms of work location, one might expect to find higher concentrations of remote workers in regions with access and rich endowments of attractive natural, cultural, and other types of amenities that people value. While there are certainly other factors likely driving location decisions of remote workers to consider, such as personal and household characteristics, this paper focuses primarily on regional amenities and attributes.

4.3. Research Methods

The goal of this paper is to investigate the distribution of remote work across US regions and to lend some empirical evidence to the role of regional amenities and attributes in explaining regional variations in remote work, with particular view on what factors matter for different size regions. I construct a series of exploratory regression models testing for differences across counties in different population groups and across the four major Census Regions. The dependent variables are constructed using Journey to Work five-year estimates from the American Community Survey (ACS) for the five-year period 2013-2017 at the county level to measure the share of adults 16 and over reporting as working from home.[25]

[25] As is the case with many large regional studies, selection of secondary data sources for this study involves trade-offs related to geographic scale. Although the US Census reports the number

There are three important limitations with this data that should be acknowledged and adjusted for. First, the underlying data only accounts for remote workers that work from home and may not account for remote workers that may still commute to a co-working space, coffee shop, library, or other alternative place to complete work. Alternatively, simply using the total share of work from home may include workers in occupations that cannot feasibly be done remotely (Wallace, 2019a). For instance, a construction worker is locationally dependent in that to do the job one must be physically present at the site of construction. It is also difficult to determine whether a home-based worker in sales lives in a customer territory that they serve or whether they service clients remotely. I account for these concerns by taking a conservative approach—including only home-based work in jobs reported in the management, business, science, and arts occupations. This also has an intended effect of focusing on workers that are typically at the higher end of the skill spectrum or 'knowledge' work.

A third limitation with this data even at the county level is the extreme high error margins of Census estimates raising concerns regarding confidence in the estimates in very small counties. I therefore limit the sample for this analysis to counties with greater than 20,000 people within the contiguous 48 US states leaving the final sample size at

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of people working from home at the tract level providing higher degrees of locational granularity, the estimates have very high error margins. On the other hand, Census Public Use Microdata Series (PUMS) data provide high degrees of individual and household granularity and have recently been used to investigate individual level of remote work characteristics (Wallace, 2019a), but the data is only publicly available at the PUMA level of geography (covering rural areas) which in most cases are arbitrarily defined by states and lack consistent definitions from decade to decade. This study therefore focuses on US counties as the unit of analysis because regional amenity data is most easily accessed at this level, while still allowing for sufficient work from home estimates and aggregate individual and regional economic characteristics. Moreover, the focus of this analysis is on regional locational amenities, measures already difficult to capture, rather than those at the neighborhood scale as policies targeting remote work attraction are typically focused on state or regional levels of geography.

1,821 counties. Although an imperfect measure, work from home estimates still provides a representative measure of the relative differences of remote workers across US regions and is an appropriate measure for the purposes of this study. Recent research has used this data to measure teleworking at the census tract level (Gallardo and Whitacre, 2018).

Figure 4.1 provides a map of the *levels* of remote workers across *all* counties in the lower 48 US states.[26] Concentrations of the levels of remote workers can largely be explained by population centers along the northeastern and mid-Atlantic regions, southeastern coastal regions and Florida, the Pacific coast, and the upper Midwest and Great Lakes region. Figure 4.2 shows the distribution of remote workers when normalizing by the share of the population 16 years or older. The resulting map shows a much different pattern of remote work and there are clear spatial patterns in the data. Although concentrations of remote workers persist in the Northeast and Western region of the country, a much larger concentration of remote workers appears in the western and Central Mountain regions and to a lesser extent the north central plains states.

To investigate how remote work differs across regions of different size, counties are subset by population thresholds into four groups or regimes: counties with a 2017 population of 500,000 people or greater ("Large counties"), counties with population between 100,000 to 500,000 ("Medium-large counties"), counties with population between 50,000 and 100,000 ("Medium-small counties"), and counties with populations between 20,000 and 50,000 ("Small counties"). Although not always the case, smaller counties are less likely to be in large metropolitan areas.

[26] Although the final sample is restricted to counties with population 20,000 or higher, I show all counties in Figures 1 and 2 to provide a cohesive view and spatial patterns of remote work concentration across the US.

Figure 4.1: Geographic Distribution of the Level of Remote Workers by US County

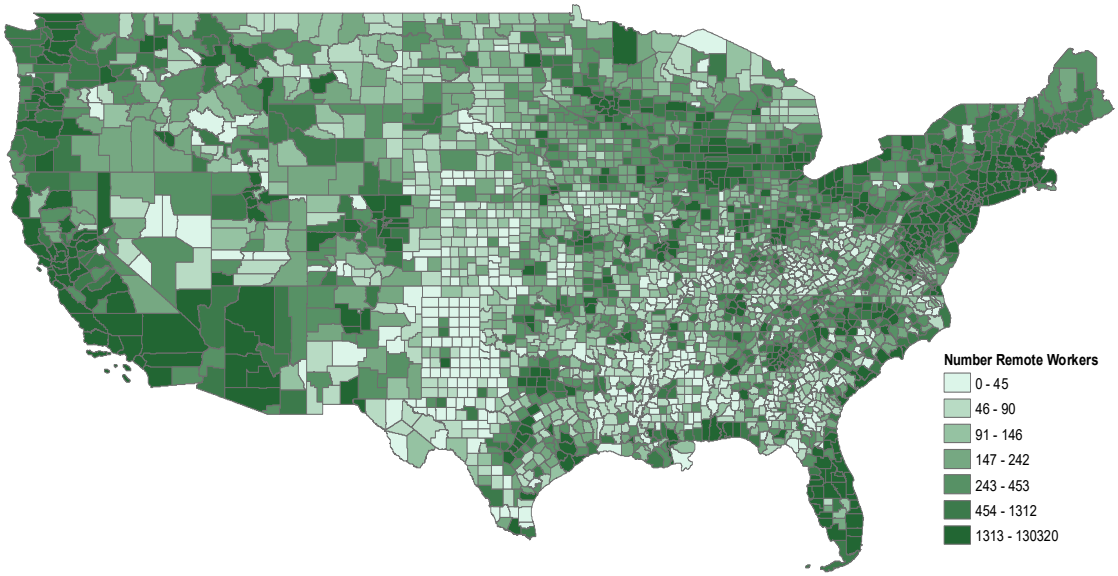
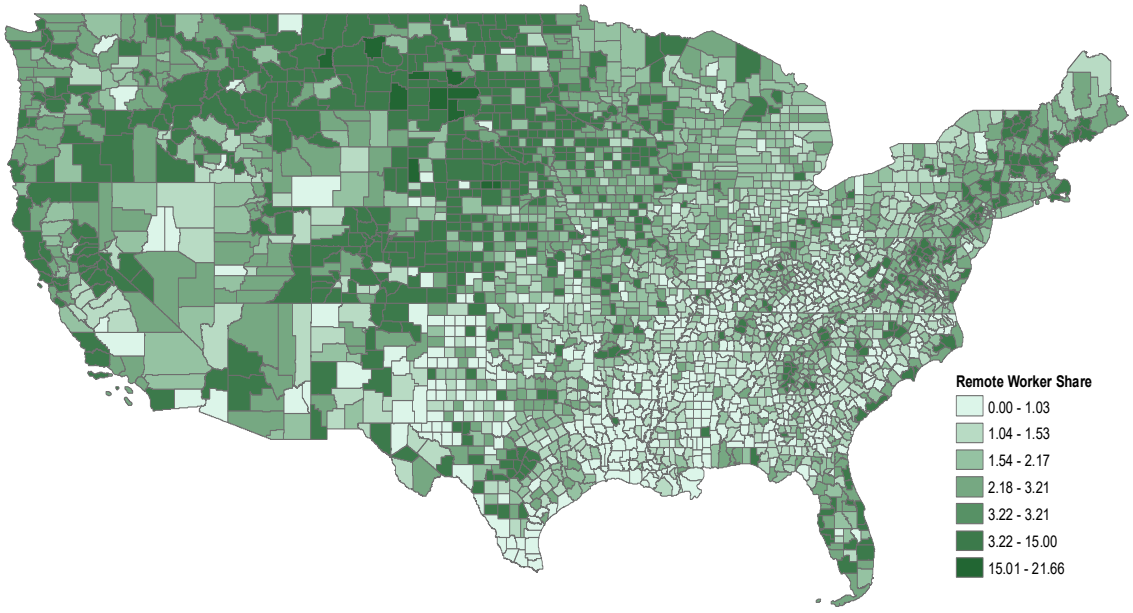


Figure 4.2: Geographic Distribution of the Share of Remote Workers by US County



Source: US Census, American Community Survey 2013-2017 5 year estimates; author's calculations.

Table 4.1 ranks counties by the dependent variable (share of remote workers) for the four defined population classifications. There are several interesting observations. First, on the whole, the smallest counties have the highest remote work share compared to the other three groupings, although medium-large counties also exhibit larger overall concentrations of remote workers. Second, there are clear spatial patterns that arise with high concentrations of remote workers in neighboring counties of differing sizes, in particular for counties in or adjacent to major metropolitan areas known as high-tech regions. For example, Fulton County Georgia and neighboring Cobb and Forsyth Counties are all among the most concentrated counties. Likewise, San Francisco County and neighboring Marin County in California, as well as several counties comprising the North Carolina research triangle region are atop the list. Third, is the presence of counties in proximity to world class landscape and recreational amenities. This is especially the case for a number of counties comprising the Denver, CO and Boulder metro areas, which boast not only recreational opportunities but also a thriving high-tech economy. This is also true for smaller, stand-alone counties that are close to natural recreational amenities but not necessarily encompassed by major city regions, such as Summit County, Utah (Park City) and Blaine County, ID.

To further control for urban-rural influence I use definitions from the U.S. Office of Management and Budget on whether a county was included in a metropolitan area or non-metropolitan statistical area, the latter of which is often used to denote rural areas. I further breakdown metropolitan counties by those within a large metropolitan area (greater than 1,000,000 people) and within a small metropolitan area (less than 1,000,000

people), as well between rural areas with no adjacency to a metropolitan area using the USDA rural–urban continuum codes (RUCC; USDA 2013).[27]

Table 4.1: County Rankings of Share of Remote Workers by County Classification (Regime)

County	Work at Home Share	County	Work at Home Share
Top 10 Large Counties		Top 10 Medium-Large Counties	
Travis County, Texas	5.40	Boulder County, Colorado	7.66
Collin County, Texas	5.27	Marin County, California	7.18
Fulton County, Georgia	5.03	Douglas County, Colorado	6.56
Wake County, North Carolina	4.85	Forsyth County, Georgia	6.51
Cobb County, Georgia	4.67	Sumter County, Florida	5.96
Jefferson County, Colorado	4.60	Williamson County, Tennessee	5.72
Denver County, Colorado	4.58	Orange County, North Carolina	5.53
New York County, New York	4.53	Hunterdon County, New Jersey	5.47
Multnomah County, Oregon	4.48	Deschutes County, Oregon	5.23
San Francisco County, California	4.47	Santa Fe County, New Mexico	5.09
Top 10 Medium-Small Counties		Top 10 Small Counties	
Rice County, Minnesota	5.95	Summit County, Utah	8.90
Nevada County, California	5.90	Taos County, New Mexico	7.90
Broomfield County, Colorado	5.73	Windham County, Vermont	6.71
Chatham County, North Carolina	4.85	Klickitat County, Washington	6.30
Eagle County, Colorado	4.84	Clark County, Wisconsin	5.96
Cheshire County, New Hampshire	4.57	Llano County, Texas	5.35
Walton County, Florida	4.39	Elbert County, Colorado	5.29
Benton County, Oregon	4.35	Addison County, Vermont	5.28
Geauga County, Ohio	4.26	Blaine County, Idaho	5.26
Franklin County, Massachusetts	4.11	Teller County, Colorado	5.14

Note: Sample includes counties with pop > 20K. Regimes classified as Large counties (pop>500,000), Med-large counties (pop>100,000, <500,000), Med-small counties (pop>50,000, <100,000), and Small counties (pop>20,000, <50,000).

Source: US Census, American Community Survey 2013-2017 5 year estimates; author's calculations.

[27] See https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/ for documentation and data. Other measures of urban influence based on core versus non-core metro counties were explored but ultimately excluded as they were a poorer fit and lacked sufficient explanatory power.

4.3.1. Independent Variables

I identified relevant explanatory and control independent variables based on an exhaustive literature review, subject to data limitations. The purpose of this research is not an exhaustive investigation of every locational attribute, but rather a focus on a common group of locational amenities and characteristics that have a theoretical basis for explaining concentrations of remote workers as discussed in the preceding sections. A number of variables were tested for model fit, but in the interest of parsimony only those variables statistically significant or adding sufficient value to model explanatory power were included.

It is important to recognize the differences that exist with respect to amenities and attributes. This study adopts the definition of amenities used by McGranahan that considers an amenity as:

> "... an attribute that enhances a location as a place of residence. It may be quite distinct from an attribute attractive to tourists. While some tourism involves travel to places attractive for residence, tourism also involves travel to places that are seasonally attractive or somehow unique - caves, canyons, historic sites, theme parks, and, especially in more recent years, casinos. These unique places may or may not be attractive as places to live." (McGranahan, 1999, page 1).

In this study, place-based attributes and amenities are organized into seven groupings: natural amenities, recreational amenities, cultural amenities, social connections, infrastructure, economic and industrial conditions, and regional wage differentials. I also control for demographic characteristics of remote workers for which data is available for the county level. Unless otherwise stated, the socio-demographic control measures come from the 2017 American Community Survey five-year estimates.

4.3.1.1. Natural Amenities

I use the 2017 US Department of Agriculture Natural Amenities Scale originally developed by McGranahan (1999) to represent the geographic distribution of several forms of natural amenities. This study focuses on average winter temperature measured by mean January temperature, and a dummy variable for regions that are mountainous and hilly based on topographic classification. I considered a number of other variables such as June humidity, number of days with sun, and coastal access but left these out of the final models because of either high correlation with other amenity variables, they were found to be insignificant, or did not add explanatory value to the models. I also tested the USDA Amenity Index, but chose to focus on specific amenities rather than an aggregate measure.

4.3.1.2. Recreational Amenities

Measures of natural amenity stocks, such as climate and topography, represent a region's "basic ingredients" but do not necessarily account for how regions may have leveraged natural amenities to advance their economic development goals (McGranahan, 1999). To account for how a region's natural amenities have been shaped by man to create an attractive destination, I use a dummy variable to denote a region with above average employment in recreation industries based on the USDA County Typology Codes as originally developed by Johnson and Beale (2002).[28]

[28] The index includes the share of employment and income in entertainment and recreation, accomodations, restaurants and eating places, and real estate industries and share of vacant housing for seasonal use for the year 2010 and 2015. See http://www.ers.usda.gov/data-products/county-typology-codes.aspx for documentation.

4.3.1.3. Cultural Amenities

Florida argues for the importance of cultural amenities such as the arts, openness, and creativity as fuel for attracting high-skilled workers and other 'creative types' that drive economic growth (Florida, 2002 & 2005). Although the emphasis of cultural amenities and the creative class theory has long focused on large cities, other researchers have considered the importance for small- and mid-sized metropolitan areas (Kelly, Ruther, Ehresman, and Nickerson, 2017) and rural areas (McGranahan and Wojan, 2007). Although there is no set definition of cultural amenities used in various research, most definitions rooted in creative class theory have typically been measured using employment shares in creative occupations (Wojan, 2018).[29]

Instead, I use a more direct measure of cultural amenities that draws from the US Bureau of Economic Analysis Arts and Culture Satellite Account industry definitions. I focus on a subset of the BEA's core cultural industries that include performing arts, independent artists, writers, and performers, museums, historical sites, and parks, and fine arts education.[30] I use the sum of establishments in these industries per 100,000 people. By using the number of establishments rather than industry employment or creative occupational employment, the variable better accounts for the approximate number of cultural amenity options in a county as opposed to the other measures which

[29] This method was first used by McGranahan and Wojan (2007) and uses the share of occupational employment for a set of occupations classified as "thinking creatively" based on Bureau of Labor Statistics (BLS) Occupational Information Network (O*Net) data.

[30] I define cultural amenities based on the number of establishments per 100,000 people in a county in the following industries: NAICS 7111 (Theater companies and dinner theaters), NAICS 7113 (Musical groups and artists), NAICS 7115 (Independent artists, writers, and performers), NAICS 712 (Museums, historical sites, zoos, and parks) and NAICS 611610 (Fine arts schools). I exclude advertising, architectural, interior design, and industrial design services, photography finishing services and all supporting industries defined by the BEA. See https://www.bea.gov/data/special-topics/arts-and-culture for more details.

could be influenced by a single large organization (industry employment) or that are highly correlated with my dependent variable as is the case with occupational employment definitions such as those used by McGranahan and Wojan (2007).

I also include a dummy variable to capture a region's characteristic as a retirement destination to account for later life migration choices that tend to favor certain locations (typically warm, southern places) over others. This measure draws from the USDA Economic Research Service (ERS) County Typology Codes and is constructed using the change in population 60 years and older between 2000 and 2010. If migration rates for the population 60 years and older were 15 percent or greater, the county is considered a retirement destination coded as a dummy variable "1".

