

The Impact of Remote Work on Domestic Brain Drain in the United States

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Abstract

This paper examines the impact of remote work, accelerated by the COVID-19 pandemic, on domestic brain drain within the United States. Using a difference-in-differences methodology, we analyze whether the increased geographic flexibility provided by remote work has mitigated the migration of skilled workers from their state of birth, commonly referred to as domestic brain drain. Our findings indicate that remote work has both a "preventative" effect, allowing individuals to remain in their home state while accessing higher-paying jobs, and a potential "reverse" effect, enabling those who previously migrated to return to their home state. While data limitations preclude a direct analysis of return migration trends, these initial findings have important implications for policymakers and regional stakeholders seeking to address talent retention and foster equitable economic development in a post-pandemic labor market.

Keywords: migration, human capital, employment

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1 Introduction

The COVID-19 pandemic catalyzed dramatic changes in global labor markets, fundamentally reshaping where and how people work. Among the most profound shifts was the widespread adoption of remote work. This transformation has reignited long-standing debates about geographic mobility, labor market inequalities, and regional economic development. In the United States, these questions intersect with domestic brain drain, where skilled workers migrate from economically disadvantaged regions to urban centers in search of better opportunities. While significant research has explored brain drain in the international setting, the domestic variant—particularly in the context of how remote work might mitigate it—remains underexamined.

Domestic brain drain represents a critical challenge for rural and economically stagnant areas, depriving many regions of the human capital necessary for growth and innovation. Traditionally, workers in these areas have faced a binary choice: either migrate to pursue economic opportunities at the cost of leaving their preferred location or remain at home, often sacrificing higher wages and career advancement (Florida, 2019; Choudhury & Kwon, 2023). The COVID-19-induced surge in remote work has disrupted this paradigm, offering a potential solution by allowing individuals to access out-of-state employment opportunities while remaining in their home regions. This decoupling of work and residence could have significant implications for reversing or mitigating brain drain within the United States, particularly in regions that have historically struggled to retain talent.

The rise of remote work offers a unique opportunity to explore the dynamics of migration and labor market flexibility in ways that were previously constrained by geographic proximity. Recent studies highlight the potential of remote work to redistribute talent, particularly to suburban and rural areas, as workers often prioritize lower costs of living, better lifestyles, and proximity to family over the benefits of urban living (Bick et al., 2024; Gallardo, 2023). However, the extent to which this shift can reverse entrenched patterns of brain drain remains uncertain. Existing research has primarily focused on international migration or descriptive analyses of remote work trends, leaving critical questions about the domestic implications of this shift largely unanswered.

This study aims to address these gaps by examining how the rise of remote work due to

COVID-19 has influenced domestic brain drain migration patterns within the United States. Using a difference in difference (DID) analysis model, we analyze the relationship between remote work adoption and migration trends, focusing on whether the increased flexibility of remote work has allowed individuals to remain in their preferred regions while accessing economic opportunities previously available only through relocation. By integrating insights from labor economics, regional development, and migration studies, this research seeks to provide a comprehensive understanding of the factors driving these changes and their broader implications.

Through our analysis, we find that remote work has both a "preventative" effect, allowing individuals to remain in their home state while accessing higher-paying jobs, and a potential "reverse" effect, enabling those who previously migrated to return to their home state. These findings have the potential to inform policymakers, employers, and regional stakeholders about the opportunities and challenges associated with remote work as a tool for mitigating domestic brain drain. By identifying the conditions under which remote work can contribute to a more equitable geographic distribution of talent, this research aims to offer actionable recommendations for fostering inclusive economic development in a rapidly evolving labor market.

1.1 What is Brain Drain?

Brain drain refers to the migration of skilled and educated individuals from one geographic area to another, often driven by disparities in opportunities, resources, and quality of life. Internationally, this phenomenon typically involves the movement of talent from developing to developed nations, resulting in significant human capital losses for the source regions (Commander et al., 2004). In the domestic context, brain drain occurs when individuals leave economically stagnant regions within a country for urban centers or more prosperous states, creating regional disparities in human capital (Florida, 2019).

The theoretical foundations of brain drain studies have evolved over decades. Early frameworks, such as Grubel and Scott (1966), conceptualized brain drain as a unidirectional flow of intellectual capital, depleting source regions of critical skills and innovation. Bhagwati and Hamada (1974) extended this analysis by emphasizing the detrimental im-

pact on economic growth and institutional capacity in source regions, particularly those investing heavily in education and training. Scholars such as Haque and Kim (1995) further emphasized the role of human capital flight in perpetuating global inequalities. In this way, early theoretical frameworks identified brain drain as a phenomenon driven by economic disparities, institutional weaknesses, and unequal opportunities.

More contemporary perspectives potentially complicate this traditional view. Stark et al. (1997) introduced the concept of "brain gain," arguing that the prospect of migration could incentivize individuals to pursue higher education, thereby increasing the total stock of human capital in a region. Other scholars, such as Nguyen (2006) and Tesón (2008), emphasize the potential benefits of diaspora networks, remittances, and return migration in offsetting brain drain's negative impacts. Despite these possibilities, the consensus across much of the literature underscores that brain drain poses severe challenges to the economic and social fabric of regions unable to retain their most skilled workers.

