

Redefining The WorkForce: Remote Work’s Impact on US Labor Force Participation and Gender Equality

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Abstract

This paper examines how access to remote work impacts the labor force participation rate, using data from the US Census. We find that access to remote work increases labor force participation by 43.7 percentage points for the entire population, 49.4 percentage points for women, and 53.9 percentage points for women and children in an Instrumental Variable Method. Difference-in-Difference models reveal that women experience an additional effect of 20.8 percentage points compared to men. Our results imply that policies that increase access to remote jobs can increase labor participation and close the labor participation gender gap.

Introduction

Recent literature studying the causes of the gender wage and earnings gaps finds a link between childcare responsibilities and labor force participation rates. For example, in “Children and Gender Inequality: Evidence from Denmark,” by Henrik Kleven, Camille Landais, and Jakob Egholt Søgaaard, the authors discuss the long-term impacts of childbirth on gender inequality in Denmark Kleven et al. (2019). They find that childbearing greatly affects women’s professional careers, spanning from gender pay gaps, employment

in specific industries, and career advancements. “The arrival of children creates a long-run gender gap in earnings of around 20 percent driven by hours worked, participation, and wage rates” Kleven et al. (2019). This implies there are likely social differences between expectations of childcare responsibilities between men and women.

If the gender wage and earnings gap can be explained by differences in childcare responsibilities, then theoretically, technological or policy advancements that provide access for women with children to remain in the workforce may increase labor force participation. Kim de Laat’s research in “Living to Work (from Home): Overwork, Remote Work, and Gendered Dual Devotion to Work and Family,” delves into this theory. Their qualitative study focuses on the gendered differences between remote work in family and careers de Laat (2023). The study highlights a phenomenon called “dual devotion,” where many working parents have a strong sense of devotion to both their families and their work. Interestingly, the author highlights men and women perceive remote work differently. They note that “men see it as an opportunity to dedicate more time to childcare, while women view it as a means to allocate more time to work.” de Laat (2023) However, De Laat also argues that while remote work may offer flexibility in a dual-devoted system, it also blurs the boundaries between work and family life, potentially increasing the workload for women de Laat (2023).

If access to remote work allows women to work more, then can access to remote work impact the labor force participation rate? Some notable efforts to answer this question include a paper by David H. Hsu and Prasanna B. Tambe and a Fed Note by Maria D. Tito. The note by Maria D. Tito in “Does the Ability to Work Remotely Alter Labor Force Attachment? An Analysis of Female Labor Force Participation,” looks at the relationship between remote work capabilities and women’s labor force participation Tito (2024). Tito defines “Remote Ability” as occupations where “usage of email, memo, and phone

is important or very important”Tito (2024). Tito finds that the ability to work remotely significantly increases labor force attachment for all prime-age individuals. However, the author also notes that these increases are due to broader labor market trends. “While the shift towards higher remote utilization is relatively recent, the ability to work remotely - which has significantly increased over the past few decades - has long influenced labor market outcomes and has created favorable conditions for particular demographic groups - such as, prime-age women”Tito (2024). The author also notes that remote work enhances female labor force attachment, particularly for those with childcare responsibilities.

David H. Hsu and Prasanna B. Tambe examine similar relationships in their paper, “Remote Work and Job Applicant Diversity: Evidence from Technology Startups,” and find that remote work options attract a more diverse workforce, including a higher proportion of women. “A discrete change in job posting to remote status (holding all else constant) is associated with an approximately 15 percent increase in applicants who are female, 33 percent increase in applicants with underrepresented minority (URM) status, and 17 percent increase in applicant experience David H. Hsu (2022). These findings suggest that remote work not only benefits individual women but also promotes broader workplace diversity.

While Hsu and Tambe find the effects of access to remote work from a recruiting perspective, they fail to answer how it attracts workers from outside of the labor force. Tito answers how an occupation’s remote ability affects labor force attachment. However, we argue that there are many factors at play when defining ”Access to Remote Work”. While an occupation’s remote ability is crucial to access to remote work, employees also need access to high-speed internet at home, industry and occupational policies that allow remote work, skills to enter a field with remote ability, and potentially other factors that affect the true access to remote work. To begin to fill this gap in the literature, this paper will use access to high-speed internet at home as an IV for ”access to remote work” to understand

how access to remote work can impact labor force participation in the US.

In our study, we focus on the relationship between gender equality and workplace dynamics, updating it to measure a modern breakthrough: remote work. Remote Work is still a relatively new concept for the general public, gaining mainstream attention during the COVID-19 pandemic. We look at how access to remote work impacts women’s decisions to participate in the labor force, covering from 2013 to 2022.

The gender wage gap is influenced by labor participation; thus, increasing participation might help close this gap. This study aims to find a causal relationship between remote work and women’s labor force participation. We defined remote work as a position of employment that had no requirements to work at a physical location, or “work-from-home” positions.