4.3.1.4. Infrastructure

Having access to reliable and fast internet connections are an important factor for remote workers (Wallace, 2019b). Broadband has been found to have a positive impact on economic development both in urban (Holt and Jamison, 2009) and rural areas (Whitacre, Gallardo, and Strover, 2014b). It follows that places with higher uptake of internet technology or broadband may enable a greater number of remote workers to locate. However, the evidence of broadband's effect on increased migration is somewhat inconclusive with a few studies finding that broadband may in fact keep people in place that may have otherwise moved (Cooke and Shuttleworth, 2018). Past studies have measured broadband using indices capturing the 'digital divide' (Gallardo, 2017) or measures of accessibility such as the US Federal Communication Commissions (FCC) Form 477 data which have been subject to criticism (Grubesic, 2008). I use the share of

broadband subscribing households from the ACS as the data better represents actual use of the technology as opposed to simply general measures of access.

Telework has largely been viewed in part as a behavioral response to traffic congestion and as a means to minimize the disamenity of long commutes. I account for this by using average commute times by county from the ACS. The prevalence of remote workers is expected to increase with length of commute.

Another important aspect of place related to infrastructure is school quality, which has been well documented as an important factor in location decisions, of families in particular (Tiebout, 1956; Rossi, 1955). Measures of school quality range from outcome based variables, such as reading and math score and graduation drop-out rates, to spending per student. Measuring school quality at the county level is difficult because of availability and other factors that may dictate education outcomes, such as state funding formulas and policies, school district scale, and other community level variables that contribute to successful education outcomes. The role of education quality in location decisions is also typically a factor at the regional level. In other words, families often decide on the area or region to locate and evaluate specific communities or neighborhoods within that region when deciding on a place of residence. For these reasons, this paper does not directly account for school quality.

4.3.1.5. Economic Conditions

Wallace (2019b) found that remote work may help fill a void in which there is a lack of labor matching opportunities in the region to which people are seeking to relocate. This may be of particular concern for rural, small, and mid-sized regions that lack dense labor market opportunities often found in large metropolitan areas. I use unemployment

rates as a broad measure to capture the general employment climate in the region, while also controlling for the share of agriculture and manufacturing employment in the region. On the other hand, there is a concern that concentration of home-based remote knowledge workers may reflect the relative industrial structure and concentrations of the region, especially in regions with dense industry clusters focused on high-tech and information technology. I use two control variables for this by using measures of industry composition and structure that include the share of *industry* employment in information, and average establishment size, which attempts to account for regions with higher concentration of self-employment and small firms.

4.3.1.6. Social Connections

Social and familial ties are important in the decisions for remote worker relocation (Wallace 2019b). An ideal measure would directly capture a remote worker's familial and community ties to a location. However, these kinds of personal ties cannot be measured directly through available secondary data. Instead, social ties are measured using the share of all residents born in the current state of residence.

4.3.1.7. Wage Differentials

Another key finding in Wallace (2019b) is that remote workers may take advantage of relative wage and price differentials by drawing a salary from a higher paying region than their place of residence or relocation. Although I cannot measure where remote workers may have lived previously, in this data, I do account for the potential wage differential by measuring the difference in median earnings for home-based workers relative to the county median.

4.3.1.8. Remote Worker Demographics

There is a limited selection of available data on the personal and household characteristics of remote workers available at the county level. However, two important measures are captured here. I use median age of all home-based workers in the county to control for lifecycle effects and the percentage of the home-based workers that are female to control for household composition.

Table 4.2: Descriptive Statistics for Dependent and Independent Variables

	Descriptive Statistics					Correlation w/
Statistic	N	Mean	St. Dev.	Min	Max	Dep. Variable
Share Home Based Work (dependent variable)	1,821	1.94	1.1	0.05	8.9	1
Population (thousands)	1,821	168	418	20	10,106	0.16***
January temp	1,819	0.13	0.96	-2.46	2.81	-0.19***
Hilly & mountain DV	1,819	0.38	0.48	0	1	0.16***
Recreation DV	1,821	0.13	0.34	0	1	0.35***
Cultural amenities	1,821	12.78	12.84	0	193.18	0.52***
Born-in-State	1,821	24.19	4.93	12.7	44.2	-0.43***
Retirement DV	1,821	66.1	14.79	18	94	0.22***
Broadband uptake	1,821	0.17	0.38	0	1	0.52***
Commute time	1,821	4.62	1.4	1.9	19.1	0.12***
Unemployment rate	1,821	14.08	3.59	4.23	28.88	-0.34***
Ag employ share	1,821	0.01	0.01	0.001	0.06	0.01
Manufacturing employ share	1,821	2.46	2.77	0	29.68	-0.29***
Information employ share	1,821	13.15	6.83	1.29	48.26	0.43***
Establishment size	1,821	48.38	5.23	20.7	67.1	-0.19***
Work home female share	1,821	0.51	0.09	0.15	0.91	-0.14***
Work home earning differential	1,731	-0.84	8.7	-28.61	53.31	0.26***
Work home median age	1,821	73.03	8.81	38.6	94.6	0.07**
Large county	1,821	0.07	0.26	0	1	0.19***
Small county	1,821	0.47	0.5	0	1	-0.15***
Medium-small county	1,821	0.21	0.41	0	1	0.13***
Medium-large county	1,821	0.25	0.43	0	1	-0.08***
Metropolitan DV	1,820	0.54	0.5	0	1	0.16***

Note: Sample includes only counties with pop > 20K. Significance levels **p<0.05, ***p<0.01.

Basic descriptive statistics and correlation coefficients of independent variables with the dependent variable are provided in Table 4.2.[31] The mean statistics for the four county classifications (Large, Small, Medium-large, and Medium-small) counties can be interpreted as the share each grouping comprises of the overall total sample. Small counties make up a larger share of the total sample (forty-seven percent), while large counties make up seven percent. All independent variables are significantly correlated with the dependent variable with the exception of the Agricultural employment (Ag employ share) control variable.

4.4. Results

4.4.1. Ordinary Least Squares and Spatial Dependence Diagnostics

I first ran simple Ordinary Least Squares (OLS) regression models for the sample of counties with population 20,000 and greater. The dependent variable is transformed by taking the square root to obtain a normal shaped distribution and the independent variables are standardized for easier interpretation of the relative magnitude of importance within and across model specifications. Tests for spatial dependence (Global Moran's I) in the base OLS model were significant, so the models were re-estimated using maximum likelihood methods to account for spatial dependence (Anselin and Bera, 1998). Lagrange Multiplier (LM) and Robust Lagrange Multiplier (RLM) tests and post-hoc model fit statistics indicate a preference for a spatial error model specification. Maximum likelihood spatial error models (SEM) were estimated using a queen contiguity

[31] A complete pairwise correlation matrix is included in Table A.4.1 in the Appendix C for reference. All correlations among the independent variables were within |.60| raising no major concerns of multicollinearity.

(first-order) weights matrix with the *spdep* package in R (Bivand, Pebesma, and Gomez-Rubio, 2013).

The general form of the spatial error model (1) can be expressed as:

$$y = X\beta + \varepsilon, \quad (1)$$

$$\varepsilon = \lambda \mathbf{W}\varepsilon + u, \quad (2)$$

where $\mathbf{W}\varepsilon$ is the spatial weights matrix and lag parameter, λ is the error coefficient, and *u* is another error term. All variables in the models had variance inflation factors (VIF) below 3, indicating no concerns with multicollinearity among variables. Table 4.3 reports the OLS and spatial error model outputs for the all counties sample.[32]

Overall the OLS model explains about 56 percent (Adjusted R^2) of the variation in the share of remote workers across counties with population greater than 20,000 people. However, comparison of model fit statistics including the Log Likelihood, Akaike Information Criterion (AIC), and Likelihood Ratio test all indicate improved model fit with the SEM. The relative magnitude of coefficients for most variables decreased slightly in the SEM model after accounting for spatial effects, although there were no noteworthy changes to direction or magnitude of effects.

[32] Subsequent individual OLS regressions and spatial diagnostics for the four county size classifications indicate spatial dependence processes in all four county classification models. However, the underlying process differed across models. While RLM statistics for the large and small county sample models indicated a preference for spatial lag specifications, models for the medium-large and medium-small samples indicated a preference for spatial error specifications. OLS and maximum likelihood spatial error models and spatial lag models ($y = X\beta + \rho W_1 y + u$, where W is the spatial weights matrix and ρ is the spatial lag parameter) were estimated for the four county classifications. Results of these model runs are reported in Table A.4.2 in Appendix C for comparative purposes.

Table 4.3: OLS and Spatial Error Model Regression Results for All County Sample

	OLS	SEM
	(1)	(2)
January temp	-.162*** (.020)	-.154*** (.025)
Hilly & mountain DV	.129*** (.033)	.120*** (.039)
Recreation DV	.321*** (.056)	.331*** (.055)
Cultural amenities	.197*** (.019)	.187*** (.019)
Born-in-State	-.118*** (.020)	-.126*** (.023)
Retirement DV	.201*** (.047)	.132*** (.045)
Broadband uptake	.209*** (.024)	.187*** (.025)
Commute time	.068*** (.022)	.080*** (.024)
Unemployment rate	-.136*** (.019)	-.154*** (.021)
Ag employ share	.154*** (.018)	.152*** (.019)
Manufacturing employ share	-.066*** (.021)	-.071*** (.023)
Information employ share	.115*** (.020)	.112*** (.020)
Establishment size	-.064*** (.021)	-.072*** (.020)
Work home female share	-.100*** (.017)	-.097*** (.016)
Work home earning differential	.119*** (.018)	.115*** (.017)
Work home median age	.004 (.018)	-.0003 (.017)
Large MSA DV	.062 (.061)	.088 (.063)
Small MSA DV	-.057 (.044)	-.022 (.042)
Non-adjacent MSA DV	-.256*** (.059)	-.192*** (.059)
Constant	-.073** (.036)	-.086** (.039)
Observations	1,729	
Log Likelihood	-1,692.87	-1,633.28
Akaike Inf. Crit.	3,427.75	3,310.56
LR Test (df = 1)	-	119.189***
Wald Test (df = 1)	-	131.182***
$sigma^2$	-	0.376
R^2	0.563	-
Adjusted R^2	0.559	-
Residual Std. Error	.648 (df = 1709)	-
F Statistic	116.113*** (df = 19; 1709)	-

Note: Sample includes counties with pop > 20K. All coeffiecients standardized for comparison of relative magnitude. Standard errors in (). Significance levels *p<0.10, **p<0.05, ***p<0.01. OLS = Ordinary Least Squares; SEM = Spatial Error Model.

The primary finding of these models is that places with higher stocks of natural, cultural, and recreational amenities are in fact a draw for remote workers, in that regions with higher levels of these variables have higher shares of their population 16 and over that are remote workers in professional, knowledge oriented occupations, once other factors are controlled for. All but a few key explanatory variables are significant at the ninety-nine percent confidence level in both the OLS and SEM models. Overall, results are mostly consistent with the *a priori* hypothesized directional influence of independent variables however, there were some surprising and relevant findings. Warmer winter temperatures have a significant and negative relationship with the concentration of remote work, contrary to the idea people are more attracted to warmer climates (McGranahan, 1999). This finding suggests the opposite is the case in relation to remote workers.

The dummy variable for recreation has the highest influence of all independent variables in explaining regional differences in remote work, suggesting remote workers do indeed highly value access to recreation. The cultural amenities variable is also significant and positively associated with greater shares of remote workers, though the magnitude is smaller than recreational amenities and several other variables in the model.

The internet has played a critical role as an intermediary in connecting remote workers with employment. Broadband uptake is positively and significant associated with the share of remote knowledge workers in US counties in both the OLS and SEM. Likewise, *commuting time*, a measure often studied as a predictor of teleworking and intra-regional residential location patterns (e.g. Kim, 2016a), is significant and positively

associated indicating that as commuting distances of a region increase, so does the share of remote workers.

Control variables for industrial structure are highly significant. As hypothesized, the share of employment in the *Information* sector has a positive and significant relationship with the share of remote work across all counties in the sample. Controlling for this variable alleviates some concerns that variations in remote work would largely be picking up variations in similar employment - many remote jobs are in the information sector (Wallace, 2019a). Even after controlling for information employment, the amenity variables remain highly significant. The variable for *Agriculture employment share*, an economic base for many rural counties, was also positively associated with shares of remote workers, while *Manufacturing employment* is statistically significant with a negative association with shares of remote work.

Another interesting finding is that as *Establishment size* increases, the share of remote work decreases. The variable *Establishment size* controls for the concentration of small businesses in a region and also the relative employment opportunities available in a region. In regions with greater concentrations of small businesses (a proxy for self-employment) this finding suggests that remote employment opportunities are used to fill a lack of employment prospects in the region of residence, thereby enabling people to locate in a region for other location preferences.

Retirement destinations (*Retirement DV)* have higher shares of remote work, indicating that older workers may choose to continue working into retirement remotely, in a consulting role or other arrangement. Relative to other variables, *Retirement DV* is second in magnitude only to *Recreation.* However, age of remote workers (*Work home*

median age) is not a statistically significant variable. Counties with higher shares of people with familial ties (*Born-in-state)* tend to have smaller shares of remote workers. Although one hypothesis is that remote workers may elect to move closer to family as found in Wallace (2019b), the finding supports research that shows high-skilled workers tend to *not* live in their place of birth and are in fact more mobile than the general population (Moretti, 2012).

Unemployment rates are negatively associated with remote work, that is, for counties with higher unemployment rates, there are lower shares of remote workers. This runs counter to the hope that remote work provides an alternative employment opportunity in regions where jobs are lacking. Remote work has been advocated as a means for residents in high unemployment regions to gain economic opportunity. Regions where remote workers earn relatively greater earnings than the general median earnings (*WH earnings differential*) are positively associated with higher shares of remote workers. Although not conclusive because of the underlying data, this does suggest that remote workers can gain utility from wage differentials assuming prices and amenities are capitalized in wage rates (Greenwood and Hunt,1989). Lastly, as the share of the regional remote worker pool comprised of the female gender increases (*Work home female share*), the lower the overall share of remote workers in a county. This may in part be reflective of the occupational mix and gender roles traditionally associated with various jobs. But it also runs counter to the argument that remote work is largely a flexible employment arrangement used to balance household roles, such as providing childcare.

4.4.2. Remote Work Across Spatial Regimes

Preliminary analysis and diagnostics of the all-county sample specifications (OLS and SEM) suggest groupwise heterogeneity among counties of different size, indicated in part from significant Breusch-Pagan statistics for heteroskedasticity. Heterogeneity exists when there is a nonconstant variance in the error term and although heterogeneity is often masked or complicated by spatial dependence, it can be difficult to untangle the two (Anselin, 1988). One solution is to impose structure on the data by systematically viewing discrete subsets of the data, often referred to as spatial regimes. This method helps to correct for spatial heterogeneity but unfortunately does not explain it (Anselin, 1990). Under the spatial regimes method all coefficients, intercepts, and variances between discrete groups (regimes) are allowed to vary. It is equivalent to running separate regressions but has the benefit of fitting one model that includes all spatial effects. Spatial regimes have been used to study spatial population data across rural-urban places (Chi and Ventura, 2011).

Non-spatial OLS regressions were first run for the four group county classifications and tested for the presence of regimes using a Chow test, which indicates coefficients do differ across county groupings (Chow, 1960). OLS regime regressions are specified in R using dummy variables for each of the four regimes which are interacted with each independent variable. Spatial diagnostics on the OLS regime model returned statistically significant values for both the RLM lag and RLM error, although significance testing and coefficient values indicate a slight preference for a spatial error regime specification that were simulated using Maximum Likelihood estimation. A significant Likelihood Ratio test confirmed a preference for the SEM model. A spatial

Chow test (Anselin, 1990) indicated that coefficients do in fact differ across subsets confirming that spatial regimes are in fact present based upon the four county classifications analyzed.

Table 4.4: Spatial Regime Regression Results by County Size Group

Variable	Large Counties	Medium-Large Counties	Medium-Small Counties	Small Counties
January temp	.028 (.076)	.022 (.041)	-.149*** (.044)	-.281*** (.033)
Hilly & mountain DV	.043 (.136)	.130* (.067)	.011 (.061)	.015 (.046)
Recreation DV	-.165 (.242)	.215* (.111)	.500*** (.103)	.226*** (.074)
Cultural amenities	.107** (.045)	.348*** (.046)	.070* (.040)	.223*** (.028)
Born-in-State	-.040 (.087)	-.063 (.040)	-.121*** (.041)	-.135*** (.030)
Retirement DV	.264 (.185)	.159** (.079)	-.063 (.079)	.185*** (.071)
Broadband uptake	.404*** (.133)	.378*** (.057)	.198*** (.054)	.113*** (.032)
Commute time	-.042 (.076)	.067* (.041)	.185*** (.040)	.172*** (.028)
Unemployment rate	-.187 (.115)	-.121*** (.037)	-.176*** (.041)	-.116*** (.028)
Ag employ share	.114 (.135)	.029 (.047)	.111** (.044)	.164*** (.022)
Manufacturing employ share	-.111 (.125)	-.059 (.047)	-.033 (.045)	-.111*** (.028)
Information employ share	.159** (.065)	.111*** (.041)	.107** (.051)	.055** (.028)
Establishment size	.002 (.082)	-.065 (.043)	-.085* (.044)	-.026 (.029)
Work home female share	-.061 (.161)	-.104** (.045)	-.016 (.035)	-.110*** (.019)
Work home earning differential	.253*** (.082)	.120*** (.042)	.114*** (.037)	.101*** (.021)
Work home median age	-.032 (.130)	.088** (.041)	-.094*** (.036)	.004 (.021)
Metropolitan DV	-.210 (.186)	-.184*** (.063)	-.131** (.057)	-.052 (.050)
Observations	1,728			
Log Likelihood	-1,558.40			
$sigma^2$	0.345			
Akaike Inf. Crit.	3,256.79			
Wald Test	147.816*** (df = 1)			
LR Test	118.523*** (df = 1)			

Note: Sample includes counties with pop > 20K. Regimes classified as Large counties (pop>500,000), Med-large counties (pop>100,000, <500,000), Med-small counties (pop>50,000, <100,000), and Small counties (pop>20,000, <50,000). All coeffiecients standardized for comparison of relative magnitude. Standard errors in (). Significance levels *p<0.10, **p<0.05, ***p<0.01

Results of the spatial regime regressions are presented in Table 4.4. [33] There are clear and obvious differences of the role amenities and place-based attributes play across county subsets. Only four variables, *Cultural amenities, Broadband* uptake*, Information employment share*, and *Work home earnings differentials,* are statistically significant at the ninety-five percent confidence level or higher for the Large county regime. As might be expected, broadband is highly significant in all four regimes and has a considerably high level of magnitude in large counties and medium-large counties; the largest magnitude variable within each of these regimes.