1.2 Domestic Brain Drain in the United States

While international studies focus on the loss of talent from developing to developed nations, domestic studies reveal similar patterns within the U.S., driven by state-level disparities in economic opportunities, education, and infrastructure (Valero, 2021). Rural and economically disadvantaged states often lose a significant share of their educated and skilled workforce to urban hubs or more prosperous states, leading to regional disparities in innovation, workforce availability, and economic growth (Florida, 2019).

Previous studies highlight the scope of these losses. Miller and Collins (2022) report that Mississippi loses an average of 1,200 college-educated residents annually, resulting in reduced GDP growth and diminished local development prospects. Research on Nevada and Michigan emphasizes the economic toll of outmigration, particularly for states that invest heavily in public education but fail to retain graduates in their local labor markets (Smith et al., 2020; Falcone, 2021). Maryland experienced a net loss of 8,881 degree-seeking students in 2014, underscoring the role of higher education in exacerbating regional disparities (Kelchen, 2018).

This migration of skilled individuals from economically disadvantaged to prosperous re-

gions critically exacerbates existing inequalities. Florida (2019) highlights the self-reinforcing nature of this cycle: as rural and less developed regions lose their talent, their economic vitality and institutional capacity diminish, making it increasingly difficult to retain or attract new talent. This cycle leaves regions with weaker public services, reduced innovation potential, and lower political influence on national policies (Nguyen, 2006).

Some scholars argue that brain drain is not inherently detrimental. Mountford (1997) suggests that the migration of skilled individuals can create “brain circulation,” where returning talent brings new skills and networks to their home regions. Nonetheless, this potential benefit remains underexplored in domestic contexts, where structural barriers such as limited industry diversity and inadequate public investment hinder the return of skilled workers (Rapoport, 2002).

In this way, addressing domestic brain drain requires understanding its multifaceted nature, encompassing not just economic factors but also social and behavioral dimensions. While some initiatives—such as tax incentives, investments in infrastructure, and state-funded scholarships tied to local employment—aim to mitigate brain drain, their effectiveness remains mixed. Moreover, structural barriers such as inadequate broadband access in rural areas and the concentration of high-paying industries in urban centers present significant challenges to reversing these trends (Vega-Muñoz et al., 2021). Nevertheless, as the dynamics of migration continue to evolve, understanding these patterns becomes essential for crafting policies that promote regional equity and sustainable growth.

1.3 COVID’s Impact in Increasing Remote Work

As regions across the United States grappled with the long-standing challenges of brain drain, the COVID-19 pandemic introduced a transformative shift in the labor market—most notably, the widespread adoption of remote work—which has redefined the geographic and economic constraints traditionally associated with talent retention and migration. Before the pandemic, remote work was relatively niche, with only about 5% of full-time employees in the U.S. working primarily from home (Levanon, 2020). By May 2020, this figure had surged to approximately 60%, with remote work becoming a necessity given the health risks associated with in-person work during the pandemic (Fulford, 2023).

Research underscores that the pandemic-induced transition to remote work was not uniform across sectors or demographics. High-skilled, white-collar occupations—particularly in industries like technology, finance, and professional services—experienced the largest uptick in remote work adoption. In contrast, sectors requiring physical presence, such as retail, manufacturing, and healthcare, saw minimal changes (Angelucci et al., 2020; Bureau of Labor Statistics, 2022). This divergence highlights both the potential and the limitations of remote work as a universal labor market solution.

Quantitative studies further illustrate the extent of this transformation. Between 2019 and 2021, the share of remote workers increased across all major industries, with some sectors experiencing growth of over 30 percentage points (Pabilonia & Redmond, 2024). These trends persisted even after pandemic restrictions eased, suggesting a permanent re-configuration of work environments. Current data indicate that approximately 30% of U.S. workdays remain remote, a significant increase compared to pre-pandemic levels (Parker, 2023). The durability of remote work is further supported by employer surveys, which reveal that over 60% of hiring managers plan to maintain higher levels of remote work moving forward (Ozimek, 2020).

Remote work’s rise has had complex implications for productivity and labor market flexibility. On one hand, remote work eliminated commuting time, reduced workplace distractions, and improved work-life balance for many employees, thereby boosting productivity in several sectors (Marcus, 2022; Pabilonia & Redmond, 2024). On the other hand, disparities in access to suitable workspaces and technological infrastructure have constrained the benefits for lower-income and rural workers (Bogason, 2024). Furthermore, the shift to remote work has necessitated significant adaptations in management practices, employee training, and social protections to accommodate a more dispersed workforce (Marcus, 2022).

Overall, the COVID-19 pandemic has catalyzed a structural shift in the labor market, embedding remote work as a key feature of the modern economy. This transformation provides a critical context for understanding its broader implications, including its potential to reshape migration patterns and address regional inequalities.

1.4 Remote Work: The Anti-Brain Drain?

Remote work, catalyzed by the COVID-19 pandemic, has emerged as a transformative force with significant implications for migration patterns and the concept of brain drain. While traditional brain drain literature has primarily focused on international migration, the massive surge of remote work as a result of the pandemic introduces new opportunities to investigate the potential of remote work to reverse and/or prevent brain drain dynamics globally and within the United States.