We utilized data from the U.S. Census Bureau through the American Community Survey (ACS) to investigate the association between remote work and labor force participation. This data provides comprehensive information on the U.S. population’s characteristics and is collected annually. We incorporated household and per-person level data, looking at variables such as high-speed internet, industry, gender, and the presence of a laptop in the home.

To analyze the impact of access to remote work on labor force participation, we employed two empirical models: (1) an Instrumental Variable (IV) approach, and (2) a Difference-in-Differences (DID) model. In addition to these models, we used a Post-Lasso approach to best select our controls for each model. Essentially, the IV model allowed us to estimate causal effects by employing high-speed internet access as an instrument for access to remote work. The DID model permitted us to analyze additional effects for women and women with children compared to men. The Post-Lasso model helped us identify all the

relevant controls for the analysis.

When running our models, we found that access to remote work significantly increased Labor Force Participation for all individuals in the U.S., with additional increases for women and women with children. We find that access to remote work increases labor force participation by 43.7 percentage points for the entire population, 49.4 percentage points for women, and 53.9 percentage points for women and children. Women experience an additional effect of 20.8 percentage points compared to men, and women with children experience an additional 11 percentage points compared to men and women without children. Our analysis additionally revealed that industry was a significant variable affecting Labor Force Participation, highlighting the correlation between occupations and potential workforce policies.

Our study underscores the need for policy shifts to improve access to remote work, particularly for women and women with childcare responsibilities. Our findings highlight the gender disparities that occur in the workspace, and continued research is needed to promote workforce participation and gender equality.

Data

We used data from the U.S. Census Bureau through the American Community Survey (ACS), which annually gathers and produces information on the U.S. population's social, economic, housing, and demographic characteristics. To get results that reflect more variance between the four years chosen, we used the one-year Public Use Microdata Sample. The one-year samples take survey responses throughout each year and take the average response for each survey respondent to account for sample variance that may occur at a daily level. Since this data only covers a year, to reduce sample variance, the ACS only surveys

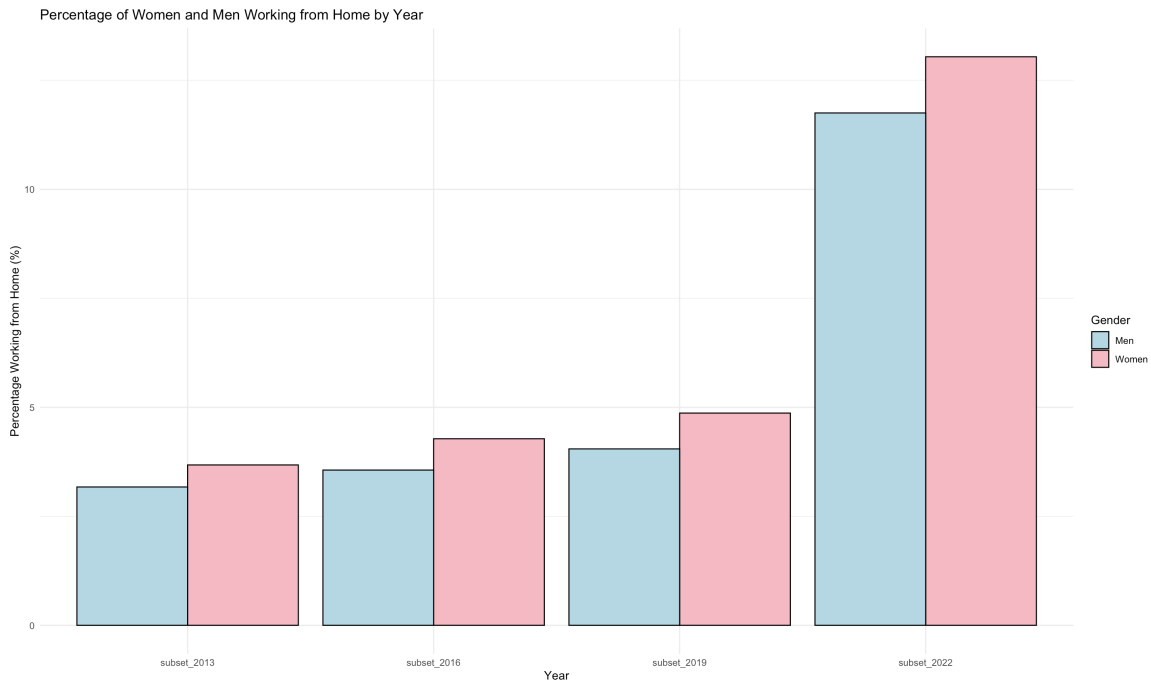


Figure 1: This Figure pulls Work-From-Home Levels for Men and Women every year. We see the percentage for women is consistently higher than the men's.

areas with populations greater than 65,000. This limits the sample to about 1 percent of the U.S. population, separated statewide. This limits the ability to pull data from smaller areas such as counties and block groups. To accurately represent the population of the U.S., we use the reconstructed weighted adjusted variables to scale the sample data.