In terms of amenity variables, only the *cultural amenities* variable is significant and positive in the large county regime, while it is significant at the 99 percent level in medium-large and small counties and significant at only the 90 percent level in medium-small counties. Cultural amenities have the largest effect across all regimes in medium-sized counties. Within the medium-sized county regime, the cultural amenities variable has the most pronounced effect of all amenity variables on the regime. The significant statistics of the *Cultural amenities'* variable confirms much of what is already known in relation to the role of the arts and the creative economy's influence in large cities, particularly considering the focus of this study on high-skilled remote workers. But this finding also lends substantiating evidence to the work by McGranahan and Wojan (2007a & 2007b) and others on the influence of cultural and creative economies theory on development in rural places, which has received much more limited attention in the literature to date.

[33] Regression results for the OLS regime specification are included in Table A.4.3 in Appendix C for reference and comparative purposes. Overall, there is not a significant difference compared to the spatial regime specification.

Recreational amenities have an important role in medium-small and small counties, where the variable is both positive and highly significant at the 99 percent level. The variable appears to play an outsized role in medium-small counties – the coefficient is the largest of any in the spatial regime model. Recreation plays a smaller role in medium-sized counties – significant at the 90 percent level – and has no significant effect in large counties. Recreation has long been recognized as a key amenity in small and rural counties and the results here follow previous findings (McGranahan, 1999; Deller et. Al., 2001). In terms of other natural amenities, topographic variation (*Hilly and mountainous DV)* is only moderately significant in one grouping (medium-large counties), while as is the case in the all-county regression models (refer to Table 4.2), colder winters (*January temps*) are positively associated with concentrations of remote workers but only in med-small and small counties.

Interestingly, counties that are located within an MSA have lower concentrations of remote workers when controlling for other factors with the exception of large counties, virtually all of which are located in metro regions. This finding suggests that rural (non-metropolitan) places may have an advantage in hosting remote workers. Although this finding does not identify whether being rural attracts more remote workers or whether the lack of employment opportunities in higher skill jobs entice residents to seek remote employment opportunities as there are clearly issues of endogeneity present, it does highlight an important and oft promoted notion that remote work has a role in supporting rural economies (Gallardo, 2016; VT Gen Assem, 2018).

Industrial structure has varying impacts depending on the size of the county. The presence of information industries is significant and positively associated with remote

worker shares across all county sizes. The magnitude of the effect is also related to county size – it is nearly three times the magnitude in large counties compared to small counties, and nearly twice as large in mid-size counties compared to small counties. It is not immediately evident whether this simply reflects larger concentrations of IT in large agglomeration regions. Agriculturally dependent counties are more likely to have higher shares of remote workers in medium-small and small counties, though not in the larger county subsets. This is in part because agriculture is typically concentrated in more rural counties. Manufacturing employment on the other hand is significant and has a negative association with only the small county regime. Establishment size is only moderately significant at the 90 percent level in the medium-county regime and has a negative association. Collectively, this suggests that a county's industrial composition and structure plays only a moderate role in explaining concentrations of remote work, with the exception of the presence of information industry employment in all regimes and agricultural employment and manufacturing in smaller county regimes. Although limited data currently exists, employer-(remote) employee matched data might better identify whether remote workers are employed by regional information firms or whether they represent a local labor pool opportunity for local firms to connect with.

In terms of remote worker demographics, the greater the concentration of female remote workers in medium-large and small counties the lower the likely concentration of remote workers. The variable is not significant for large and medium-small counties. For social connections, the variable *Born in-state* is only significant (95 percent and above) for medium-small and small counties and has a negative association. This suggests a more limited role for place affinity for native populations in these types of places,

although this finding is not inconsistent with past research characterizing the rural brain drain phenomena.[34] *Earnings differentials* are significant and positively associated the share of remote workers in all four regimes, while unemployment is significant and negatively associated with remote worker concentrations in all by large counties.

4.4.3. Variations Across Census Regions

Finally, this paper explores the variation of remote work across Census regions.[35] Referring to Figure 4.2, there are clear macro patterns present in the concentration of remote workers and there are reasons why place based amenities and attributes may differ across Census regions just as they differ across counties of varying size.

I assessed OLS and spatial dependence models for each of the four major Census regions, including the Northeast (1), South (2), Midwest (3), and West (4). Spatial diagnostics of the four Census region OLS models indicated differences in the underlying spatial processes. LM and RLM statistics for the Northeast and Midwest regions indicated a spatial error process is at work, a spatial lag process in the South, and no spatial dependence for the West region (Global Moran's I and LM and RLM statistics were all insignificant). To properly account for the underlying spatial process, I specify a spatial error model for the Northeast and Midwest regions, a spatial lag for the South region, and an OLS model for the West.[36] Post-hoc models fits show an improvement in

[34] https://www.citylab.com/life/2019/03/mobile-stuck-us-geography-map-where-americans-moving/584083/
https://www.jec.senate.gov/public/index.cfm/republicans/analysis?ID=581865E8-F994-44C1-AD45-48644F31E624

[35] Census region definitions are shown in Figure A.4.1 in the Appendix C.

[36] Log likelihood ratio tests for the spatial error and spatial lag models for the West region were insignificant, providing confirmation that no added information or benefit of the spatial is provided over the OLS specification.

the spatial models relative to the OLS indicated by significant Likelihood Ratio Tests and improvements in the Log Likelihood and AIC measures. Diagnostics for all models raised no concerns for multicollinearity or heteroskedasticity. Table 4.5 reports the spatial model results for each region and also includes the OLS regressions for each region for comparative purposes.

There are several interesting observations from this set of regression models that suggests subtle differences as well as commonalities in the concentration of remote workers across broad regions of the US. Both recreation and cultural amenities are positively and significantly associated with higher shares of remote workers across all four Census regions. Recreational amenities have the largest effect in the Northeast, while cultural amenities have the largest effect in the West region. Topography (Hilly and Mountainous) has a relatively large effect and is significant and positive in the Northeast and West region, both home to attractive and large mountain ranges. *January temp* is significant only for the Midwest and South regions. As has been suggested in past studies, the South region is an attractive retirement destination (McGranan, 1999) and has a statistically significant association with the share of remote workers. In line with earlier model findings in this paper, recreational amenities are significant across all regions with the largest relative magnitude of association in the Northeast region, both home to a number of large urban city regions.

Agriculture is positive and significant in all regions, except for the West. However, agriculture has the largest impact in the Midwest. The coefficient for *Agriculture employment share* in the Midwest is not only very high relative to other regions but it also has the largest relative impact of all variables in the Midwest model.

Given the landscape character of the Midwest region and heavy concentration on agriculture, this is not surprising. A high employment concentration in the Information sector is only significant in the South. Establishment size and unemployment have a significant association in all but the Midwest regions.

Median age of remote workers has a different effect depending on the region. For both the Northeast and Midwest regions the variable has a negative statistically significant association with the concentration of remote workers, meaning that in these regions concentrations of remote workers are more likely to be younger. For the South and West regions, the direction of the association changes so that as the share of remote worker population increases, so does the median age.

The variable *Earnings differential* is significant in all regions but the Midwest. *Broadband uptake* is significant in all regions with the exception of the West. Whether a county is located in a large or small MSA or whether adjacent to an MSA has no real statistically significant association after accounting for spatial effects. The exception is in the West region where the share of remote workers decrease in counties that are non-adjacent to metropolitan areas.

Table 4.5: Regression results for Census Regions

	Northeast (1)		Midwest (2)		South (3)		West (4)
	OLS (1)	*Spatial error* (2)	*OLS* (3)	*Spatial error* (4)	*OLS* (5)	*Spatial lag* (6)	*OLS^* (7)
January temp	.073 (.064)	.037 (.076)	-.132*** (.041)	-.136*** (.050)	-.078*** (.027)	-.067*** (.026)	.024 (.061)
Hilly & mountain DV	.401*** (.096)	.274** (.111)	.010 (.085)	.032 (.091)	.060 (.056)	.038 (.054)	.322*** (.111)
Recreation DV	.468*** (.132)	.415*** (.116)	.347*** (.133)	.277** (.133)	.256*** (.095)	.273*** (.090)	.238** (.118)
Cultural amenities	.230*** (.064)	.193*** (.056)	.126*** (.038)	.103*** (.036)	.218*** (.027)	.192*** (.025)	.286*** (.057)
Born-in-State	-.090 (.059)	-.173*** (.061)	-.067* (.037)	-.068* (.039)	-.152*** (.030)	-.103*** (.030)	-.002 (.052)
Retirement DV	-.148 (.276)	-.019 (.239)	.106 (.143)	.010 (.134)	.211*** (.061)	.188*** (.058)	.068 (.106)
Broadband uptake	.255*** (.077)	.211*** (.074)	.261*** (.048)	.273*** (.047)	.144*** (.038)	.141*** (.036)	-.052 (.067)
Commute time	-.079 (.070)	-.096 (.068)	.194*** (.057)	.216*** (.058)	.091*** (.032)	.060** (.030)	.106* (.059)
Unemployment rate	-.370*** (.060)	-.340*** (.068)	-.033 (.044)	-.043 (.048)	-.139*** (.029)	-.103*** (.028)	-.169*** (.064)
Ag employ share	.278*** (.061)	.292*** (.058)	.487*** (.049)	.488*** (.048)	.099*** (.027)	.083*** (.026)	-.043 (.054)
Manufacturing employ share	-.035 (.054)	-.076 (.054)	-.102** (.045)	-.114** (.047)	-.076*** (.029)	-.066** (.028)	-.022 (.051)
Information employ share	.120 (.075)	.199*** (.074)	.111*** (.038)	.098*** (.036)	.120*** (.028)	.108*** (.027)	.191*** (.059)
Establishment size	-.059 (.064)	-.118** (.058)	.027 (.048)	.026 (.046)	-.039 (.029)	-.041 (.027)	-.249*** (.064)
Work home female share	-.006 (.045)	.023 (.039)	-.143*** (.036)	-.154*** (.033)	-.074*** (.025)	-.075*** (.023)	-.125*** (.048)
Work home earning differential	.161*** (.057)	.093* (.053)	.063* (.038)	.053 (.035)	.189*** (.025)	.186*** (.023)	.124** (.053)
Work home median age	-.176*** (.053)	-.156*** (.049)	-.175*** (.037)	-.181*** (.034)	.051** (.026)	.048* (.024)	.107* (.054)
Large MSA DV	-.147 (.162)	-.011 (.148)	.175 (.138)	.182 (.137)	.128 (.087)	.096 (.083)	.289 (.204)
Small MSA DV	-.200 (.128)	-.102 (.112)	.019 (.094)	.072 (.088)	.053 (.063)	.082 (.060)	.043 (.127)
Non-adjacent MSA DV	-.245 (.214)	-.311 (.198)	-.256** (.117)	-.194* (.117)	-.069 (.094)	-.022 (.090)	-.295** (.138)
Constant	-.240* (.123)	-.221* (.130)	-.048 (.068)	-.081 (.072)	-.098* (.051)	-.111** (.049)	-.327** (.141)
Observations	204	204	519	519	783	783	223
Log Likelihood	-167.74	-161.23	-557.89	-541.30	-728.52	-705.58	-201.04
Akaike Inf. Crit.	377.48	366.46	1157.79	1126.60	1499.04	1455.15	444.08
LR Test (df = 1)	-	13.024***	-	33.190***	-	45.894***	-
Wald Test (df = 1)	-	33.407***	-	42.210***	-	48.169***	-
$sigma^2$	-	0.27	-	0.458	-	0.349	-
R^2	0.70	-	0.48	-	0.61	-	0.64
Adjusted R^2	0.66	-	0.46	-	0.60	-	0.61
Residual Std. Error	.580 (df = 184)	-	.723 (df = 499)	-	.622 (df = 763)	-	.625 (df = 203)
F Statistic	22.099*** (df =	-	24.144*** (df =	-	63.403*** (df =	-	18.994*** (df =

Note: Sample includes counties with pop > 20K. All coeffiecients standardized for comparison of relative magnitude. Standard errors in (). ^ Spatial dependence was not exhibited in spatial doagnostics in the West Region. Therefore only the OLS results are reported here. Significance levels *p<0.10, **p<0.05, ***p<0.01.

4.5. Conclusions

Fundamental shifts are underway in the places and spaces where people work and how work is conducted. The locationally flexible nature of remote work suggests that places with preferred amenities and place-based attributes may be better positioned as an ideal location for remote workers. Empirical studies in this domain have been absent until now. This paper provides a first attempt to explore the geography of remote work and placed-based amenities in US regions. The findings of this paper suggest that regions with higher stocks of recreational, cultural, and natural amenities are more likely to have higher concentrations of remote workers. There are important distinctions and implications, however, for counties of varying sizes and the types of amenities that are most associated with concentrations of remote workers. Recreational amenities appear to have a more pronounced role in smaller regions, while cultural amenities have the largest effect in larger regions, though have an important impact across all size regions.

Although the role of creative class theory has long focused on the role of cultural amenities in large city regions, this paper lends supporting evidence to recent investigations of cultural amenities and rural places (McGranahan and Wojan, 2007; McGranahan, Wojan, and Lambert, 2010). Especially considering the occupational makeup of the remote workforce in high-skill jobs (Wallace, 2019a) that are often the target of creative class policies, it is unsurprising though interesting, that creative economy activities in smaller less densely populated regions are attractive to the remote worker population.

From a policy perspective this evidence may be appealing to policymakers in small and mid-sized city regions and rural areas that are attempting to incorporate remote

worker attraction into regional economic development strategies as an alternative to more traditional approaches and point of emphasis. The role of quality of life/place as a focus for economic development strategy and policy is not new (Salveson and Renski, 2003; Reilly and Renski, 2007; Kelly et al, 2017). However, the locus has typically been from the perspective of the firm or cultivating the region's industrial labor pool rather than from the targeting the individual worker in their own right. Municipalities, regions, and states spend billions of dollars each year on incentives to attract firms with the hopes of creating new jobs that will in turn catalyze demand for induced employment. For regions with limited financial resources, attractive firm externalities, and market power, shifting focus towards attracting footloose workers may prove a more viable and realistic development opportunity.

Often these arguments are made in tandem with broadband expansion in underserved areas. Broadband availability, a key enabling technology, has a strong association with the concentration of remote workers in this study. Although this finding does not untangle potential endogenous effects, future research may attempt to better unravel the relationship between the two using a comparative, experimental design at a more refined level of geographic detail. Furthermore, the extent to which implemented policies, including broadband, that target increasing the remote worker population, research can assist in evaluating their success or failure.

There are several limitations to this study that should be acknowledged. First, the cross-sectional nature of this study limits any claims to causality. While it is certainly the case that amenities play some role in explaining the geography of remote workers, I am careful to suggest whether or not amenities are a *causal* factor in the location or

migration decision of remote workers. Nor is this study able to consider the *decision to work remotely* and the interaction with a migration or location choice. The dependent variable in this study likely captures remote workers that migrated to the region, as well as residents that did not migrate but rather took up a remote employment arrangement. The latter could also have been a means to stay in place rather than relocate to a physical employment opportunity located elsewhere. Related to this, a second limitation is that this study is not able to consider a wide array of personal and household characteristics of individual remote workers and the relationships to regions of different characteristics and the extent to which they assist in explaining location and migration decisions of remote workers. Lastly, as discussed previously in this paper, measurement challenges pertaining to telework has been a consistent challenge for researchers and this study is not immune to concept operationalization. Most all of the limitations discussed above are in part related to the scant nature of consistent data and measurement of the remote worker concept.

Despite these limitations, the underlying contribution of this research is not altered. This paper provides an important first step in evaluating how the changing nature of work and workplace locations are playing out in space. As regional and local policies aimed at exploiting remote employment as a development strategy continue to emerge and evolve, it is important for scholars and policymakers alike to understand how placed-based assets, such as amenities and other attributes, can assist in shaping strategy. Future research should address the underlying *causal* relationships that exist between natural amenities and growth of the remote worker population. Incorporating personal and household level data will better evaluate preferences for different types of amenities and

regions, as well as assist in explaining how remote employment interacts with location decisions.