As mentioned above, historically, domestic brain drain in the United States has been driven by workers migrating from rural or economically disadvantaged regions to urban hubs for better career prospects, often at the cost of leaving their home communities (Florida, 2019). Remote work, accelerated by the COVID-19 pandemic, disrupts this paradigm by enabling individuals to access jobs outside their local labor markets while remaining in their preferred geographic locations.

This phenomenon can be understood through the concept of "bundled choices." Workers have traditionally faced a binary decision:

- **Option A:** Remain in their home state, prioritizing familial and community ties but potentially sacrificing higher pay and benefits.
- **Option B:** Migrate to another state, gaining access to better economic opportunities at the cost of leaving their preferred location.

Remote work introduces a third option, allowing individuals to retain the advantages of both bundles. Workers can pursue competitive salaries and career advancement typically associated with urban job markets while maintaining residence in their home state, fulfilling their geographic and social preferences (Choudhury & Kwon, 2023). This dynamic has significant implications for domestic and international brain drain, particularly in regions historically characterized by high outmigration rates.

Evidence of this shift is clear in migration and labor market data. On a global scale, remote work has the potential to mitigate brain drain by enabling individuals to remain in or return to their home regions while maintaining employment in high-quality jobs. Bakalova et al. (2021) estimate that millions of European migrants could return to their

home countries while continuing to work for firms in more developed regions, effectively reversing the traditional brain drain dynamic. Mierina and Šūpule (2024) highlight Latvia as a case study, where remote work has engaged the diaspora in local labor markets, alleviating longstanding deficits in human capital.

In the United States, remote work has significantly altered traditional migration patterns, offering new pathways to address domestic brain drain. The decoupling of employment and residential location has allowed workers to prioritize factors such as affordability, quality of life, and proximity to family, particularly in regions historically affected by talent outflows (Bick et al., 2024). Research shows that remote workers were 50% more likely to move across state lines compared to their in-office counterparts during the pandemic, a trend that has persisted even as restrictions have eased (Ozimek, 2020).

Choudhury (2022) emphasizes the transformative potential of work-from-anywhere (WFA) policies, which reduce geographic mobility frictions by enabling workers to decouple their residence from their job location. These policies increase access to high-quality employment from across state lines, particularly for skilled workers in regions that traditionally lacked access to global job markets. The result is a two-way flow of human capital: host regions retain productive connections with remote workers, while source regions benefit from the return of educated and skilled individuals.

Programs like Tulsa Remote, an initiative by the Oklahoma State Government that offers subsidies for young people who live in the city of Tulsa while working remotely elsewhere, demonstrate how remote work can be leveraged to reverse brain drain domestically. By offering financial incentives to remote workers willing to relocate, the program has successfully attracted thousands of participants, creating measurable economic benefits for both the workers and the host city. Such initiatives highlight the potential for smaller cities and rural areas to capitalize on remote work as a means of revitalizing local economies and addressing labor shortages (McKinsey Global Institute, 2021).

Thus, remote work's broader implications extend beyond migration patterns. It has introduced the concept of "reverse brain drain," where skilled individuals relocate back to their preferred geographic regions while maintaining the economic benefits of urban employment. This shift has the potential to address regional inequalities by redistributing

human capital, strengthening local economies, and fostering sustainable development.

1.5 Implications and Gaps from the Literature

The growing body of literature on brain drain and remote work provides several relevant themes for understanding their intersection and contextualizing the potential for the increase of remote work during COVID-19 to facilitate reverse brain drain effects. Yet, remote work’s potential to influence domestic migration and reduce brain drain hinges on several factors.

First, the feasibility of remote work is unevenly distributed across industries, occupations, and income levels (Aleem et al., 2023; Pabilonia Redmond, 2024). While sectors such as technology and finance have widely adopted remote work practices, service-oriented and lower-income professions often remain tied to physical job requirements, limiting the extent to which remote work can address migration pressures in these sectors. The technology sector and professional services industries saw some of the most significant transitions to remote work, while sectors requiring physical presence, such as healthcare and retail, faced more limited adoption of remote work (Chetty et al., 2023). Additionally, rural areas with inadequate broadband access and digital infrastructure remain excluded from many of the benefits of remote work, perpetuating regional disparities (Levanon, 2020). These disparities reflect broader inequalities in geographic mobility and economic opportunities, emphasizing that remote work’s benefits are not universally accessible.

Second, structural barriers such as the digital divide pose significant challenges for remote work adoption in rural and underserved areas. Bakalova et al. (2021) caution that the benefits of remote work for reversing brain drain depend heavily on the availability of digital infrastructure and access to remote-compatible employment, which remain unevenly distributed across countries and regions. Without equitable access to affordable and reliable broadband, these regions risk being excluded from the opportunities created by remote work (Gallardo, 2023). While the rise of remote work has been correlated with increased geographic flexibility and reduced migration pressures, the extent to which it can foster a “reverse brain drain” — enabling workers to return to or remain in their preferred regions — remains an open question (DeFilippis et al., 2020).