The PUMS surveys include two separate files per year: one file with person-level data, and one file with household-level data. The variables that we used from the person-level data are sex, race, educational attainment, state, marital status, employment status, industry, female parent, means of transportation to work, personal income, and age. We also needed variables such as couple type that asks about the gender of individuals in each couple, the presence of a laptop in the home, access to high-speed internet, and family income from the household-level data.

To create our final dataset, we first merged the household and person datasets for each year

to create data at the person-household level. We then created a new Work from Home variable from the Means of Transportation variable from the original ACS. In the survey, this question asks about how individuals commute to work, but it also provides an option that says "I work from home". Our work-from-home variable is an indicator equal to 1 if the individual selected this option from the means of transportation to work, 0 if they selected another option, if they are out of the labor force, or if they are unemployed. The way that this variable is created only allows for analysis for those who are currently employed. Therefore, the IV is vital to understanding how access to remote work impacts labor force participation.

Methodology

To carry out our study, we employed an Instrumental Variable (IV) method to estimate the causal relationship between female labor force participation and work-from-home rates. Whether one works from home cannot be used to directly explain how access to work from home increases labor force participation due to the classification of our remote work variable. Working from home implies that the individual is in the labor force and it does not accurately measure remote work access. To mitigate this, we will use high-speed internet as an instrumental variable to measure access to remote work. A valid instrument will induce changes in the explanatory variable correlated with the endogenous variable but has no independent effect on the dependent variable. In this study, we identified high-speed internet access as our instrumental variable (Z_i), the work-from-home indicator variable as the independent variable (D_i), and labor force participation as our outcome (Y_i). First, we employ the First Stage Regression to show that the treatment variable is regressed on the instrument and mainly is used to show that the instrument is strongly correlated with the endogenous explanatory variable. In our study, our First Stage estimates the effect of high-speed internet on the work-from-home rate. The Reduced Form model shows the

relationship between the outcome variable from the First Stage and the instrument and estimates the impact of high-speed internet on labor force participation. We employ various specifications including regressions for the entire population, only women, and only women with children.

For the First Stage Regression, the empirical model applied is:

$$WorksFromHome = \alpha + \beta * AccesstoHighSpeedInternet + u \quad (1)$$

For the Reduced Form Regression, the empirical model applied is:

$$LaborForceParticipation = \alpha + \beta * AccesstoHighSpeedInternet + u \quad (2)$$

The two models are used to estimate our IV model:

$$LaborForceParticipation = \alpha + \beta * AccesstoRemoteWork + u \quad (3)$$

We use these models to study the effects for data of the entire US, only women, and only women with children.

Two additional Difference-in-Difference (DID) models are also run to estimate the additional effects for women and women with children, compared to men and women without children. The treatment groups are defined as individuals who have access to remote work (indicated by the 'WFH' variable below). Throughout this model, we compare changes in Labor Force Participation rates between the treatment and control groups.

The DID models are specified as follows:

$$LaborForceParticipation = \alpha + \beta_1 * WFH * Female + \beta_2 WFH + \beta_3 * Female + \beta_n * X_n + u \quad (4)$$

$$LaborForceParticipation = \alpha + \beta_1 * WFH * FemaleParent + \beta_2 WFH + \beta_3 * FemaleParent + \beta_n * X_n + u \quad (5)$$

These equations estimate the effects of access to remote work for women (indicated by "Female") and women with children (indicated by "FemaleParent") with controls X_n .

In addition to the IV and DID analyses, we also employed a post-Lasso model to identify all relevant controls correlated with access to high-speed internet and Labor Force Participation. This model was important in understanding the factors in our dataset that influence our question, allowing us to include relevant covariates when carrying out our regressions. All estimates are produced in R Studio.

Results

To evaluate if access to high-speed internet is a good instrument, we created a balance table to measure the differences in characteristics between the treatment and control groups. A variance ratio different from 1 would imply that there is a significant difference between the means of individuals with high-speed internet and individuals without high-speed internet. Table 1 below shows that all variance ratios are very close to one. This implies that our sample is balanced and can produce causal results. However, the variance ratio in industry may be misleading due to the structure of the variable. Since the industry variable is measured with industry codes, the means are not interpretable. To provide additional security that our sample is balanced, we used Post-Lasso to search for variables that are correlated with high-speed internet and labor force participation. Post-lasso found that industry is cor-

related with both High-Speed Internet and labor force participation. We included industry as a control in the following regressions.