CHAPTER 5

CONCLUSIONS

5.1. Introduction

This dissertation is a compilation of three articles that investigate the emerging phenomenon of remote work. Despite the large literature on the related concepts of telework and telecommuting, remote work has received minimal attention in the academic literature. Much of the motivation behind this research stems from the fundamental occupational shifts underway in the types of jobs people do, the ways that people work, and the places and spaces where people work. Within this context, remote work and the locational flexibility of remote workers imply opportunities and challenges for places, regional economies, and labor markets, among other aspects of society.

Chapter 2 investigates the prevalence and growth of remote employment in US occupations using a shift-share analysis based on census microdata. The findings clearly show a marked increase in remote work employment particularly in salaried and wage employees suggesting that both workers and firms find utility in more flexible work arrangements. All but a few occupations experienced growth in remote employment since 2000, including middle skill jobs that have been vulnerable to automation, computerization, and outsourcing in recent decades. Overall, remote workers tend to have higher levels of formal education that align with occupational requirements, higher incomes, and age, and when remote workers migrate, they appear to move greater distances than their counterparts.

Chapter 3 uses a mixed-method approach based on surveys and interviews of remote workers in the Portland, Maine region to understand the role of remote work

arrangements in migration decisions of remote workers. I find that remote work enables greater locational flexibility when households consider a move, especially to locations that may offer fewer employment opportunities that match the skill sets and expertise of specialized knowledge workers. Remote workers are much more likely to decide on a region or place to locate and use remote work as a means to facilitate the move, especially when local labor market opportunities are lacking. In a vast majority of cases, remote work enables employment and occupational continuity in which workers maintain or access opportunities aligning with skill sets not available in the new location. While there is strong evidence of urban preferences and movements back to the city, findings suggest preferences for large, dense urban areas are not necessarily shared by all. Remote workers in this study reported preferences for natural amenities, proximity to family, and general place affinity. Remote workers also balance wage differentials relative to the local labor market, in which remote workers are able to draw wages from a high paying region relative to the new location, thus having the effect of increasing utility. Over time this may have the effect of eroding the urban wage premium.

Chapter 4 uses a cross-sectional design and spatial econometric models to explore the geography of remote work and the relationship of placed-based amenities in US counties. I find that regions with higher stocks of cultural and natural amenities are more likely to have higher concentrations of remote workers. However, there are important distinctions and implications for different sized regions and the types of amenities that are most associated with concentrations of remote workers in those counties. Although the role of cultural amenities has long focused on large city regions via the creative class theory, the evidence lends support to recent applications to rural places (McGranahan and

Wojan, 2007; McGranahan, Wojan, and Lambert, 2010). It is also noteworthy that recreational amenities which are typically characteristic of rural places, appear highly valued by remote worker populations as well.

Broadband enabling technology is also highly significant across all county sizes, while remote workers also appear to take advantage of regional wage differentials – higher shares of remote workers are found in counties with larger differences in the median wages of remote workers compared to the median wage of the county.

5.2. Informing Planning and Policy

Practitioners of planning, economic development, and policy may find the empirical evidence in this dissertation useful in developing strategies to attract remote workers, to support local firm competitiveness, and as a workforce strategy for local residents. In addition, tools for measuring remote workers proposed in Chapter 2 are useful for counting and profiling their local remote population as well as evaluating policy targeting remote work attraction and potential community impacts of remote workers.

5.2.1. Remote Worker Attraction

Planners in rural, small and mid-sized cities may target remote workers in large cities where prices are higher by highlighting the increased utility gains a remote worker could capture by relocating to the lower cost region while still drawing earnings remotely from the higher wage region. This might be especially true if there are wage differentials between local prices and prevailing wages derived from higher cost regions, and for regions able to capitalize on high levels of amenities and other quality of place qualities

attractive to remote worker households. Specifically, attraction strategies that leverage existing social connections to the planner's region can be designed. As an example, planners seeking to attract remote workers to Maine may target diaspora living in the Boston Metropolitan region, highlighting the relatively lower housing prices and appealing to emotional affinities for 'home'. Traditional print advertising and social media outreach through existing networks may be one component of this place marketing strategy. On the other hand, using remote work as a retention strategy may also be appealing for places struggling with out-migration and limited economic opportunities. Though this type of strategy may be more difficult to implement.

Planners and policymakers are cautioned, however, that they should not expect to lure remote workers simply because remote workers are more footloose. This is particularly the case if a significant wage differential exists as well as mismatched end skills of the worker and those that are in demand by regional organizations. The economic implications of remote workers with higher levels of income and educational attainment in rural areas, where wages are typically lower, are likely to be even more pronounced. Nor should these strategies be viewed as a replacement for, or independent of, more traditional economic development activities. Rather, planners should focus on the amenity assets in their region and embrace placemaking strategies to lure remote workers, but also to bolster traditional strategies of firm attraction.

The role of quality of life/place as a focus for economic development strategy and policy is not new (Salveson and Renski, 2003; Reilly and Renski, 2007; Kelly et al, 2017). However, the locus has typically been from the perspective of the firm or cultivating the region's industrial labor pool rather than from targeting the individual

worker in their own right. Municipalities, regions, and states spend billions of dollars each year on incentives to attract firms with the hopes of creating new jobs that will in turn catalyze demand for induced employment. For regions with limited financial resources, attractive firm externalities, or market power, shifting focus of economic development policy towards attracting footloose workers may prove a more viable and realistic development opportunity. Much like firms that sell products or services outside of a region, remote workers can be viewed as 'exporting services' and thus importing dollars into the local economy that, in turn, go through additional rounds of local spending supporting additional economic activity. From this perspective, attracting remote workers can have a positive impact on local economies through multiplier effects. The most logical role for planners and policymakers seeking to attract remote workers is to focus on making sure critical infrastructure is available, such as reliable broadband access that remote workers report as being essential for daily work activities. Likewise, building soft supporting infrastructure for remote work, including networking opportunities, public spaces to work, and branding as a remote work friendly place may also be important.

While their effectiveness has yet to be empirically evaluated, a number of policies and initiatives are being experimented with in order to attract and promote remote work opportunities. For example, Vermont recently passed legislation providing financial incentives in the form of tax breaks to remote workers who move to live and work in the US state of Vermont (VT Gen Assem. S. 94, Act 197; Matthew, 2018). Substate regions and municipalities in the U.S. are also experimenting with and explicitly incorporating remote work into economic and workforce development strategies, both to boost local

economic opportunities but also to attract people to live and work (Duluth, MN; Mead, CO).

Other implications of remote work for planners is the potential impact of remote worker populations on local housing markets. Remote workers drawing high wages from outside the home region with large differentials relative to local wages may inflate local prices. This issue has been raised in policy circles in some small city regions in which a growing concentration of remote workers from outside the region have located. Public officials must consider to what extent the location of remote workers receiving high wage differentials influence local prices, particularly related to housing markets and local wages. If local firms are to recruit remote workers to transition from a remote to local employment, they will need to compete with wage rates paid in a different region. In some cases, this may mean competing with prevailing wage rates in large metropolitan areas. However, empirical evidence on the impact of remote worker wage differentials on local prices is still absent.

5.2.2. Global Labor Pools for Local Firms

Another implication of remote work for economic development planners is the extent to which firms leverage flexible work arrangements to access high-skilled, specialized talent that may not exist in their home labor market. The attraction and retention of talent is cited as one of the most pressing challenges of human resource professionals and firms in the current economy and firms are looking at new, nontraditional solutions (Frank, Finnegan, & Taylor, 2004; Karoly & Panis, 2004). Given the demands of workers for more flexible work opportunities and talent needs of firms, it is reasonable to expect these arrangements to continue and grow. Furthermore, the range

of potential remote work occupations is not limited to one set of occupations or skill level. Rather firms may be able to access talent from afar for any number of jobs. Career advancement is a challenge for remote workers and many hold a preference for a local brick and mortar jobs based on evidence from Chapter 3. Economic developers and planners should focus on building networking opportunities that match remote workers and specialized skills with local firms.

5.2.3. Linking Local Labor with Remote Employment Opportunities

Lastly, planners and policymakers have expressed interest in remote work oriented around regional workforce development initiatives. In regions where jobs are lacking, perhaps because of industrial decline or large plant/employment closings, efforts may be able to link local incumbents with remote job opportunities elsewhere. There have been some successful efforts in this vein, such as the Telework USA initiative in Eastern Kentucky. However, it remains unclear the extent to which rural regions can leverage remote opportunities for displaced workers. Although skill levels and occupations that are amenable to remote work and have seen remote employment growth, there is likely significant differences in the skill sets of a workforce traditionally engaged in production or extraction-oriented jobs with even low skilled remote jobs that require some level of computer and digital skills. Skill mismatch and broadband accessibility are all critical barriers to linking with remote opportunities in these settings.

5.3. Directions for Future Research

This dissertation makes an incremental, yet significant scholarly contribution of new knowledge to the fields of planning, regional studies, and economic development. It is the first body of research, that I am aware of, that focuses on remote workers, remote occupational employment and skill sets, and the relationship of remote work concentration to places. As such, the papers of this dissertation raise a number of questions to guide future research.

First, while Chapter 3 considers the role of remote work in migration decisions for one particular case (Maine) and Chapter 4 investigates the place-based amenities associated with higher concentrations of remote workers, future research should build on these findings to investigate the causal effects of place-based factors on the migration of remote workers across a large sample of regions or places. Incorporating personal and household characteristics will also lead to better understanding of whether certain workers are attracted to certain types of places or amenities. Within this framework, specific questions that emerge from the papers in this dissertation can be tested. For instance, do remote workers have different geographic migration patterns than non-remote workers and how might personal and household characteristics influence these patterns? And to what extent have migration patterns of remote workers changed over time? What role do social and community ties play in driving migration decisions? Given that remote workers command relatively higher wages and higher household incomes, to what extent do regional wage differentials factor into migration decisions? How does the concentration of remote workers influence local prices and housing markets given the differentials that might exist for wage and local prices? Are there differences between

rural and urban remote workers in terms of personal characteristics, job and skill type, or motivations for relocating? To what extent do remote workers prefer rural areas compared to urban and what does this say for strategies that are targeting the recruitment of remote workers by rural areas?

Second, with respect to linking local residents with remote employment opportunities there are several lines of research to follow. For example, what are the prospects and types of occupations that displaced rural workers may qualify for under programs to link incumbent workers with remote jobs elsewhere? To what extent is remote work a catalyst or stepping stone to entrepreneurship and is there a relationship between the two? Are there differences between rural and urban regions? A key question that has not sufficiently been answered is whether broadband access and quality have a material impact on the growth of remote job prospects for a region? Analysis of broadband uptake modelled in Chapter 4 proved inconclusive whether broadband plays a necessary role.

Third, more primary large-scale data collection would help our understanding of how, what, and where remote workers actually engage in their work. The basis for measuring remote workers in Chapter 2 and Chapter 4 rests on journey to work data reported in the Census. The remote worker sample is thus limited to people reporting working at home and may not capture remote workers that work outside the home, such as coffee shops, libraries, or co-working spaces. Variables of remote workers are highly dependent on the responses of interviewees and very likely limits the true number of remote workers. Primary data collection may be better able to learn the extent to which remote workers use spaces other than the home to complete work.

Lastly, there is a very important and wide open line of inquiry to be addressed pertaining to the use of remote work by firms and organizations. Although the papers in this dissertation only tangentially touched on this by way of growing remote occupations and skills in Chapter 2, it is clear that understanding the motivations of firms to use remote work as a means to access talent is of critical importance. Several research questions follow: What is the prevalence of firms using remote workers? How does a firm's propensity to use remote employees differ across industry and metropolitan area and firm size? What types of occupations do firms use remote workers for? Does it differ between occupations that require more ubiquitous skills versus more specialized or more routine tasks versus non-routine? Are firms in smaller, less diverse or tight labor markets more prone to allow remote work or seek remote work solutions? How do firms use remote work to grow and expand? To what extent do remote work opportunities influence the location decisions of technology firms and to what extent does remote work factor into expansion and growth decisions? How do firms use flexible workers to address labor market shortages of skilled workers?

The papers comprising this dissertation provide a critical first step in evaluating how the changing nature of work and workplace locations are playing out in space. Communities, local and regional economies, and labor markets will increasingly face challenges and opportunities and it will be important to move our understanding of the issues forward.

APPENDIX A

CHAPTER 2 SUPPLEMENTAL DATA TABLES

Table A.2.1: List of U.S. Remote Occupations, Employment, Growth, and Characteristics, 2000-16

Code	Occupation	Remote Employ-ment	Emp % Share 2016 Total Occ.	Emp % Share 2016 Total Remote	Growth 2000-2016 Employ-ment	Growth 2000-2016 Share Occ-upation	Share % Wage & Salary	Occ Class	Job Zone
20	General & operations managers	39,875	4.6%	1.0%	117.0%	118.0%	77.4%	BOPS	4
100	Administrative services managers	5,580	3.8%	0.1%	272.0%	126.0%	94.4%	BOPS	3
110	Computer & information systems managers	64,861	10.8%	1.7%	758.0%	342.0%	91.6%	KNOW	4
120	Financial managers	51,639	4.6%	1.3%	184.0%	127.0%	81.2%	BOPS	5
130	Human Resources Managers	23,459	4.8%	0.6%	158.0%	124.0%	87.1%	BOPS	4
140	Industrial production managers	7,279	3.1%	0.2%	116.0%	171.0%	83.6%	BOPS	4
150	Purchasing managers	7,572	3.9%	0.2%	221.0%	209.0%	91.6%	BOPS	4
160	Transportation, storage, & distribution managers	5,844	2.5%	0.2%	100.0%	92.0%	72.4%	BOPS	4
230	Education administrators	28,918	3.4%	0.7%	199.0%	127.0%	67.2%	KNOW	5
300	Architectural & engineering managers	4,573	3.0%	0.1%	278.0%	288.0%	94.0%	KNOW	5
350	Medical & health services managers	25,152	3.8%	0.6%	404.0%	193.0%	81.3%	HEPS	5
360	Natural sciences managers	1,920	9.3%	0.0%	175.0%	147.0%	87.0%	KNOW	5
420	Social & community service managers	24,790	7.0%	0.6%	301.0%	154.0%	83.8%	HEPS	4
430	Misc. managers	422,843	10.1%	10.9%	447.0%	146.0%	51.9%	BOPS	3
500	Agents & business managers of artists, performers, & athletes	8,603	19.7%	0.2%	100.0%	35.0%	37.1%	CREATE	4
510	Buyers & purchasing agents, farm products	251	3.0%	0.0%	-70.0%	-58.0%	82.9%	BOPS	4
520	Wholesale & retail buyers, except farm products	9,352	5.0%	0.2%	82.0%	95.0%	44.0%	BOPS	3
530	Purchasing agents, except wholesale, retail, & farm products	7,970	3.0%	0.2%	185.0%	158.0%	74.9%	BOPS	4
540	Claims adjusters, appraisers, examiners, & investigators	45,022	16.1%	1.2%	254.0%	231.0%	90.2%	BOPS	4
560	Compliance officers	12,889	5.4%	0.3%	962.0%	303.0%	94.5%	BOPS	4
600	Cost estimators	7,800	5.9%	0.2%	77.0%	34.0%	68.4%	BOPS	4
620	Human Resources, Training, & Labor Relations Specialists	68,452	7.3%	1.8%	172.0%	137.0%	77.2%	BOPS	4
700	Logisticians	3,283	2.4%	0.1%	994.0%	224.0%	79.5%	BOPS	4
710	Management analysts	207,889	26.1%	5.3%	96.0%	26.0%	41.1%	BOPS	5
720	Meeting & Convention Planners	20,536	10.2%	0.5%	948.0%	47.0%	54.1%	BOPS	4
730	Other Business Operations Specialists	66,523	12.3%	1.7%	1161.0%	382.0%	61.6%	BOPS	4
800	Accountants & auditors	116,895	6.4%	3.0%	55.0%	34.0%	56.4%	BOPS	4
820	Budget analysts	841	1.8%	0.0%	198.0%	187.0%	96.0%	BOPS	4
830	Credit analysts	1,387	5.2%	0.0%	434.0%	436.0%	97.5%	BOPS	4
840	Financial analysts	13,977	7.1%	0.4%	27.0%	-62.0%	66.3%	BOPS	4
850	Personal financial advisors	31,438	8.7%	0.8%	31.0%	-16.0%	49.5%	BOPS	4
860	Insurance underwriters	11,575	11.0%	0.3%	939.0%	653.0%	93.8%	BOPS	4
900	Financial examiners	646	4.3%	0.0%	493.0%	336.0%	92.0%	BOPS	4
910	Credit counselors & loan officers	17,799	5.8%	0.5%	177.0%	162.0%	89.2%	BOPS	4
930	Tax examiners & collectors, & revenue agents	2,423	5.0%	0.1%	8.0%	56.0%	97.3%	BOPS	3
940	Tax preparers	9,687	9.7%	0.2%	-25.0%	-24.0%	27.6%	BOPS	3
950	Financial specialists	3,197	6.2%	0.1%	227.0%	157.0%	55.4%	BOPS	5
1000	Computer Scientists & Systems Analysts	166,755	11.5%	4.3%	214.0%	92.0%	72.5%	KNOW	5
1010	Computer programmers	58,752	14.6%	1.5%	86.0%	168.0%	78.1%	KNOW	4
1020	Software developers, applications & systems software	129,810	11.0%	3.3%	403.0%	179.0%	81.3%	KNOW	4
1050	Computer support specialists	72,052	11.9%	1.9%	843.0%	410.0%	84.9%	AD&SUP	4
1060	Database administrators	12,158	11.4%	0.3%	413.0%	243.0%	92.7%	KNOW	4
1100	Network & computer systems administrators	14,954	7.2%	0.4%	525.0%	431.0%	87.6%	KNOW	4
1200	Actuaries	3,101	12.3%	0.1%	283.0%	181.0%	93.0%	BOPS	4