The COVID-19 pandemic provides a unique lens for exploring these issues. As mentioned above, emerging research indicates that remote work reduced migration pressures for many workers, allowing them to remain in or return to less populated areas without sacrificing career opportunities (Bakalova, 2021). For example, Work From Anywhere (WFA) policies at the U.S. Patent and Trademark Office (USPTO) improved employee retention while reducing geographic concentration among its workforce (TEAPP, 2017). However, while remote work has been shown to increase geographic flexibility, its long-term implications for reversing brain drain remain unclear. These challenges underscore the need for further analysis to determine how remote work shapes migration patterns and mitigates regional disparities.

In this way, despite the depth of the growing body of literature, significant gaps remain in understanding the intersection of COVID-19, remote work, and domestic brain drain. Most existing studies either focus on international migration or provide descriptive analyses of remote work trends, leaving critical questions about domestic dynamics largely unanswered. Few studies explicitly explore how the COVID-19-induced surge in remote work opportunities influenced domestic migration patterns, nor do they employ rigorous econometric methodologies to quantify these effects. This study seeks to fill these gaps by employing empirical analysis to examine the relationship between remote work and domestic brain drain. By integrating quantitative and qualitative insights, it aims to provide actionable recommendations for policymakers seeking to balance regional development and talent retention in a post-pandemic labor market.

2 Data and Methodology

2.1 Defining Domestic Brain Drain

For the purposes of this study, domestic brain drain is defined as the migration of educated individuals away from their state of birth in pursuit of better economic opportunities. While some studies (e.g., Hershbein, 2024) evaluate brain drain based on migration away from the location where an individual received higher education, birthplace serves as a potent proxy for a state’s initial investment in an individual’s development, as emphasized

in past research (Social Capital Project, 2019). Migration away from one’s birthplace can thus be viewed as a loss of that investment, raising concerns about regional disparities in human capital.

A critical component of domestic brain drain is the behavioral preference of individuals to remain in their state of birth. Choudhury and Kwon (2023) highlight that social, cultural, and familial ties often anchor individuals to their home states, even when economic incentives favor migration. This preference is particularly strong in rural areas, where community bonds and identity play a significant role in shaping migration decisions. However, these preferences are frequently overridden by economic realities. Push factors such as limited career opportunities, inadequate infrastructure, and declining industries compel skilled individuals to leave their home state. Conversely, pull factors—including higher salaries, better career advancement opportunities, and urban amenities—draw them to metropolitan regions (Johnson, 2008; Sowl et al., 2022). Ultimately, the desire for increased wages and benefits often outweighs the preference to remain close to home, creating a domestic brain drain effect.

This study seeks to examine the extent to which this established preference to stay “closer to home” comes into play when workers are granted greater geographic freedom through remote work. Importantly, when identifying individuals who have taken advantage of the remote work surge to remain in their home state, our analysis considers two distinct variables of migration rather than one. First, we examine remote workers who have returned to their home state post-COVID. Second, we analyze individuals who grew up in their state of birth and chose to remain.

We posit that the behavioral preference to live in one’s home state not only has a reversal effect on brain drain dynamics through return migration but also plays a preventative role by enabling individuals to access higher-paying jobs out of state without ever leaving their home state in the first place. Measuring trends among these two groups post-COVID is crucial for understanding regional talent retention and migration. By doing so, we acknowledge not only the significant investments states make in their residents’ early education but also the multifaceted ways behavioral preferences influence migration dynamics.

2.2 Identification Strategy

2.2.1 Justification for The Difference in Difference Methodology

We conduct our analysis using a Difference-in-Difference (DiD) methodology, a quasi-experimental method that compares the changes in outcomes over time between a treatment group and a control group. We chose this model due to a phenomenon that occurred during the COVID-19 pandemic, when the Department of Homeland Security defined individuals employed in certain vocations as ‘essential workers’ or those who perform a variety of tasks and services that are generally vital for maintaining the functioning of critical infrastructure (NCSL). An example of a vocation within this definition is individuals working in the healthcare industry, who were deemed critical to continuing the functions of the United States. Essential workers faced a unique distinction from the rest of the United States labor force in that their work habits generally remained unchanged despite the growth of the COVID-19 outbreak.

Essential workers often had to remain physically present at their jobs during the pandemic, regardless of location. This characteristic makes them less likely to be directly influenced by the option to work remotely, reducing confounding effects related to remote work trends. The essential worker group represents a “business-as-usual” scenario where workers’ migration patterns were not significantly altered by remote work opportunities during the pandemic. This allows us to exploit the industries defined as ‘essential workers’ as a control group, that remains unchanged by the increase in remote work opportunities that came with the introduction of COVID-19.

Remote work industries, on the other hand, saw significant shifts in work practices during the pandemic, which may have influenced migration patterns (e.g., moving to cheaper or more desirable areas while retaining employment). Essential workers provide a natural contrast because their roles typically lack geographic flexibility (see Angelucci et al., 2020; Pabliona, 2024).

The Centers for Disease Control and Prevention defines essential workers based on the industry an individual works, not based on their occupation. Therefore, we match the industries from the CDC guidelines to the industries in our IPUMS USA dataset to create our control group.