	Means Treated	Means Control	Std. Mean Diff.	Var. Ratio	eCDF Mean	eCDF Max	Std. Pair Dist.
distance	0.80	0.80	-0.00	1.00	0.00	0.00	0.00
State	26.10	26.11	-0.00	0.97	0.01	0.02	1.15
Female	0.51	0.51	-0.00		0.00	0.00	0.99
Industry	6545.74	6635.89	-0.04	0.99	0.01	0.04	0.95
Female Parent	1.52	1.53	-0.01	1.00	0.00	0.01	1.06
Educational Attainment	18.38	18.33	0.01	1.07	0.01	0.02	0.61
Race	2.60	2.64	-0.02	0.98	0.01	0.01	0.89
Age	42.13	42.33	-0.02	0.95	0.01	0.02	1.13
Family Income	89292.23	89307.38	-0.00	0.93	0.01	0.03	0.37
Rent as Percent of Income	28.73	28.51	0.01	0.82	0.02	0.07	0.95

Table 1: Balance Table

In Table 2 below, we find for all individuals in the US, access to remote work increases the likelihood that one participates in the labor force by 69.2 percentage points at a 0.01 significance level. For women, access to remote work increases labor force participation by 68 percentage points at a 0.01 significance level. Lastly, access to remote work increases labor force participation by 63.7 percentage points for women with children. There seems

Table 2: Regression Results

	<i>Dependent variable:</i>		
	Labor Force Participation		
	US	Women	Women with Children
Works From Home	0.692*** (0.035)	0.680*** (0.049)	0.637*** (0.076)
Has High Speed Internet	-0.00001*** (0.00000)	0.00000*** (0.00000)	0.00000*** (0.00000)
Industry	0.861*** (0.002)	0.746*** (0.004)	0.777*** (0.006)
First-stage F-statistic	1942.39		
First-stage p-value	$< 2e - 16$		
Observations	674,769	344,392	128,895
R ²	-0.136	-0.080	-0.090
Adjusted R ²	-0.136	-0.080	-0.090

Note:

*p<0.1; **p<0.05; ***p<0.01

to be some differences in the effects for women and women with children compared to the entire US, so to understand if there is a statistically significant difference, we ran 2

differences in difference regressions below. In Table 3, The first regression estimates the additional effect of access to work from home for women on labor force participation. The second regression estimates the additional effect of access to remote work for women with children on labor force participation. We find that women experience an additional 16.9 percentage point increase in labor force participation compared to men, while women with children experience an additional 9.1 percentage point increase compared to men and women without children, both at a 0.01 significance level.

Table 3: Regression Results

	<i>Dependent variable:</i>	
	Labor Force Participation	
	(1)	(2)
Works From Home	0.524*** (0.052)	0.500*** (0.048)
Female	-0.113*** (0.004)	
Woman with Children		-0.029*** (0.001)
Industry	-0.00000 (0.00000)	-0.00000*** (0.00000)
Works From Home*Female	0.169** (0.067)	
Works From Home* Female Parent		0.091*** (0.020)
Constant	0.887*** (0.002)	0.883*** (0.002)
First-stage F-statistic	1942.39	
First-stage p-value	$< 2e - 16$	
Observations	674,769	674,769
R ²	-0.077	-0.106
Adjusted R ²	-0.077	-0.106

Note: *p<0.1; **p<0.05; ***p<0.01

All of these models have very low R^2 values. While that is typically cause for concern, Wooldridge claims that the R^2 value is very uninformative for 2-stage least squares regres-

sions and recommends using the F statistic instead. Wooldridge (2013) We've reported the F statistic at the bottom of these tables for the first stage regressions of access to high-speed internet on work from home. The F statistic is very high at 1942.39 with a p-value very close to zero. In general, a low p-value of the f statistic would indicate that the model fits very well. However, such a large F statistic is concerning and highly unlikely. More research is needed before verifying these results.

Additionally, our paper has some limitations when carrying out our experiment. Using the 1-year ACS data files from the U.S. Census Bureau restricts our sample to areas with populations of 65,000 persons or higher. This excludes rural areas which may experience different impacts to access to remote work. We recommend further research using the 5-year estimates to better understand the impact on rural communities. Lastly, there are many barriers to remote work access and high-speed internet is only one of them. While access to high-speed internet does increase the likelihood that one works from home, it does not comprehensively explain access to remote work. More research should be done with other measurements of access to remote work to verify our results.

Conclusion

In conclusion, we find that access to remote work increases Labor Force Participation rates, and has additional increases for women and women with children. However, our results rely on the relationship between internet access and remote work. While access to the internet does increase labor force participation, there may be alternative explanatory variables to use that may better measure access to remote work. Future research should focus on new methods of measuring access to remote work and advancing policies regarding workforce dynamics and gender equality.

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