Code	Occupation	Remote Employ-ment	Emp % Share 2016 Total Occ.	Emp % Share 2016 Total Remote	Growth 2000-2016 Employ-ment	Growth 2000-2016 Share Occ-upation	Share % Wage & Salary	Occ Class	Job Zone
1220	Operations research analysts	7,996	6.1%	0.2%	109.0%	59.0%	88.7%	KNOW	5
1240	Misc. mathematical science occupations, inc. mathematicians & statisticians	5,401	9.2%	0.1%	491.0%	171.0%	84.1%	KNOW	5
1300	Architects, except naval	24,263	13.3%	0.6%	33.0%	34.0%	29.5%	KNOW	4
1310	Surveyors, cartographers, & photogrammetrists	2,290	6.7%	0.1%	60.0%	53.0%	49.4%	KNOW	4
1320	Aerospace engineers	3,730	3.1%	0.1%	218.0%	173.0%	79.9%	KNOW	4
1350	Chemical engineers	1,495	2.5%	0.0%	121.0%	120.0%	94.1%	KNOW	4
1360	Civil engineers	17,860	5.4%	0.5%	97.0%	54.0%	44.8%	KNOW	4
1400	Computer hardware engineers	4,217	8.3%	0.1%	47.0%	68.0%	75.0%	KNOW	4
1410	Electrical & electronics engineers	9,503	4.9%	0.2%	46.0%	120.0%	77.7%	KNOW	4
1420	Environmental engineers	1,544	5.4%	0.0%	157.0%	193.0%	78.3%	KNOW	5
1430	Industrial engineers, inc. health & safety	5,756	3.0%	0.1%	249.0%	224.0%	95.4%	KNOW	5
1440	Marine engineers & naval architects	176	1.5%	0.0%	-35.0%	-41.0%	48.3%	KNOW	4
1450	Materials engineers	733	2.3%	0.0%	159.0%	166.0%	93.0%	KNOW	4
1460	Mechanical engineers	8,529	3.4%	0.2%	95.0%	97.0%	86.2%	KNOW	4
1520	Petroleum, mining & geological engineers, inc. mining safety engineers	1,567	4.4%	0.0%	98.0%	16.0%	62.3%	KNOW	4
1530	Misc. engineers, inc. nuclear engineers	29,359	5.7%	0.8%	153.0%	56.0%	72.0%	KNOW	4
1540	Drafters	10,013	6.9%	0.3%	8.0%	37.0%	37.1%	CREATE	3
1550	Engineering technicians, except drafters	4,889	1.5%	0.1%	73.0%	103.0%	86.4%	KNOW	3
1560	Surveying & mapping technicians	2,011	3.5%	0.1%	68.0%	85.0%	54.4%	KNOW	3
1600	Agricultural & food scientists	1,387	5.5%	0.0%	18.0%	21.0%	86.5%	KNOW	5
1610	Biological scientists	3,217	4.3%	0.1%	84.0%	88.0%	85.3%	KNOW	5
1640	Conservation scientists & foresters	629	3.1%	0.0%	0.0%	29.0%	24.2%	KNOW	4
1650	Medical scientists, & life scientists	7,818	5.8%	0.2%	451.0%	215.0%	87.8%	KNOW	5
1700	Astronomers & physicists	796	6.9%	0.0%	101.0%	244.0%	47.5%	KNOW	5
1710	Atmospheric & space scientists	617	6.2%	0.0%	350.0%	348.0%	100.0%	KNOW	4
1720	Chemists & materials scientists	2,681	3.4%	0.1%	154.0%	206.0%	79.3%	KNOW	5
1740	Environmental scientists & geoscientists	5,482	7.8%	0.1%	38.0%	56.0%	66.8%	KNOW	4
1760	Physical scientists	9,830	4.4%	0.3%	136.0%	42.0%	73.6%	KNOW	5
1800	Economists	1,394	5.6%	0.0%	-87.0%	-44.0%	68.9%	KNOW	5
1830	Sociologists	813	3.3%	0.0%	24.0%	11.0%	35.9%	KNOW	5
1840	Urban & regional planners	4,255	12.6%	0.1%	79.0%	81.0%	58.6%	KNOW	5
1900	Agricultural & food science technicians	476	1.6%	0.0%	52.0%	16.0%	74.6%	KNOW	3
1960	Other Life, Physical, & Social Science Technicians	5,338	3.6%	0.1%	129.0%	58.0%	59.0%	KNOW	4
2010	Social workers	32,222	3.0%	0.8%	281.0%	106.0%	84.7%	HEPS	5
2020	Misc. Community & Social Service Specialists	4,058	4.9%	0.1%	1.0%	179.0%	83.0%	HEPS	4
2100	Lawyers, & judges, magistrates, & other judicial workers	80,762	7.2%	2.1%	122.0%	81.0%	37.4%	HEPS	5
2140	Paralegals & legal assistants	13,740	3.8%	0.4%	205.0%	110.0%	73.7%	HEPS	3
2150	Misc. legal support workers	16,691	10.6%	0.4%	138.0%	187.0%	56.7%	HEPS	3
2200	Postsecondary teachers	64,283	4.7%	1.7%	361.0%	249.0%	93.1%	KNOW	5
2340	Other teachers & instructors	78,964	12.2%	2.0%	37.0%	-11.0%	32.5%	HEPS	4
2400	Archivists, curators, & museum technicians	2,352	5.0%	0.1%	185.0%	89.0%	65.3%	KNOW	5
2550	Other education, training, & library workers	10,765	10.0%	0.3%	243.0%	63.0%	62.7%	KNOW	5
2600	Artists & related workers	57,757	30.6%	1.5%	-14.0%	-7.0%	9.3%	CREATE	4
2630	Designers	131,511	16.2%	3.4%	67.0%	31.0%	25.4%	CREATE	4
2800	Announcers	3,318	7.4%	0.1%	104.0%	75.0%	22.6%	CREATE	3
2810	News analysts, reporters & correspondents	51,772	22.1%	1.3%	100.0%	100.0%	42.7%	CREATE	4
2825	Public relations specialists	11,774	9.8%	0.3%	50.0%	52.0%	47.0%	BOPS	4
2840	Technical writers	11,091	18.8%	0.3%	107.0%	133.0%	73.3%	CREATE	4
2850	Writers & authors	85,051	40.5%	2.2%	35.0%	-8.0%	23.1%	CREATE	4

Code	Occupation	Remote Employ-ment	Emp % Share 2016 Total Occ.	Emp % Share 2016 Total Remote	Growth 2000-2016 Employ-ment	Growth 2000-2016 Share Occ-upation	Share % Wage & Salary	Occ Class	Job Zone
2860	Misc. media & communication workers	13,003	13.6%	0.3%	152.0%	31.0%	32.8%	KNOW	4
2900	Broadcast & sound engineering technicians & radio operators, & media & communication equipment workers	8,450	9.4%	0.2%	205.0%	155.0%	30.9%	CREATE	3
2910	Photographers	37,770	26.8%	1.0%	139.0%	64.0%	6.4%	CREATE	3
2920	Television, video, & motion picture camera operators & editors	7,446	14.9%	0.2%	303.0%	97.0%	17.6%	CREATE	3
3030	Dietitians & nutritionists	3,971	3.9%	0.1%	88.0%	31.0%	37.2%	HEPS	5
3130	Registered nurses	71,894	2.3%	1.8%	338.0%	194.0%	92.9%	HEPS	4
3200	Radiation therapists	129	1.0%	0.0%	NA	NA	100.0%	HEPS	3
3260	Health diagnosing & treating practitioners	3,453	11.0%	0.1%	149.0%	-25.0%	9.6%	KNOW	5
3300	Clinical laboratory technologists & technicians	3,726	1.3%	0.1%	163.0%	147.0%	93.0%	HEPS	4
3320	Diagnostic related technologists & technicians	3,988	1.2%	0.1%	309.0%	157.0%	90.5%	KNOW	3
3410	Health practitioner support technologists & technicians	3,516	0.7%	0.1%	239.0%	46.0%	100.0%	HEPS	3
3510	Medical records & health information technicians	27,670	16.5%	0.7%	2439.0%	1133.0%	96.2%	HEPS	3
3530	Misc. health technologists & technicians	3,648	3.1%	0.1%	139.0%	49.0%	74.4%	HEPS	3
3650	Medical Assistants & Other Healthcare Support Occupations	25,035	3.4%	0.6%	-21.0%	-53.0%	72.3%	HEPS	3
3820	Detectives & criminal investigators	9,953	1.2%	0.3%	274.0%	214.0%	97.2%	HEPS	3
3910	Private detectives & investigators	9,854	12.9%	0.3%	138.0%	79.0%	66.6%	HEPS	3
4800	Advertising sales agents	22,728	13.9%	0.6%	43.0%	61.0%	62.7%	BOPS	3
4810	Insurance sales agents	54,712	10.6%	1.4%	85.0%	68.0%	52.9%	BOPS	4
4820	Securities, commodities, & financial services sales agents	26,865	12.6%	0.7%	-12.0%	39.0%	51.1%	BOPS	4
4830	Travel agents	21,108	31.7%	0.5%	101.0%	287.0%	54.7%	BOPS	3
4840	Sales representatives, services	91,070	15.5%	2.3%	108.0%	85.0%	77.6%	BOPS	4
4850	Sales representatives, wholesale & manufacturing	178,042	13.8%	4.6%	58.0%	57.0%	76.7%	BOPS	4
4930	Sales engineers	11,020	29.7%	0.3%	280.0%	225.0%	96.3%	BOPS	4
4940	Telemarketers	4,952	10.3%	0.1%	-49.0%	26.0%	67.0%	AD&SUP	2
4965	Sales & Related Workers	22,695	10.1%	0.6%	75.0%	46.0%	76.2%	BOPS	3
5000	First-line supervisors of office & administrative support workers	42,569	3.3%	1.1%	59.0%	90.0%	80.2%	AD&SUP	3
5010	Switchboard operators, inc. answering service	948	4.1%	0.0%	-20.0%	109.0%	100.0%	AD&SUP	2
5020	Telephone operators	1,644	5.5%	0.0%	138.0%	369.0%	63.8%	AD&SUP	2
5030	Communications Equipment Operators	72	0.7%	0.0%	1.0%	20.0%	100.0%	KNOW	2
5100	Bill & account collectors	6,516	5.0%	0.2%	120.0%	181.0%	79.7%	AD&SUP	2
5110	Billing & posting clerks	28,538	6.1%	0.7%	168.0%	88.0%	75.4%	AD&SUP	2
5120	Bookkeeping, accounting, & auditing clerks	102,950	9.2%	2.6%	-7.0%	26.0%	51.2%	AD&SUP	3
5140	Payroll & timekeeping clerks	6,127	4.1%	0.2%	31.0%	64.0%	89.2%	AD&SUP	2
5150	Procurement clerks	1,381	4.8%	0.0%	321.0%	415.0%	83.1%	AD&SUP	3
5165	Financial Clerks	6,053	5.4%	0.2%	NA	NA	71.0%	AD&SUP	2
5200	Brokerage clerks	260	4.1%	0.0%	-8.0%	17.0%	100.0%	AD&SUP	3
5230	Credit authorizers, checkers, & clerks	1,386	4.7%	0.0%	131.0%	241.0%	100.0%	AD&SUP	3
5240	Customer service representatives	111,292	5.3%	2.9%	413.0%	262.0%	89.6%	AD&SUP	2
5250	Eligibility interviewers, government programs	2,701	3.3%	0.1%	800.0%	555.0%	100.0%	AD&SUP	3
5260	File clerks	7,416	4.1%	0.2%	45.0%	70.0%	74.6%	AD&SUP	2

Code	Occupation	Remote Employ-ment	Emp % Share 2016 Total Occ.	Emp % Share 2016 Total Remote	Growth 2000-2016 Employ-ment	Growth 2000-2016 Share Occ-upation	Share % Wage & Salary	Occ Class	Job Zone
5310	Interviewers, except eligibility & loan	7,412	6.2%	0.2%	62.0%	114.0%	89.3%	AD&SUP	2
5320	Library assistants, clerical	970	1.2%	0.0%	112.0%	182.0%	93.0%	AD&SUP	2
5330	Loan interviewers & clerks	6,822	5.9%	0.2%	248.0%	194.0%	86.5%	AD&SUP	3
5340	New accounts clerks	278	2.4%	0.0%	348.0%	379.0%	100.0%	AD&SUP	2
5350	Correspondence clerks & order clerks	12,483	11.0%	0.3%	179.0%	228.0%	40.9%	AD&SUP	2
5360	Human resources assistants, except payroll & timekeeping	1,057	2.3%	0.0%	101.0%	106.0%	91.9%	AD&SUP	3
5410	Reservation & transportation ticket agents & travel clerks	13,415	11.6%	0.3%	278.0%	391.0%	88.9%	AD&SUP	2
5420	Information & Record Clerks	9,671	9.7%	0.2%	492.0%	313.0%	93.4%	AD&SUP	2
5500	Cargo & freight agents	678	3.3%	0.0%	361.0%	292.0%	23.5%	AD&SUP	2
5520	Dispatchers	10,850	4.2%	0.3%	150.0%	106.0%	61.0%	AD&SUP	2
5800	Computer operators	4,599	5.5%	0.1%	-19.0%	113.0%	71.0%	KNOW	3
5810	Data entry keyers	22,062	7.8%	0.6%	57.0%	146.0%	85.0%	AD&SUP	2
5820	Word processors & typists	20,470	7.7%	0.5%	3.0%	-43.0%	63.0%	CREATE	2
5840	Insurance claims & policy processing clerks	34,594	9.9%	0.9%	845.0%	400.0%	95.8%	AD&SUP	3
5860	Office clerks, general	43,683	4.0%	1.1%	45.0%	44.0%	71.1%	AD&SUP	2
5910	Proofreaders & copy markers	3,334	29.8%	0.1%	45.0%	143.0%	29.6%	CREATE	4
5920	Statistical assistants	1,016	6.9%	0.0%	0.0%	85.0%	100.0%	KNOW	4
5940	Misc. office & administrative support workers, inc. desktop publishers	26,549	5.0%	0.7%	89.0%	61.0%	74.5%	AD&SUP	3

Source: Decennial Census (2000) and ACS 1 yr. est; BLS O*Net; author's calculations

Table A.2.2: Top Remote Work Intensive U.S. Occupations by Worker Class, 2016

Occupation	All Self-Employed Employment	Remote Share
Proofreaders and copy markers	2,965	79.2%
Misc. mathematical science, including mathematicians and statisticians	1,150	74.7%
Conservation scientists and foresters	1,770	75.8%
Writers and authors	92,880	70.4%
Medical records and health information technicians	1,536	68.4%
Correspondence clerks and order clerks	11,071	66.6%
Urban and regional planners	2,757	63.9%
Technical writers	4,656	63.7%
Medical scientists, & life scientists, other	1,503	63.7%
News analysts, reporters & correspondents	46,710	63.6%
All self-employed employment	4,147,731	34.2%

Occupation	All Wage and Salary Employment	Remote Share
Sales engineers	35,545	29.9%
Travel agents	49,241	23.4%
Writers and authors	117,380	16.7%
Medical records and health information technicians	166,548	16.0%
Management analysts	553,054	15.5%
Claims adjusters, appraisers, examiners, and investigators	269,115	15.1%
Technical writers	54,211	15.0%
Sales representatives, services, all other	531,466	13.3%
Computer programmers	377,366	12.2%
Proofreaders and copy markers	8,226	12.0%
All wage and salary employment	46,290,580	5.3%

Source: Decennial Census (2000) and ACS 1 yr. est; BLS O*Net; author's calculations.

APPENDIX B

CHAPTER 3 SURVEY INSTRUMENT AND INTERVIEW PROTOCOL

The Remote Work Project: A Survey of People That Work in Place

The Center for Business and Economic Research at the University of Southern Maine is conducting the first-ever survey of remote workers to better understand the prevalence of remote work and why people work remotely. One specific area of interest is how remote work connects to place or geographic location.

The survey should take you no more than 5 minutes to complete. Your participation in this survey is voluntary, and all individual responses will remain confidential and be reported in aggregate. To learn more about this project, please contact MCBER or Ryan Wallace at 207-780-5859, mcber@maine.edu. Thank you for your participation, and please encourage your remote worker colleagues to participate in the survey as well.

In continuing with this survey, you certify that you are at least 18 years of age.

Q1 Remote workers are also commonly referred to as mobile, distributed, or virtual workers. These are people who complete work tasks away from a centralized office location with all or a majority of their time. Remote workers are able to choose where they live and work and are not necessarily restricted to a particular geographic location relative to their employer or clientele. In general, do you agree with this definition?

[ ]Yes
[ ]No

Q2 During an average month, how often does your job require you to commute to a physical centralized office location as part of your standard work activities?

[ ]Never
[ ]1-2 times
[ ]3-5 times
[ ]6-10 times
[ ]Greater than 10 times per month

Q3 When you commute to a central office, what type of transportation do you take most often?

[ ]Air transport

[ ]Bus

[ ]Personal vehicle

[ ]Train

Other:

[_____
_____]

Q4 What class of worker best identifies your current employment arrangement?