Our DiD identification strategy setup now consists of a treatment group (remote workers), a control group (essential workers), and a time period before and after COVID-19’s introduction in 2020. Our *brain drain* variable offers a 0 or 1 outcome, therefore a logit diff in diff model is constructed and is denoted as such:

$$Y_i = \beta_0 + \beta_1 \cdot \text{treatment}_i + \beta_2 \cdot \text{post}_i + \beta_3 \cdot (\text{treatment}_i \times \text{post}_i) + X_i + \epsilon_i \quad (1)$$

Where X_i represents demographic control variables such as sex, race, and age. Y_i is our binary brain drain variable for each individual i , denoted by a 0 if an individual currently lives in the state they were born in, and a 1 if the individual does not currently live in their birthplace state. The treatment coefficient represents the individuals in our dataset who work remotely. The post variable represents the time period associated post-COVID-19 (2021 and 2022 in our dataset). Additionally, we interact with the treatment group with the post-COVID-19 identifier to observe remote workers’ tendencies to exhibit brain drain after 2020. β_3 is our coefficient of interest, reflecting the extent to which the average brain drain of remote workers has changed during the period following the treatment, compared to what would have occurred for the same group in the absence of COVID-19. Lastly, ϵ denotes the error term for our model.

2.2.2 Relevant Methodologies from the Literature

In migration research, logistic regression models have frequently been used to analyze binary outcomes, such as the decision to migrate or remain in a specific location. Gibson and McKenzie (2011) highlight the effectiveness of these models in capturing individual-level migration decisions while accounting for demographic and socioeconomic variables. Utilizing a difference-in-difference (DID) analysis allows for a nuanced analysis of migration patterns over time, enabling researchers to identify causal relationships between remote work adoption and domestic brain drain.

Other studies, such as those by DeFilippis et al. (2020) and Gallardo (2023), have incorporated econometric models to assess the geographic redistribution of workers in response to remote work policies. These approaches emphasize the importance of controlling for industry-specific and regional factors, which are critical for understanding the hetero-

geneous impacts of remote work on migration decisions.

2.3 Dataset - IPUMS USA

This study utilizes data from the Integrated Public Use Microdata Series USA (IPUMS USA), a comprehensive database comprising U.S. Census and American Community Survey (ACS) microdata. IPUMS USA is widely recognized for its reliability and versatility in demographic and economic analyses (Özden & Schiff, 2006). Our analysis spans the years 2012 to 2022, a period marked by significant transformations in work patterns due to the COVID-19 pandemic.

To examine the impact of the remote work phenomenon of domestic brain drain, we focus on individuals with at least a bachelor’s degree. This subset, representing skilled and educated individuals, aligns with standard definitions of brain drain as the migration of highly educated talent from one region to another (Chellaraj et al., 2006). Educational attainment categories include "Bachelor’s," "Master’s," "Professional Degree," and "Doctorate Degree," yielding approximately 3.4 million observations after filtering.

2.3.1 Strength of IPUMS USA

IPUMS USA is a robust, cross-section dataset frequently used in studies of migration and education, reinforcing its appropriateness for our analysis. The Social Capital Project (2019) leveraged IPUMS data to explore interstate brain drain within the United States, identifying trends in gross and net migration among highly educated individuals. Similarly, Chellaraj et al. (2006) employed IPUMS for examining education-migration dynamics, demonstrating its utility in understanding human capital mobility. These precedents validate our data selection, underscoring its capacity to provide granular insights into domestic migration and brain drain trends.

2.4 Variables of Interest

Key variables incorporated from the IPUMS USA into our analysis include:

- Birthplace: The state in which an individual was born.

- Current State of Residence: Identified using state Federal Information Processing Standards (statefip) codes, allowing for migration tracking.
- Educational Attainment: Limited to individuals with a bachelor’s degree or higher.
- Demographics: Age, sex, and race.
- Migration Indicators: Variables distinguishing movers (those residing in a state other than their birthplace) from stayers.

As mentioned above, IPUMS USA is a cross-section dataset, where different individuals are surveyed for each year of the survey. Cross-section data is well-designed for the implementation of aggregated trends for different groups of individuals and regions. However, its limitations should be acknowledged to contextualize the findings. Since the dataset does not follow the same individuals over multiple years, tracking personal migration patterns or pinpointing the timing of movements is not feasible. This ultimately means we cannot track specific individuals across time to identify their migration, employment, and decision-making at the individual level. If we were able to track individuals across time, we would be able to denote precisely when an individual returns or exits their state of birth. However, due to the nature of IPUMS USA’s migration and statefip indicators, we cannot identify the difference between someone who has recently moved back to their birthplace state versus someone who has never left.

Despite these constraints, IPUMS USA remains a useful tool for understanding the overlap of migration and remote work patterns - especially for investigating overarching population changes, such as the changes in the percentage of remote workers for any given state. By leveraging indicators such as state of current residence and state of birth, we can construct proxies for return migration. This approach allows us to identify patterns and associations at the population level, even if individual trajectories are not directly observable.

3 Exploratory Analysis

3.1 Remote Work Increase

Previous literature highlights COVID-19’s impact in boosting remote jobs across the United States. Figure 1 reinforces this observation by presenting cross-sectional data that shows a steady rise in remote work, with a sharp spike in 2020, coinciding with the onset of the pandemic.

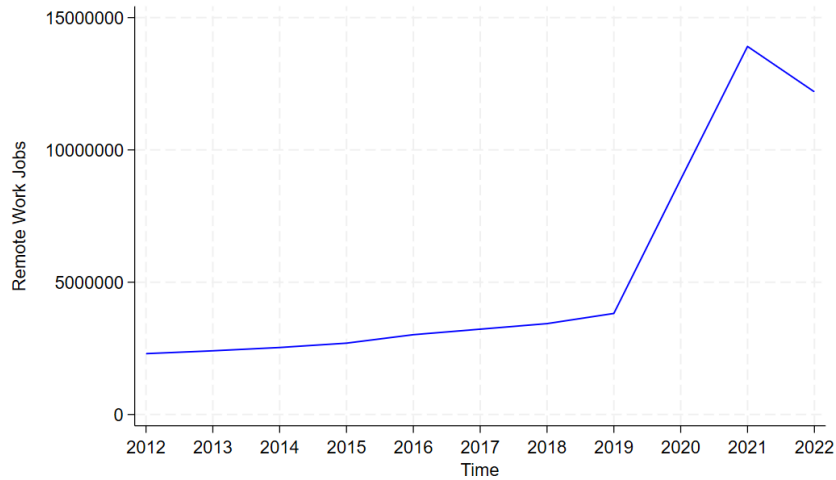


Figure 1: Remote Work Jobs Over Time

The slight decline in 2022 raises questions about whether the shift in work patterns will be permanent and if the proportion of remote work opportunities will remain at these elevated levels. Alternatively, remote work opportunities may return to pre-COVID-19 levels as companies resume in-person work or implement hybrid schedules.

3.2 Remote Worker’s Brain Drain Tendencies

Table 1 below provokes an interesting thought. The table reflects *only* the share of workers who dictate their work is performed remotely.

Period	"Brain Drain"	Percent
Pre-COVID (2012-2019)	Yes	49.26%
	No	50.74%
	Total	100.00%
Post-COVID (2020-2022)	Yes	42.86%
	No	57.14%
	Total	100.00%

Table 1: Remote Worker's "Brain Drain" Tendencies Before and During COVID

It is important to note that before the onset of COVID-19, approximately 51% of individuals working remotely lived in their state of birth, while 49% did not. However, after COVID-19¹, this figure increased to around 57%, indicating a 6% relative rise in the proportion of individuals working in their state of birth.

3.3 Differences Among States

States experiencing high levels of brain drain face significant challenges in retaining skilled workers, potentially due to lower wages, limited job opportunities in specialized fields, or a lack of industry presence. Individuals tend to migrate toward urban areas or states with robust job markets that offer better career prospects and quality of life (Florida, 2019). Figure 2 denotes the states that suffer the most from educated individuals leaving their state of birth.

¹There is a negligible difference whether or not 2020 is included in the post-COVID period

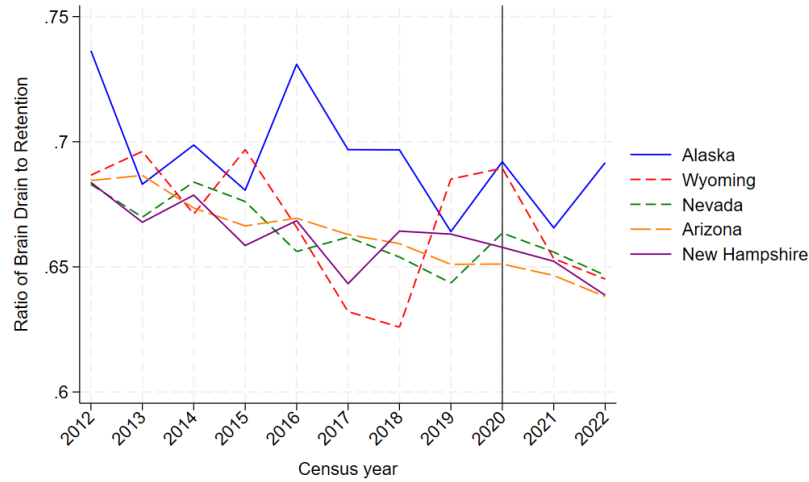


Figure 2: States that Experience the Highest Levels of Brain Drain

The interpretation of the visual above is that a value of 0.75 indicates that three out of every four *educated* individuals currently reside in a state different from the one they were born in.