[ ]Employee (wages reported on a W-2)

[ ]Independent contractor / Freelancer / Contingent / 1099 /
Temporary / Sole-proprietor

[ ]Business owner

Q5 During the course of an average week, what percentage of time do you estimate you work at home?

[ ]0-10

[ ]10-20

[ ]20-30

[ ]30-40

[ ]40-50

[ ]50-60

[ ]60-70

[ ]70-80

[ ]80-90

[ ]90-100

Q6 During the course of an average week, what percentage of time do you work at cafes or in public spaces, such as a library?

[ ]0-10

[ ]10-20

[ ]20-30

[ ]30-40

[ ]40-50

[ ]50-60

[ ]60-70

[ ]70-80
[ ]80-90
[ ]90-100

Q7 Do you rent commercial office space, such as co-working or other physical space?
[ ]Yes
[ ]No

Q8 Approximately, what percentage of time does your work require you to use information and communication technologies, such as a computer, an internet connection, a telephone, or a related device?
[ ]0 to 20%
[ ]20% to 40%
[ ]40% to 60%
[ ]60% to 80%
[ ]80 to 100%

Q9 What is the zip code of your current primary residence? [_____]

Q10 Have you always lived in your current state?
[ ]Yes
[ ]No

Q11 In what year did you (re)locate to your current state?
[____]

Q12 What was your previous location's zip code (or state initials)?
[_____]

Q13 Did you work remotely in this location?
[ ]Yes
[ ]No

Q14 Please rank the importance of the following factors in your decision to live in your current geographic location, assuming you already have access to necessary infrastructure to your job,

including transportation and communication access (1 = most important, 5 = not a factor).

	1 - Most important	2	3	4	5 - Not a factor
Partner/spouse took job here	[ ]	[ ]	[ ]	[ ]	[ ]
Social connections (family and/or friends)	[ ]	[ ]	[ ]	[ ]	[ ]
Raising a family (schools, safety, location, etc.)	[ ]	[ ]	[ ]	[ ]	[ ]
Relative cost of living	[ ]	[ ]	[ ]	[ ]	[ ]
Cultural and social amenities	[ ]	[ ]	[ ]	[ ]	[ ]
Outdoor and other natural amenities	[ ]	[ ]	[ ]	[ ]	[ ]
Overall quality of life	[ ]	[ ]	[ ]	[ ]	[ ]

Other:

Q15 Please indicate any connections that you and your partner/spouse had to your current geographic location (if applicable).

	Me	Partner/Spouse	Both	Neither
Born in state of current residence	[ ]	[ ]	[ ]	[ ]
Attended grade school	[ ]	[ ]	[ ]	[ ]
Attended college or postsecondary ed	[ ]	[ ]	[ ]	[ ]
Attended camp and/or vacation	[ ]	[ ]	[ ]	[ ]
Have or had family residing nearby	[ ]	[ ]	[ ]	[ ]

Other:

Q16 What broad category best describes the industry you work in?

[ ]Information and Computer Related
[ ]Professional, Scientific, and Technical Services
[ ]Finance and Insurance
[ ]Educational and Health Care Services
[ ]Health Care and Social Assistance
[ ]Tourism, Arts, Entertainment, and Recreation
[ ]Public Administration / Government
[ ]Real Estate and Rental and Leasing
[ ]Natural Resource Based
[ ]Manufacturing, Transportation, and Warehousing
[ ]Wholesale or Retail Trade

Q17 What broad category best describes the type of work you do?

[ ]Computer, Mathematical, or Information Related
[ ]Architecture and Engineering

[ ]Business and Financial Operations

[ ]Legal

[ ]Management

[ ]Sales and Related

[ ]Office and Administrative Support

[ ]Arts, Design, Entertainment, Sports, and Media

[ ]Education, Training, and Library

[ ]Healthcare Practitioners and Technical

[ ]Life, Physical, or Social Science

Other:

Q18 In what year were you born?

[____]

Q19 Do you identify as:

[ ]Female

[ ]Male

[ ]Prefer not to answer

Q20 What best describes your highest level of education completed?

[ ]Less than high school

[ ]High school or equivalent

[ ]Some college, no degree

[ ]Associate's degree to similar

[ ]Bachelor's degree or similar

[ ]Master's or professional degree

[ ]Doctorate or advanced degree

Q21 What range best describes your annual income last year?

[ ]Below $25,000

[ ]$25,001 to $50,000 [

]$50,001 to $75,000 [

]$75,001 to $100,000

[ ]$100,001 to $125,000

[ ]$125,001 to $150,000

[ ]$151, 000 or greater

[ ]Prefer not to answer

Q22 Please rank the importance of the following to your current work arrangement on a scale of 1 to 5 (1 = most important, 5 = not a factor).

Broadband (internet) speed and accessibility [ ] [ ] [ ] [ ]

[ ] Local networking opportunities [ ] [ ] [ ] [ ] [ ]

Access to transport facilities (air, rail, etc.) [ ] [ ] [ ] [ ]

[ ] Availability of co-working space [ ] [ ] [ ] [ ] [ ]

Prevalence of other remote workers [ ] [ ] [ ] [ ]

[ ] Support from employer [ ] [ ] [ ] [ ] [ ]

Quality of life of location [ ] [ ] [ ] [ ] [ ]

Workplace flexibility (schedule, location, etc.) [ ] [ ] [ ] [ ]

[ ] Education and training [ ] [ ] [ ] [ ] [ ]

Q23 Please offer any additional comments below that you feel should be considered.

Thank you very much for your participation. Please forward this survey link to any colleagues or other networks that may reach remote workers.If you would like more information or to be kept in the loop regarding news on this study or other remote worker happenings, please enter your email address below and visit one of our partner organization websites: www.workinplace.org, www.liveworkportland.org, and www.mainestartupandcreateweek.com.

:SURVEY:=Survey of Remote Workers

:FORMAT:=EMAIL

Remote Worker Semi-Structured Interview Protocol

[Record] With your permission, I would like to audio record our conversation to refer to afterwards. Upon completion of this research, the recordings will be erased. Do you agree to allow our conversation to be recorded? Thank you.

[Continue recording during interview or stop, per request of subject]

Informed Consent

This research project titled "The location and migration decisions of remote workers" is attempting to understand how remote jobs emerge and to understand how the option to work remotely influences a person's decision to move or locate in a particular place. Your participation in this research study is completely voluntary and you may stop at any time. This interview should take no more than 1 hour to complete. Data collected from you during this interview will be kept confidential and anonymously - no personally identifiable information will be stored with your responses. All data collected through this research project (approximately 20 subjects) will be reported in aggregate and is intended to be published in an academic journal. We believe there are no known risks associated with this research study; however, a possible inconvenience may be the time it takes to complete the study. If you have questions or concerns about this research, or to receive information on the study findings you may contact Ryan Wallace rdwallac@larp.umass.edu, 617-233-2010 or Dr. Henry Renski hrenski@umass.edu, 413-545-6638. If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at (413) 545-3428 or humansubjects@ora.umass.edu. A copy of this information and informed consent statement will be provided to you electronically.

[Begin questions]

Questions

1. Tell me about your current job/occupation.
    a. How long?
    b. W-2, independent contractor, or other self-employed?
    c. Type of job and what it entails.
2. Tell me about your current organization that you work remotely for.
    a. Public, private, government?
    b. Size and central office locations (city and state)
    c. What industry do you work in and what types of customers do you serve?
    d. Can you tell me about your organization's remote work policies?
    e. To what extent or how frequent are you expected to to go a central office location for things like company/organizational meetings, client visits, etc.?
3. Tell me a bit about previous jobs/occupations
    a. Were previous jobs remote?

    b. Same organization?
4. Tell me about how you landed in a remote work situation.
    a. How did it emerge?
    b. What drove your decision to work remotely?
    c. Benefits? (flexibility, etc.)
    d. Challenges? (career advancement, solitary, other)
    e. Can you tell me about what you expect in the future in terms of your situation of remote working?
        i. Do you expect to continue?
        ii. What would change your mind?
5. Can you tell me more about how you ended up in the place you live?
    a. What factors / reasons led to you moving there?
        i. Family?
        ii. Partner job?
        iii. Quality of life?
        iv. Cost of living?
        v. Other?
        vi. Can you elaborate on these things? [Probing Qs]
    b. What role did your remote job play? Help? Hinder?
    c. What are the reasons you like the location you are in?
    d. Can you tell me a bit about where you lived previously if you worked remotely, and why you moved to / from that place?
    e. What does quality of life / place mean to you?
    f. How does your current location provide or lack these things?
6. Demographic questions
    a. Do you mind sharing some of your personal descriptive information with me?
        i. Age
        ii. Education background
        iii. Where lived previously? Grown up? Where family lives?
        iv. Family? (age of kids?)
        v. Partner or spouse? Do they work remotely? What is there job?
        vi. Do you mind offering me the range of your personal income?
            1. [>$50K; $50K-$100K; $100K-$150K; >$150K]
            2. Household income?
7. Is there anything else that you'd like to share that you think would be important to this study or our knowledge about remote workers?
8. Likewise, are there any questions that you think are important that you'd like to know, or that are important to answer?

Thank you very much for your time. It is greatly appreciated.

APPENDIX C

CHAPTER 4 SUPPLEMENTAL DATA

Table A.4.1: Pairwise Correlation Matrix for All County Sample

	Share Home Based Work	Metropolitan DV	Population	January temp	Hilly & Mountain DV	Recreation DV	Creative economies	Commute time	Born-in-State	Retirement DV	Unemployment rate	Establishment size	Information employ share	Ag employ share	Manufacturing employ share	Work Home Median age	Work Home Female share	Work Home Earning differential	Broadband uptake	Large County	Medium-large County	Medium-small County
Metropolitan DV	0.16***																					
Population	0.16***	0.28***																				
January temp	-0.19***	0.10***	0.12***																			
Hilly & Mountain DV	0.16***	-0.05*	-0.01	-0.10***																		
Recreation DV	0.35***	-0.12***	-0.04	-0.10***	0.11***																	
Cultural amenities	0.52***	0.05*	0.22***	-0.20***	0.14***	0.37***																
Commute time	0.12***	0.29***	0.19***	0.24***	0	0	0.17***															
Born-in-State	-0.43***	-0.24***	-0.22***	-0.18***	-0.09***	-0.24***	-0.45***	-0.06*														
Retirement DV	0.22***	0.14***	-0.02	0.24***	0.01	0.18***	0.17***	0.21***	-0.32***													
Unemployment rate	-0.34***	-0.17***	-0.06*	0.25***	0	0.02	-0.39***	0.06*	0.22***	-0.10***												
Establishment size	-0.19***	0.22***	0.20***	-0.03	-0.13***	-0.35***	0.13***	-0.23***	0.08***	-0.19***	-0.12***											
Information employ share	0.43***	0.34***	0.36***	-0.07**	0.09***	0.04	0.60***	0.19***	-0.33***	0.08**	-0.27***	0.11***										
Ag employ share	0.01	-0.35***	-0.18***	-0.06**	0	0.03	-0.39***	-0.22***	0.07**	-0.09***	0.15***	-0.26***	-0.28***									
Manufacturing employ share	-0.29***	-0.22***	-0.17***	-0.21***	-0.08**	-0.23***	-0.40***	-0.12***	0.41***	-0.17***	-0.11***	0.30***	-0.29***	0.08***								
Work Home Median age	0.07**	-0.12***	-0.08***	0.01	0.06**	0.22***	-0.08**	0.11***	0.02	0.11***	0.05*	-0.26***	-0.08**	0.12***	0.07**							
Work Home Female share	-0.14***	0.08***	0	-0.01	0	-0.02	0.02	-0.01	-0.01	-0.01	0.06**	0.08***	-0.01	-0.09***	-0.07**	0						
Work Home Earning differential	0.26***	0.21***	0.14***	0.17***	0.01	0.11***	0.27***	0.22***	-0.20***	0.22***	-0.09***	0.01	0.22***	-0.18***	-0.12***	0.15***	-0.14***					
Broadband uptake	0.52***	0.44***	0.26***	-0.27***	0.03	0.14***	0.74***	0.06**	-0.41***	0.18***	-0.44***	0.08**	0.47***	-0.24***	-0.27***	-0.09***	0.03	0.15***				
Large County	0.19***	0.26***	0.67***	0.07**	-0.05*	-0.06*	0.39***	0.21***	-0.22***	-0.04	-0.06**	0.22***	0.39***	-0.18***	-0.17***	-0.07**	-0.02	0.17***	0.27***			
Medium-large County	0.13***	0.49***	0.06*	0.05*	-0.06*	-0.03	0.35***	-0.01	-0.19***	0.12***	-0.09***	0.23***	0.20***	-0.23***	-0.16***	-0.12***	0.07**	0.14***	0.37***	-0.16***		
Medium-small County	-0.08***	-0.03	-0.12***	-0.01	0.07**	0.03	-0.05*	-0.03	0.03	0.05*	0.02	0	-0.06*	-0.07**	0	-0.01	0.02	-0.07**	0.02	-0.15***	-0.30***	
Small County	-0.15***	-0.53***	-0.30***	-0.07**	0.02	0.04	-0.47***	-0.08**	0.25***	-0.12***	0.10***	-0.31***	-0.33***	0.36***	0.23***	0.15***	-0.07**	-0.16***	-0.47***	-0.27***	-0.54***	-0.48***

Table A.4.2: OLS and Spatial Dependence Regression Results by County Classification

	Large Counties		Medium-Large Counties		Medium-Small Counties		Small Counties	
	OLS	SLM	OLS	SEM	OLS	SEM	OLS	SLM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
January temp	.082 (.068)	.080 (.059)	-.015 (.034)	-.005 (.035)	-.216*** (.046)	-.203*** (.048)	-.285*** (.034)	-.247*** (.034)
Hilly & mountain DV	.094 (.126)	.081 (.111)	.176*** (.056)	.186*** (.059)	.111 (.077)	.105 (.080)	.153*** (.054)	.124** (.053)
Recreation DV	-.263 (.242)	-.240 (.212)	.198** (.098)	.208** (.095)	.597*** (.133)	.602*** (.127)	.289*** (.085)	.286*** (.083)
Cultural amenities	.171*** (.065)	.217*** (.058)	.313*** (.033)	.305*** (.032)	.096** (.047)	.096** (.044)	.220*** (.031)	.210*** (.030)
Born-in-State	-.078 (.073)	-.034 (.064)	-.119*** (.033)	-.102*** (.034)	-.125*** (.046)	-.106** (.046)	-.069** (.030)	-.068** (.029)
Retirement DV	.280 (.181)	.291* (.159)	.227*** (.069)	.195*** (.068)	.022 (.100)	.066 (.095)	.353*** (.084)	.308*** (.081)
Broadband uptake	.407*** (.080)	.430*** (.071)	.315*** (.035)	.316*** (.035)	.160*** (.052)	.165*** (.052)	.067* (.036)	.057* (.035)
Commute time	-.105 (.068)	-.098* (.059)	.033 (.036)	.039 (.038)	.153*** (.053)	.136*** (.052)	.077** (.037)	.072** (.036)
Unemployment rate	-.147* (.082)	-.098 (.073)	-.085*** (.032)	-.096*** (.034)	-.152*** (.045)	-.170*** (.045)	-.131*** (.031)	-.113*** (.031)
Ag employ share	.079 (.070)	.045 (.062)	.036 (.030)	.034 (.031)	.106*** (.040)	.101** (.041)	.182*** (.027)	.172*** (.027)
Manufacturing employ share	-.061 (.065)	-.071 (.057)	-.022 (.033)	-.054 (.033)	-.009 (.050)	-.028 (.049)	-.103*** (.034)	-.089*** (.033)
Information employ share	.251*** (.078)	.216*** (.071)	.111*** (.032)	.113*** (.031)	.094** (.044)	.066 (.042)	.032 (.028)	.033 (.027)
Establishment size	.047 (.070)	.059 (.062)	-.068** (.034)	-.049 (.033)	-.125** (.048)	-.127*** (.046)	-.039 (.033)	-.036 (.032)
Work home female share	-.048 (.055)	-.053 (.048)	-.076*** (.026)	-.081*** (.025)	.001 (.038)	-.005 (.036)	-.135*** (.028)	-.134*** (.027)
Work home earning differential	.256*** (.058)	.220*** (.051)	.108*** (.032)	.102*** (.031)	.108** (.042)	.103** (.040)	.079*** (.027)	.082*** (.026)
Work home median age	-.034 (.064)	.015 (.057)	.096*** (.030)	.099*** (.029)	-.109** (.043)	-.104** (.042)	.008 (.027)	.004 (.026)
Large MSA DV			-.237 (.156)	-.250* (.149)	-.103 (.139)	-.053 (.133)	.076 (.102)	.102 (.100)
Small MSA DV			-.296** (.143)	-.313** (.135)	-.104 (.091)	-.099 (.085)	.021 (.074)	.036 (.072)
Non-adjacent MSA DV			-.253 (.407)	-.229 (.390)	-.239* (.132)	-.212* (.129)	-.231*** (.077)	-.199*** (.074)
Constant	-.047 (.067)	-.078 (.059)	.133 (.143)	.144 (.137)	-.057 (.080)	-.070 (.079)	-.080* (.044)	-.076* (.043)
Observations	135		451		378		765	
Log Likelihood	-104.72	-97.53	-331.14	-324.90	-391.10	-384.17	-786.60	-777.43
Akaike Inf. Crit.	243.43	233.05	704.28	693.80	822.19	812.35	1,615.19	1,598.87
LR Test (df = 1)	-	13.751***	-	12.476***	-	11.665***	-	18.328***
Wald Test (df = 1)	-	15.786***	-	16.034***	-	13.587***	-	17.794***
$sigma^2$	-	0.24	-	0.24	-	0.44	-	0.44
R^2	0.724	-	0.744	-	0.521	-	0.519	-
Adjusted R^2	0.687	-	0.733	-	0.496	-	0.507	-
Residual Std. Error	.561 (df = 118)	-	.516 (df = 431)	-	.698 (df = 358)	-	.686 (df = 745)	-
F Statistic	19.385*** (df = 16; 118)	-	65.907*** (df = 19; 431)	-	20.525*** (df = 19; 358)	-	42.366*** (df = 19; 745)	-