Conversely, states with the highest levels of retention likely provide environments that encourage skilled workers to stay or return. For example, New York, with New York City as a major center of economic opportunity and growth, stands out. Its high retention rate is unsurprising, as individuals have easier access to economic prospects while maintaining strong familial and cultural connections to their birthplace in the state. Similar states can be referenced in Figure 3 below:

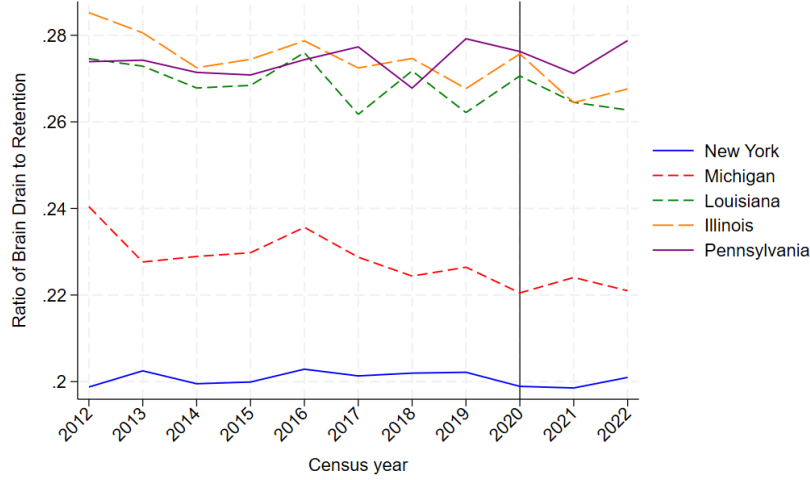


Figure 3: States that Experience the Lowest Levels of Brain Drain

For both "leave" states and the "retain" states, we see a relative decrease in brain drain compared to retention coinciding with COVID-19's timeline. This indicates that individuals are more likely to reside in their birthplace state in 2021 compared to a year before.

4 Logistic Difference in Difference Regression

The most important assumption for a DiD model is the parallel trends assumption, which asserts that both groups followed similar brain drain trends prior to COVID-19. The parallel trends assumption is crucial for difference-in-difference models to ensure validity. If the parallel trends assumption doesn't hold true, then this can lead to a biased estimation of the causal effect. This assumption holds true via visualization of pre-COVID-19 trends for both treatment and control groups, confirming that we would be able to accurately calculate the counterfactual using the trend observed in the control group. The difference between the remote workers' counterfactual trend (if the pre-COVID-19 trend was extended through 2022 on the same slope) and the actual post-COVID-19 trend reveals the causal effect of COVID on brain drain.

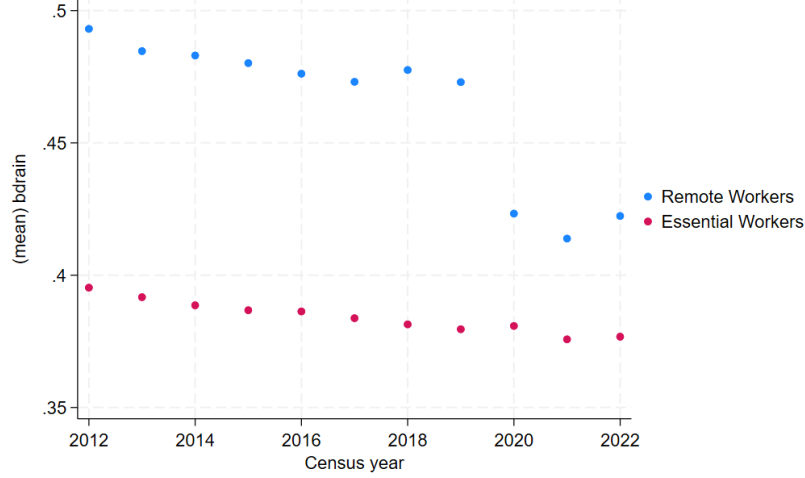


Figure 4: Parallel Trends Assumption Check

The post-COVID-19 results for remote workers show a notable decline compared to the pre-COVID-19 period, suggesting a negative causal effect of COVID-19 on brain drain among remote workers. This indicates that remote workers are now more likely to reside in the state where they were born. While this visual trend is insightful, a more precise understanding of the causal effect from a statistical perspective is provided in the following table which reveals the output of the logit model described in Equation 1.

Variable	Coefficient	Std. Err.	z	$P > z $	95% Conf. Interval
treated	0.3998609	0.0055376	72.21	0.000	[0.3890074, 0.4107144]
post_covid	-0.0414972	0.0085014	-4.88	0.000	[-0.0581595, -0.0248348]
treat_post	-0.0632739	0.0090919	-6.96	0.000	[-0.0810938, -0.0454541]
age	0.0123454	0.0001245	99.17	0.000	[0.0121014, 0.0125894]
race	-0.2051364	0.0012352	-166.07	0.000	[-0.2075573, -0.2027154]
sex	-0.0349229	0.0035198	-9.92	0.000	[-0.0418215, -0.0280242]
_cons	-0.6766208	0.0197006	-34.35	0.000	[-0.7152332, -0.6380083]

Table 2: Logistic Regression Results

The coefficient value of importance here corresponds to the `treatment_post` variable. This value denotes the difference between what happens vs. the counterfactual world if COVID hadn't happened. Since brain drain is a binary variable, a logit model was used.

The outputted coefficient needs to be converted to a ‘log-odds.’ The interpretation of the `treatment_post` coefficient, -0.0632739, is as such:

$$\log \left(\frac{P(Y = 1)}{P(Y = 0)} \right) \quad (2)$$

That being said, being a remote worker post-COVID-19 will result in a decrease in the log-odds by an amount of -0.0632739 . To translate the log-odds into an interpretable manner, we exponentiate Euler’s number, e , by the coefficient value.

$$e^{-0.0632739} \approx 0.938 \quad (3)$$

In other words, for the treatment group post-COVID-19, the odds of the outcome variable Y (brain drain = 1) against $Y = 0$ will decrease, making $Y = 1$ less likely than it was before the increase. Therefore, by interpreting the -0.0632739 coefficient, we can assert that the odds of brain drain for the treated group (remote workers) are approximately **6.2% lower** in the post-COVID-19 period relative to the control group (essential workers—who exhibited the same trends post-COVID-19 as before), all else equal. Working from home in the post-COVID period is associated with a decrease in the odds of brain drain.

5 Future Supporting Analysis

Although our robust difference-in-differences approach provides valuable insights into the impact of remote work on brain drain within the United States, additional complexities remain that our current dataset cannot fully address. Specifically, our analysis is constrained by the absence of longitudinal data that would allow us to disentangle the multifaceted dynamics of domestic brain drain and its potential reversal.

A dream dataset for this analysis would include panel data tracking individuals over time, capturing critical variables such as birthplace, current state of residence, higher education location, work modality (remote, hybrid, or in-person), occupation/industry, and the location of family members, particularly parents. Furthermore, access to data capturing individuals’ reasons for migration would enable a more nuanced understanding of behavioral and economic factors shaping migration decisions.

Such a dataset would allow us to isolate the two distinct dimensions of domestic brain drain hypothesized in this study: the "preventative" effect and the "reverse" effect. While our current data allow us to measure the preventative effect—where individuals remain in their home state while taking advantage of remote work opportunities—we cannot explicitly analyze the reverse effect, where former "home state leavers" return due to the increased geographic flexibility afforded by remote work. This limitation arises because our dataset only identifies individuals currently residing in their state of birth but cannot distinguish between those who have lived there continuously and those who have recently returned.

By addressing this gap, future research could provide a more comprehensive understanding of how remote work influences migration dynamics. Specifically, panel data would enable us to track individuals' movement patterns over time, offering critical insights into the behavioral preference to stay "closer to home" and its implications for both regional talent retention and the redistribution of human capital. Such an approach would enhance the ability to quantify the full impact of remote work on mitigating brain drain and fostering equitable regional development.

We have dedicated a significant amount of time to searching for a dataset that would allow us to conduct this next stage of analysis, but we have thus far been unsuccessful. Datasets that come close to meeting our needs include:

Panel Study of Income Data: The restricted access section includes essentially all variables necessary, *except for remote work*. Although it is not a complete dataset containing every ideal aspect, it still allows for further analysis at the individual decision making level. This would allow us to see when an individual moves around, their relative proximity to family and their birth state, location of higher education, etc.

National Longitudinal Survey: This is a panel study that tracks young individuals into adulthood and incorporates a variety of rich variables for analysis. Unfortunately, the same problem arises within this dataset wherein it lacks the essential variable needed; modality of work.

Real-Time Population Survey: This dataset, developed by Alexander Bick, Adam Blandin, and Karel Mertens in April 2020, aims to offer timely labor market data amid the COVID-19 crisis. While it provides valuable insights into the post-COVID-19 labor

market, a key limitation is the absence of pre-COVID-19 data, restricting the ability to observe historical trends before the pandemic.

6 Conclusion

The COVID-19 pandemic has reshaped labor markets globally, with remote work emerging as a pivotal force in redefining migration dynamics and addressing domestic brain drain within the United States. Our analysis provides compelling evidence that the decoupling of work and residence allowed by remote work has contributed to a measurable decline in brain drain tendencies among remote workers, with implications for regional talent retention and equitable economic development.

By employing a difference-in-differences methodology, this study highlights the potential of remote work to alter long-standing patterns of migration, offering individuals the opportunity to access economic opportunities without forgoing geographic or social preferences. The findings suggest that the expansion of remote work can reverse brain drain trends and potentially foster a "reverse brain drain," wherein skilled workers remain in or return to their home states while maintaining employment in urban job markets. However, the benefits of remote work are not uniformly distributed, as structural barriers such as inadequate digital infrastructure and disparities in job sector compatibility continue to limit its impact in rural and economically disadvantaged regions.

Despite these advancements, the limitations of the available data and the emerging nature of this labor shift indicate the need for further research. Longitudinal panel datasets tracking individual migration decisions over time would offer more precise insights into the causal mechanisms driving brain drain trends. Additionally, understanding how policies like broadband expansion or targeted remote work incentives might amplify these effects could provide actionable pathways for policymakers and regional stakeholders seeking to mitigate talent loss.

This study underscores the transformative potential of remote work in addressing regional inequalities, suggesting that the pandemic-era shifts in labor markets could yield lasting benefits for geographic mobility and economic resilience. However, realizing these outcomes will require deliberate policy interventions to ensure that the benefits of remote

work extend to all regions and demographics. By leveraging the insights from this research, stakeholders can foster a more equitable and inclusive economic landscape in the post-pandemic era.

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