Note: Sample includes counties with pop > 20K. Regimes classified as Large counties (pop>500,000), Med-large counties (pop>100,000, <500,000), Med-small counties (pop>50,000, <100,000), and Small counties (pop>20,000, <50,000). All coeffiecients standardized for comparison of relative magnitude. Standard errors in (). Significance levels *p<0.10, **p<0.05, ***p<0.01

Table A.4.3: OLS Regime Regression Results by County Group Size

Variable	Large Counties	Medium-Large Counties	Medium-Small Counties	Small Counties
January temp	.062 (.075)	-.016 (.040)	-.171*** (.045)	-.285*** (.031)
Hilly & mountain DV	.073 (.142)	.155** (.067)	.028 (.062)	.035 (.044)
Recreation DV	-.204 (.271)	.172 (.118)	.417*** (.111)	.213*** (.075)
Cultural amenities	.087* (.048)	.359*** (.050)	.099** (.044)	.244*** (.029)
Born-in-State	-.067 (.090)	-.106*** (.040)	-.117*** (.043)	-.116*** (.029)
Retirement DV	.218 (.203)	.207** (.083)	-.060 (.086)	.257*** (.074)
Broadband uptake	.499*** (.141)	.415*** (.060)	.206*** (.057)	.143*** (.032)
Commute time	-.084 (.078)	.047 (.041)	.167*** (.042)	.182*** (.028)
Unemployment rate	-.148 (.120)	-.073* (.038)	-.161*** (.043)	-.121*** (.028)
Ag employ share	.110 (.141)	.040 (.046)	.124*** (.045)	.165*** (.022)
Manufacturing employ share	-.085 (.129)	-.024 (.049)	.007 (.047)	-.115*** (.028)
Information employ share	.149** (.066)	.115*** (.043)	.134** (.055)	.066** (.030)
Establishment size	.039 (.086)	-.068 (.045)	-.122*** (.047)	-.002 (.031)
Work home female share	-.105 (.175)	-.104** (.048)	.007 (.038)	-.114*** (.021)
Work home earning differential	.261*** (.085)	.122*** (.045)	.125*** (.039)	.101*** (.022)
Work home median age	-.052 (.141)	.104** (.044)	-.083** (.039)	.005 (.022)
Metropolitan DV	-.271 (.193)	-.226*** (.065)	-.170*** (.060)	-.106** (.052)
Observations	1,728			
Log Likelihood	-1,618			
Akaike Inf. Crit.	3,373			
R^2	0.601			
Adjusted R^2	0.584			
Residual Std. Error	.630 (df = 1660)			
F Statistic	36.733*** (df = 68; 1660)			

Note: Sample includes counties with pop > 20K. Regimes classified as Large counties (pop>500,000), Med-large counties (pop>100,000, <500,000), Med-small counties (pop>50,000, <100,000), and Small counties (pop>20,000, <50,000). All coeffiecients standardized for comparison of relative magnitude. Standard errors in (). Significance levels *p<0.10, **p<0.05, ***p<0.01

Figure A.4.1:Figure: 1Figure 1: Map of US Census Designated Regions

Source: US Census

BIBLIOGRAPHY

Acosta, R. A., Wiatrowski, William. (2017). *National Compensation Survey: Employee Benefits in the United States, March 2017*. Retrieved from: https://www.bls.gov/ncs/

Aguilera, A., Lethiais, V., Rallet, A., & Proulhac, L. (2016). Home-based telework in France: Characteristics, barriers and perspectives. *Transportation Research Part A: Policy and Practice, 92*, 1-11.

Alizadeh, T. (2012). Teleworkers' Characteristics in Live/Work Communities: Lessons from the United States and Australia. *Journal of Urban Technology, 19*(3), 63-84. doi:10.1080/10630732.2011.642569

Allen, T. D., Golden, T. D., & Shockley, K. M. (2015). How effective is telecommuting? Assessing the status of our scientific findings. *Psychological Science in the Public Interest, 16*(2), 40-68.

Alonso, W. (1968). Urban and regional imbalances in economic development. *Economic Development and Cultural Change, 17*(1), 1-14.

Anselin, L. (1988). Lagrange multiplier test diagnostics for spatial dependence and spatial heterogeneity. *Geographical Analysis, 20*(1), 1-17.

Anselin, L. (1988). Model validation in spatial econometrics: a review and evaluation of alternative approaches. *International Regional Science Review, 11*(3), 279-316.

Anselin, L. (1990). Spatial dependence and spatial structural instability in applied regression analysis. *Journal of Regional Science, 30*(2), 185-207.

Anselin, L., & Bera, A. K. (1998). Introduction to spatial econometrics. *Handbook of Applied Economic Statistics, 237*.

Anselin, L., Bera, A. K., Florax, R., & Yoon, M. J. (1996). Simple diagnostic tests for spatial dependence. *Regional Science and Urban Economics, 26*(1), 77-104.

Autor, D. (2015). Why are there still so many jobs? The history and future of workplace automation. *Journal of economic perspectives, 29*(3), 3-30.

Autor, D. H. (2001). Wiring the Labor Market. *The Journal of Economic Perspectives, 15*(1), 25-40.

Autor, D., & Dorn, D. (2013). The growth of low-skill service jobs and the polarization of the US labor market. *American Economic Review, 103*(5), 1553-1597.

Autor, D., Katz, L. F., & Kearney, M. S. (2006). The polarization of the US labor market. *American Economic Review, 96*(2), 189-194.

Autor, D., Levy, F., & Murnane, R. J. (2003). The Skill Content of Recent Technological Change: An empirical exploration. *Quarterly Journal of Economics, 118*(4), 1279-1333.

Autor, D. H., & Price, B. (2013). The changing task composition of the US labor market: An update of Autor, Levy, and Murnane (2003). *Unpublished Manuscript., 28*, 2015.

Avery, C., & Zabel, D. (2001). *The flexible workplace: A sourcebook of information and research*. Westport, CT: Quorom Books.

Bailey, D. E., & Kurland, N. B. (2002). A review of telework research: Findings, new directions, and lessons for the study of modern work. *Journal of organizational behavior, 23*(4), 383-400.

Baker, R., Brick, J. M., Bates, N. A., Battaglia, M., Couper, M. P., Dever, J. A., ... & Tourangeau, R. (2013). Summary report of the AAPOR task force on non-probability sampling. Journal of Survey Statistics and Methodology, 1(2), 90-143. Becker, K., Hyland, P., & Soosay, C. (2013). Labour attraction and retention in rural and remote Queensland communities. *Australasian Journal of Regional Studies, The, 19*(3), 342.

Bélanger, F. (1999). Workers' propensity to telecommute: An empirical study. *Information &* Management, 35(3), 139-153.

Bivand, R., Altman, M., Anselin, L., Assunção, R., Berke, O., Bernat, A., & Blanchet, G. (2015). Package 'spdep'. *Last modified January, 16*.

Blakely, E. J. (2001). Competitive Advantage for the 21st-Century City: Can a Place-Based Approach to Economic Development Survive in a Cyberspace Age? *Journal of the American Planning Association, 67*(2), 133-141. doi:10.1080/01944360108976221

Bloom, N., Liang, J., Roberts, J., & Ying, Z. J. (2015). Does Working from Home Work? Evidence from a Chinese Experiment *. *The Quarterly Journal of Economics, 130*(1), 165-218. doi:10.1093/qje/qju032

Boell, S. K., Cecez-Kecmanovic, D., & Campbell, J. (2016). Telework paradoxes and practices: the importance of the nature of work. *New Technology Work and Employment, 31*(2), 114-131. doi:10.1111/ntwe.12063

Booth, D. E. (1999). Spatial patterns in the economic development of the Mountain West. *Growth and change, 30*(3), 384-405.

Bound, J., Braga, B., Golden, J. M., & Turner, S. (2013). Pathways to adjustment: The case of information technology workers. *American Economic Review, 103*(3), 203-207.

Brown, W. M., & Scott, D. M. (2012). Human capital location choice: Accounting for amenities and thick labor markets. *Journal of Regional Science, 52*(5), 787-808.

Burke, R. J., & Ng, E. (2006). The changing nature of work and organizations: Implications for human resource management. *Human Resource Management Review, 16*(2), 86-94.

Burris, B. H. (1998). Computerization of the workplace. *Annual review of Sociology, 24*(1), 141-157.

Cairncross, F. (2001). *The death of distance: How the communications revolution is changing our lives*: Harvard Business Press.

Caldow, J. (2009). Working outside the box: A study of the growing momentum in telework. *Institute for Electronic Government, IBM Corporation*.

Cappelli, P., & Keller, J. (2013). Classifying work in the new economy. *Academy of Management Review, 38*(4), 575-596.

Carnoy, M., Castells, M., & Benner, C. (1997). Labour markets and employment practices in the age of flexibility: A case study of Silicon Valley. *Int'l Lab. Rev., 136*, 27.

Castells, M. (2011). *The Rise of the Network Society: The Information Age: Economy, Society, and Culture* (Vol. 1): Wiley-Blackwell.

Center, P. R. (2018). Internet Broadband Factsheet. Retrieved from http://www.pewinternet.org/fact-sheet/internet-broadband/

Center, P. R. (2018). Social Media Use in 2018. Retrieved from http://www.pewinternet.org/2018/03/01/social-media-use-in-2018/

Chen, Y., & Rosenthal, S. S. (2008). Local amenities and life-cycle migration: Do people move for jobs or fun? *Journal of Urban Economics, 64*(3), 519-537. doi:http://dx.doi.org/10.1016/j.jue.2008.05.005

Chi, G., & Marcouiller, D. W. (2013). Natural amenities and their effects on migration along the urban–rural continuum. *The Annals of Regional Science, 50*(3), 861-883.

Chi, G., & Ventura, S. J. (2011). Population change and its driving factors in rural, suburban, and urban areas of Wisconsin, USA, 1970–2000. *International Journal of Population Research, 2011*.

Chow, G. C. (1960). Tests of Equality Between Sets of Coefficients in Two Linear Regressions. *Econometrica, 28*(3), 591-605. doi:10.2307/1910133

Chrisinger, C. K., Fowler, C. S., & Kleit, R. G. (2012). Shared skills: Occupation clusters for poverty alleviation and economic development in the US. *Urban Studies, 49*(15), 3403-3425.

Clark, W. A., & Onaka, J. L. (1983). Life cycle and housing adjustment as explanations of residential mobility. *Urban Studies, 20*(1), 47-57.

Cooke, T. J., & Shuttleworth, I. (2018). The effects of information and communication technologies on residential mobility and migration. *Population, Space and Place, 24*(3), e2111.

Costa, D. L., & Kahn, M. E. (2000). Power couples: changes in the locational choice of the college educated, 1940–1990. *The Quarterly Journal of Economics, 115*(4), 1287-1315.

Crandall, R. W., Lehr, W., & Litan, R. E. (2007). The effects of broadband deployment on output and employment: A cross-sectional analysis of US data.

Creswell, J. W. (2009). Research design: Qualitative, quantitative, and mixed methods approaches: Sage Publications, Inc.

Creswell, J. W., & Clark, V. L. P. (2007). Designing and conducting mixed methods research. Sage publications.

Cromartie, J., von Reichert, C., & Arthun, R. (2015). Factors Affecting Former Residents' Returning to Rural Communities (No. 206008). United States Department of Agriculture, Economic Research Service.

Dell, Incorporated (2016). *Future Workforce Study - United States*. Retrieved from http://www.workforcetransformation.com/workforcestudy/us/

Deller, S. C., Tsai, T.-H., Marcouiller, D. W., & English, D. B. (2001). The role of amenities and quality of life in rural economic growth. *American Journal of Agricultural Economics, 83*(2), 352-365.

Dorfman, J. H., Partridge, M. D., & Galloway, H. (2011). Do Natural Amenities Attract High-tech Jobs? Evidence From a Smoothed Bayesian Spatial Model. *Spatial Economic Analysis, 6*(4), 397-422. doi:10.1080/17421772.2011.610811

Dunn, H. S. (2016). Teleworking the mobile Caribbean: enabling remote work among the marginalized in Jamaica and Trinidad and Tobago. *ICT Skills & Employability, vol. 5, issue 2, Summer 2009.*

Ellison, N. B. (1999). Social Impacts New Perspectives on Telework. *Social science computer review, 17*(3), 338-356.

Engagement, N. C. S. U. O. o. O. a. (2016). *Dare County 2020 Economic Development & Diversification Strategic Plan*. Retrieved from https://www.darenc.com/home/showdocument?id-1233

Erard, M. (2016). Remote? that's no way to describe this work. *New York Times*. Retrieved from https://www.nytimes.com/2016/06/19/jobs/remote-thats-no-way-to-describe-this-work.html

Felstead, A. (2012). Rapid change or slow evolution? Changing places of work and their consequences in the UK. *Journal of Transport Geography, 21*, 31-38. doi:http://dx.doi.org/10.1016/j.jtrangeo.2011.10.002

Ferguson, M., Ali, K., Olfert, M. R., & Partridge, M. (2007). Voting with their feet: jobs versus amenities. *Growth and change, 38*(1), 77-110.

Firpo, S., Fortin, N. M., & Lemieux, T. (2011). Occupational tasks and changes in the wage structure.

Florida, R. (2005). *Cities and the Creative Class*. New York: Routledge.

Florida, R. L. (2002). The rise of the creative class: and how it's transforming work, leisure, community and everyday life: Basic Civitas Books.

Fowler Jr, F. J. (2013). *Survey research methods*: Sage publications.

Forum, W. E. (2016). *The Future of Jobs: Employment, skill and workforce strategy for the fourth industrial revolution*. World Economic Forum.

Frank, F. D., Finnegan, R. P., & Taylor, C. R. (2004). The race for talent: retaining and engaging workers in the 21st century. *People and Strategy, 27*(3), 12.

Fricker, R. D. (2008). Sampling methods for web and e-mail surveys. *N. Fielding*, 195-216.

Fujita, M. (1989). *Urban economic theory: land use and city size*: Cambridge University Press.

Gabe, T. M. (2006). Growth of Creative Occupations in US Metropolitan Areas: A Shift-Share Analysis. *Growth and Change, 37*(3), 396-415.

Gabe, T. M., & Abel, J. R. (2012). Specialized knowledge and the geographic concentration of occupations. *Journal of Economic Geography, 12*(2), 435-453. doi:10.1093/jeg/lbr006

Gallardo, R. (2016). Responsive countryside: The digital age and rural communities. *Starkville, MS: Mississippi State University Extension Service*.

Gallardo, R. (2016). *Work in place: A telework-friendly policy framework*. Mississippi State University Extension. Retrieved from http://extension.msstate.edu/publications/work-place-telework-friendly-policy-framework

Gallardo, R. (2017). Digital divide index. Mississippi State Extension. Extension Report.

Gallardo, R., & Whitacre, B. (2018). 21st century economic development: Telework and its impact on local income. *Regional Science Policy & Practice*.

Gallup, I. (2017). *State of the American Workplace*. Retrieved from Washington, D.C.: https://www.gallup.com/workplace/238085/state-american-workplace-report-2017.aspx

Garrett, R. K., & Danziger, J. N. (2007). Which telework? Defining and testing a taxonomy of technology-mediated work at a distance. *Social Science Computer Review, 25*(1), 27-47.

Glaeser, E. L., Kolko, J., & Saiz, A. (2001). Consumer city. *Journal of Economic Geography, 1*(1), 27-50.

Glaeser, E. L., Ponzetto, G. A., & Tobio, K. (2014). Cities, skills and regional change. *Regional Studies, 48*(1), 7-43.

Glaeser, E. L., Scheinkman, J. A., & Shleifer, A. (1995). Economic growth in a cross-section of cities. *Journal of Monetary Economics, 36*(1), 117-143.

Global Workforce Analytics (2016). *Latest telecommuting statistics.* Retrieved last from www.globalworkplaceanalytics.com on August 21, 2017.

Goss, E. P., & Phillips, J. M. (2002). How information technology affects wages: Evidence using internet usage as a proxy for IT skills. *Journal of Labor Research, 23*(3), 463-474.

Gould-Ellen, I., & Hempstead, K. (2002). Telecommuting and the demand for urban living: A preliminary look at white-collar workers. *Urban Studies, 39*(4), 749-766. doi:10.1080/00420980220119552

Graham, S., & Marvin, S. (1996). *Telecommunications and the city : electronic spaces, urban places*. London; New York: Routledge.

Graves, P. E. (1980). Migration and climate. *Journal of Regional Science, 20*(2), 227-237.

Greenwood, M. J. (1975). Research on internal migration in the United States: a survey. *Journal of Economic Literature*, 397-433.

Greenwood, M. J. (1985). Human migration: Theory, models, and empirical studies. *Journal of Regional Science, 25*(4), 521-544.

Greenwood, M. J., & Hunt, G. L. (1989). Jobs versus amenities in the analysis of metropolitan migration. *Journal of Urban Economics, 25*(1), 1-16.

Grubesic, T. H. (2008). Spatial data constraints: Implications for measuring broadband. *Telecommunications Policy, 32*(7), 490-502.

Gurstein, P. (1996). Planning for telework and home-based employment: Reconsidering the home/work separation. *Journal of Planning Education and Research, 15*(3), 212-224.

Haddon, L., & Brynin, M. (2005). The character of telework and the characteristics of teleworkers. *New Technology, Work and Employment, 20*(1), 34-46.

Handy, S. L., & Mokhtarian, P. L. (1995). Planning for Telecommuting Measurement and Policy Issues. *Journal of the American Planning Association, 61*(1), 99-111. doi:10.1080/01944369508975623

Hanson, S., & Pratt, G. (2003). *Gender, Work and Space*: Routledge.

Helling, A., & Mokhtarian, P. L. (2001). Worker Telecommunication and Mobility in Transition: Consequences for Planning. *Journal of Planning Literature, 15*(4), 511-525. doi:10.1177/08854120122093168

Holt, L., & Jamison, M. (2009). Broadband and contributions to economic growth: Lessons from the US experience. *Telecommunications Policy, 33*(10-11), 575-581.

Hunt, G. L. (1993). Equilibrium and disequilibrium in migration modelling. *Regional Studies, 27*(4), 341-349.

Johnson, K. M., & Beale, C. L. (2002). Nonmetro Recreation Counties Their Identification and Rapid Growth. *Rural America/Rural Development Perspectives*, *17*(4).

Jolley, G. J., Khalaf, C., Michaud, G., & Sandler, A. M. The Economic, Fiscal, and Workforce Impacts of Coal–Fired Power Plant Closures in Appalachian Ohio. *Regional Science Policy & Practice*.

Kahn, M. E., & Costa, D. L. (2000). Power Couples: Changes in the Locational Choice of the College Educated, 1940–1990*. *The Quarterly Journal of Economics, 115*(4), 1287-1315. doi:10.1162/003355300555079

Kan, K. (2007). Residential mobility and social capital. *Journal of Urban Economics, 61*(3), 436-457. doi:http://dx.doi.org/10.1016/j.jue.2006.07.005

Karoly, L. A., & Panis, C. W. (2004). *The 21st century at work: Forces shaping the future workforce and workplace in the United States* (Vol. 164): Rand Corporation.

Katz, L. F., & Krueger, A. B. (2019). The rise and nature of alternative work arrangements in the United States, 1995–2015. *ILR Review*, 72(2), 382-416.

Kelly, J., Ruther, M., Ehresman, S., & Nickerson, B. (2017). Placemaking as an economic development strategy for small and midsized cities. *Urban Affairs Review, 53*(3), 435-462.

Kim, S.-N. (2016). Two traditional questions on the relationships between telecommuting, job and residential location, and household travel: revisited using a path analysis. *The Annals of Regional Science, 56*(2), 537-563.

Kim, S. N. (2017). Is telecommuting sustainable? An alternative approach to estimating the impact of home-based telecommuting on household travel. *International Journal of Sustainable Transportation*, 11(2), 72-85.

Kim, S.-N., Choo, S., & Mokhtarian, P. L. (2015). Home-based telecommuting and intra-household interactions in work and non-work travel: A seemingly unrelated censored regression approach. *Transportation Research Part A: Policy and Practice, 80*, 197-214.

Kim, S.-N., Mokhtarian, P. L., & Ahn, K.-H. (2012). The Seoul of Alonso: New Perspectives on Telecommuting and Residential Location from South Korea. *Urban Geography, 33*(8), 1163-1191. doi:10.2747/0272-3638.33.8.1163

Knapp, T. A., & Gravest, P. E. (1989). On the role of amenities in models of migration and regional development. *Journal of Regional Science, 29*(1), 71-87.

LaRose, R., Gregg, J. L., Strover, S., Straubhaar, J., & Carpenter, S. (2007). Closing the rural broadband gap: Promoting adoption of the Internet in rural America. *Telecommunications Policy, 31*(6-7), 359-373.

Lawson, M. (2019). *How Outdoor Recreation Supports Rural Economic Development*. Retrieved from https://headwaterseconomics.org/wp-content/uploads/recreation-counties-attract-report.pdf

Lui, C. Y., & Kolenda, R. (2012). Counting and Understanding the Contingent Workforce Using Georgia as an Example. *Urban Studies, 49*(5), 1003-1025.

Mahasuweerachai, P., Whitacre, B. E., & Shideler, D. W. (2010). Does broadband access impact migration in America? Examining differences between rural and urban areas. *The Review of Regional Studies, 40*(1), 5-26.

Malecki, E. J. (2001). Going digital in rural America. In *Proceedings–Rural and Agricultural Conferences* (No. Sep, pp. 49-68). Federal Reserve Bank of Kansas City.

Markusen, A. (2004). Targeting occupations in regional and community economic development. *Journal of the American Planning Association, 70*(3), 253-268.

Marshall, A. (1890). Principles of Economics, An introductory volume. *London: McMillan, 9th ed. Reprint*.

Mason, C. M., Carter, S., & Tagg, S. (2011). Invisible Businesses: The Characteristics of Home-based Businesses in the United Kingdom. *Regional Studies, 45*(5), 625-639. doi:10.1080/00343401003614241

Mateyka, P. J., Rapino, M., & Landivar, L. C. (2012). *Home-based workers in the United States: 2010*: US Department of Commerce, Economics and Statistics Administration, US Census Bureau.

Matthew, T. (2018). Remote Workers: Vermont Will Pay You To Move There. *CityLab*. Retrieved from https://www.citylab.com/life/2018/05/remove-work-vermont-money/561626/

Mayo, M., Pastor, J.-C., Gomez-Mejia, L., & Cruz, C. (2009). Why some firms adopt telecommuting while others do not: A contingency perspective. *Human Resource Management, 48*(6), 917-939. doi:10.1002/hrm.20322

McDonald, N. C. (2015). Are Millennials Really the "Go-Nowhere" Generation? *Journal of the American Planning Association, 81*(2), 90-103. doi:10.1080/01944363.2015.1057196

McGranahan, D., Wojan, T. (2007). The creative class: a key to rural growth. *Amber Waves*. Retrieved from https://www.ers.usda.gov/amber-waves/2007/april/the-creative-class-a-key-to-rural-growth/

McGranahan, D., & Wojan, T. (2007). Recasting the creative class to examine growth processes in rural and urban counties. *Regional Studies, 41*(2), 197-216.

McGranahan, D. A. (1999). Natural Amenities Drive Rural Population Change (No. 33955). United States Department of Agriculture, Economic Research Service.

McGranahan, D. A., Wojan, T. R., & Lambert, D. M. (2010). The rural growth trifecta: outdoor amenities, creative class and entrepreneurial context. *Journal of Economic Geography, 11*(3), 529-557. doi:10.1093/jeg/lbq007

Mincer, J. (1978). Family migration decisions. *Journal of Political Economy, 86*(5), 749-773.

Mirchandani, K. (1999). Feminist insight on gendered work: New directions in research on women and entrepreneurship. *Gender, Work & Organization, 6*(4), 224-235.

Mokhtarian, P. L. (1991). Telecommuting and travel: state of the practice, state of the art. *Transportation, 18*(4), 319-342.

Mokhtarian, P. L., Bagley, M. N., & Salomon, I. (1998). The impact of gender, occupation, and presence of children on telecommuting motivations and constraints. *Journal of the American Society for Information Science, 49*(12), 1115-1134.

Mokhtarian, P. L., Salomon, I., & Choo, S. (2005). Measuring the Measurable: Why can't we Agree on the Number of Telecommuters in the U.S.? *Quality and Quantity, 39*(4), 423-452. doi:10.1007/s11135-004-6790-z

Moos, M., & Skaburskis, A. (2007). The Characteristics and Location of Home Workers in Montreal, Toronto and Vancouver. *Urban Studies, 44*(9), 1781-1808. doi:10.1080/00420980701507639

Moretti, E. (2012). *The New Geography of Jobs*: Houghton Mifflin Harcourt.

Mueser, P. R., & Graves, P. E. (1995). Examining the role of economic opportunity and amenities in explaining population redistribution. *Journal of Urban Economics*, *37*(2), 176-200.

Muhammad, S., Ottens, H. F., Ettema, D., & de Jong, T. (2007). Telecommuting and residential locational preferences: a case study of the Netherlands. *Journal of Housing and the Built Environment, 22*(4), 339-358.

Mulder, C. H., & Malmberg, G. (2014). Local ties and family migration. *Environment and Planning A, 46*(9), 2195-2211.

Muro, M., Liu, S., Whiton, J., & Kulkarni, S. (2017). *Digitalization and the American workforce*. Retrieved from https://www.brookings.edu/research/digitalization-and-the-american-workforce/

Ng, E. S., Schweitzer, L., & Lyons, S. T. (2010). New generation, great expectations: A field study of the millennial generation. *Journal of Business and Psychology, 25*(2), 281-292.

Nilles, J. (1975). Telecommunications and organizational decentralization. *IEEE Transactions on Communications, 23*(10), 1142-1147.

Nilles, J., Carlson Jr, F., Gray, P., & Hanneman, G. (1976). The Telecommuting Transportation Trade Off: New York, NY: John Wiley & Sons, Inc.

Nolan, C., Morrison, E., Kumar, I., Galloway, H., & Cordes, S. (2011). Linking industry and occupation clusters in regional economic development. *Economic Development Quarterly, 25*(1), 26-35.

Noonan, M. C., & Glass, J. L. (2012). Hard Truth about Telecommuting, The. *Monthly Lab. Rev., 135*, 38.

Oberhauser, A. M. (1995). Gender and household economic strategies in rural Appalachia. *Gender, Place & Culture, 2*(1), 51-70.

Oliver, Z., Dana Schoewe, Lawrence, Sara. (2016). *Attracting Talent Who Can Live and Work Anywhere*. Retrieved from https://www.darenc.com/home/showdocument?id=1239

Onwuegbuzie, A. J., & Collins, K. M. (2007). A typology of mixed methods sampling designs in social science research. *The Qualitative Report, 12*(2), 281-316.

Ory, D. T., & Mokhtarian, P. L. (2006). Which Came First, the Telecommuting or the Residential Relocation? An Empirical Analysis of Causality. *Urban Geography, 27*(7), 590-609. doi:10.2747/0272-3638.27.7.590

Potter, E. E. (2003). Telecommuting: The Future of Work, Corporate Culture, and American Society. *Journal of Labor Research, 24*(1), 73-84.

Poudyal, N. C., Hodges, D. G., & Cordell, H. K. (2008). The role of natural resource amenities in attracting retirees: Implications for economic growth policy. *Ecological Economics, 68*(1-2), 240-248.

Pratt, J. H. (2000). Asking the right questions about telecommuting: Avoiding pitfalls in surveying homebased work. *Transportation, 27*(1), 99-116. doi:10.1023/a:1005288112292

Rabe, B. (2011). Dual-earner migration. Earnings gains, employment and self-selection. *Journal of Population Economics, 24*(2), 477-497.

Reeder, R. J. (1998). Retiree-Attraction Policies for Rural Development. Agriculture Information Bulletin no. 741. US Department of Agriculture, Economic Research Service, Food and Rural Economics Division.

Roback, J. (1982). Wages, rents, and the quality of life. *Journal of Political Economy, 90*(6), 1257-1278.

Rossi, P. H. (1955). Why families move: A study in the social psychology of urban residential mobility: Free Press Glencoe, IL.

Ruggles, S., Genadek, Katie, Goeken, Ronald, Grover, Josiah, & Sobek, Matthew (2017). *Integrated Public Use Microdata Series: Version 7.0*. Integrated Public Use Microdata Series: Version 7.0. Retrieved from: https://doi.org/10.18128/D010.V7.0

Rupasingha, A., & Goetz, S. J. (2004). County amenities and net migration. *Agricultural and Resource Economics Review, 33*(2), 245-254.

Salemink, K., Strijker, D., & Bosworth, G. (2017). Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. *Journal of Rural Studies, 54*, 360-371.

Salganik, M. J., & Heckathorn, D. D. (2004). Sampling and estimation in hidden populations using respondent-driven sampling. *Sociological Methodology, 34*(1), 193-240.

Shockley, K. M., & Allen, T. D. (2012). Motives for flexible work arrangement use. *Community, Work & Family, 15*(2), 217-231.

Simon, C. J. (2018). Migration and career attainment of power couples: the roles of city size and human capital composition. *Journal of Economic Geography, 19*(2), 505-534. doi:10.1093/jeg/lby009

Simpson, L., Daws, L., Pini, B., & Wood, L. (2003). Rural telework: case studies from the Australian outback. *New Technology, Work and Employment, 18*(2), 115-126.

Smith, S. (2017). The Economic Development Benefits of Broadband. *Broadband Communities*.

Society for Human Resource Management (2017). *2017 Employee Benefits: Remaining Competitive in a Challenging Talent Marketplace*. Retrieved from https://www.shrm.org/hr-today/trends-and-forecasting/research-and-surveys/Documents/2017%20Employee%20Benefits%20Report.pdf

Sullivan, C. (2003). What's in a name? Definitions and conceptualisations of teleworking and homeworking. *New Technology, Work and Employment, 18*(3), 158-165. doi:10.1111/1468-005X.00118

Sullivan, C., & Lewis, S. (2001). Home-based telework, gender, and the synchronization of work and family: perspectives of teleworkers and their co-residents. *Gender, Work & Organization, 8*(2), 123-145.

Tashakkori, A., & Teddlie, C. (2003). The Past and the Future of Mixed Methods Research: From 'Methodological Triangulation'to 'Mixed Methods Designs' (pp. 671-701): Thousand Oaks, CA: Sage Publications.

Tayyaran, M. R., Khan, A. M., & Anderson, D. A. (2003). Impact of telecommuting and intelligent transportation systems on residential location choice. *Transportation Planning and Technology, 26*(2), 171-193. doi:10.1080/0308106032000096561

Teleworks, U. www.teleworksusa.com. Last visited August 21, 2017.

Thompson, W. R., & Thompson, P. R. (1987). National Industries and Local Occupational Strengths: The Cross-Hairs of Targeting. *Urban Studies, 24*(6), 547-560. doi:10.1080/00420988720080781

Tiebout, C. M. (1956). A pure theory of local expenditures. Journal of political economy, 64(5), 416-424.Toffler, A. (1980). The third wave. *New York: Morrow*, 27-28.

Toffler, A. (1980). The third wave. *New York: Morrow*, 27-28.

Tomer, A., & Kane, J. (2015). *Broadband adoption rates and gaps in US metropolitan areas*: Metropolitan Policy Program at Brookings.

U.S. Department of Agriculture. 2013. Rural–urban continuum codes: Documentation. Washington, DC: U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/data-products/rural-urban-continuum-codes (last accessed 11 May 2019)

Vermont General Assembly (2018). An act relating to promoting remote work, Act 197.

Vilhelmson, B., & Thulin, E. (2001). Is Regular Work at Fixed Places Fading Away? The Development of ICT-Based and Travel-Based Modes of Work in Sweden. *Environment and Planning A, 33*(6), 1015-1029. doi:10.1068/a33207

Vilhelmson, B., & Thulin, E. (2016). Who and where are the flexible workers? Exploring the current diffusion of telework in Sweden. *New Technology, Work and Employment, 31*(1), 77-96.

Wallace, R. D. (2019a). *Measuring Remote Work Employment and Occupations*. Unpublished Manuscript.

Wallace, R. D. (2019b). *The Location and Migration Decisions of Remote Workers: A Focus on Maine*. Unpublished Manuscript.

Wallace, R. D. (2019c). *The Geography of Remote Work: Differences Across US regions*. Unpublished Manuscript.

Walters, W. H. (2002). Later-life migration in the United States: A review of recent research. *Journal of Planning Literature, 17*(1), 37-66.

Weiler-Reynolds, B. (2018). 100 Top Companies with Remote Jobs in 2018. Retrieved from https://www.flexjobs.com/blog/post/100-top-companies-with-remote-jobs-in-2018/

Whisler, R. L., Waldorf, B. S., Mulligan, G. F., & Plane, D. A. (2008). Quality of life and the migration of the college-educated: a life-course approach. *Growth and Change, 39*(1), 58-94.

Whitacre, B., Gallardo, R., & Strover, S. (2014a). Broadband′s contribution to economic growth in rural areas: Moving towards a causal relationship. *Telecommunications Policy, 38*(11), 1011-1023. doi:https://doi.org/10.1016/j.telpol.2014.05.005

Whitacre, B., Gallardo, R., & Strover, S. (2014b). Does rural broadband impact jobs and income? Evidence from spatial and first-differenced regressions. *The Annals of Regional Science, 53*(3), 649-670. doi:10.1007/s00168-014-0637-x

Whitney, E. (2015). Tired of the Big CIty? Consider Telecommuting From Montana. Retrieved from https://www.darenc.com/home/showdocument?id=1239

Wojan, T. (2018). Creative Class County Codes.

World Economic Forum (W.E.F.) (2016). The Future of Jobs: Employment, skill and workforce strategy for the fourth industrial revolution. World Economic Forum.

Zhu, P. (2013). Telecommuting, Household Commute and Location Choice. *Urban Studies, 50*(12), 2441-2459. doi:10.1177/004209