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ABSTRACT

Remote Work, Children's Health and the Racial Gap in Female Wages

This paper studies the racial gap in the female wage penalty to remote work. Using a temporary child health problem as a source of exogenous variation in the propensity to work from home, wage penalties reach 86 percent for black women and 77 percent for white women. Promotion bias, task re-assignment and lack of productive social interaction are the most likely mechanisms for the wage losses. The estimates provide rare evidence on the differential costs of social distancing by race and may be especially applicable when children are temporarily quarantined due to illness.

JEL Classification: C26, J13, J22, I19

Keywords: female labor supply, female earnings, race, remote work, telecommuting, flexible working arrangements, fertility, health

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1 INTRODUCTION

Do women who work at least some hours from home earn less on average than similar women who work exclusively on-site? Remote work could lead to a reduction in earnings if jobs that permit work from home offer lower wage rates. Lower wage rates may arise if working from home is considered an employee benefit. The perceived benefits can include better coordination of time needed to care for children as well as reduced childcare and commuting costs. Previous research has also shown that remote work is associated with an increase in job satisfaction (Virick et al., 2010) and helps alleviate fears of social stigma (Ghumman and Jackson, 2010; Tislick et al., 2015; Follmer et al., 2018).

Another possibility for the existence of a wage penalty is that remote work negatively impacts an individual's productivity. Lower productivity may result from distractions in the home, shirking due to less effective monitoring, or the employee being re-assigned to less valuable job tasks that are more suitably performed at home. A desire to work from home might also signal to employers a limited commitment and devotion to the job which then delays or prevents a move up the job ladder (Golden, 2008; Kaplan et al., 2018; Golden and Eddleston, 2020). In addition, sociologists, psychologists, economists and organizational behavior researchers have long emphasized the importance of social capital, network relationships and interaction with co-workers as key factors for successful employment outcomes (Milgrom and Oster, 1987; Williams, 2000; Blair-Loy, 2006; Hersby et al., 2009; Williams et al., 2013; Allen et al., 2015; Cassidy et al., 2016; Bertrand et al., 2019).

While the effect of general work flexibility on earnings has been studied extensively

(see e.g., Goldin and Katz (2011); Flabbi and Moro (2012); Goldin (2014); Goldin and Katz (2016); Wiswall and Zafar (2018); Cortes and Pan (2019); Cubas et al. (2019); Ishizuka and Musick (2021)), the empirical evidence on remote-work wage losses (or gains) remains sparse and inconclusive. Notable previous research in this specific area includes Bertrand et al. (2010) which finds that female MBA graduates suffer earnings penalties that range between 20 and 60 percent. In contrast, Glass and Noonan (2016) find in more representative data that remote work during regular working hours is associated with only a very modest effect on earnings. Bloom et al. (2015) provide evidence of a positive rather than a negative productivity effect of working at home amongst call-center employees in China. Using a sample of professional employees in a company providing technology services with locations throughout the U.S., Golden and Eddleston (2020) find that telecommuters experience lower salary growth compared to non-telecommuters.

In this paper, the relationship between remote work and earnings is studied by linking data on women in the National Longitudinal Study of Youth (NLSY79) to their children in the NLSY79 Child and Young Adult Survey (CYA). Our main contribution to the literature is twofold: (i) this is the first study that focuses exclusively on the racial gap in female wage penalties to remote work and (ii) the data allow us to provide a range of estimates that include not only Ordinary Least Squares (OLS) and Fixed Effects (FE) results but also Instrumental Variables (IV) estimates. The IV procedure exploits a temporary child health problem as a source of exogenous variation in the propensity to work from home. To the extent that a temporary child health issue is a valid instrument, the IV estimates help further correct for biases due to unobserved omitted variables that change over time and reverse causality that have also not been comprehensively

addressed in the literature on remote-work wage losses.

It is important to note that working from home was already a major phenomenon well before the COVID-19 pandemic emerged. Prior to the start of the pandemic, Dingel and Neiman (2020) estimated that 37 percent of all jobs in the US could be performed entirely at home, and that these jobs accounted for 46 percent of all wages. As a result of public health policies that were adopted during the pandemic, and as metaverse platforms further develop, it is likely that the share of all jobs involving at least some remote work will continue on an upward trend. Since public health measures can also impact time spent by children in school and at daycare centers, disruption in child care needs may also continue to have consequences, especially for working mothers, through the loss of work experience, delayed promotion, a shift to employment in less demanding jobs and prolonged exit from the labor market. This will potentially lead to a further widening in race and gender inequality (Alon et al., 2020).

Results from studies that concentrate on the labor market impact of the recent pandemic clearly show that average hours worked have declined more for females than males in percentage terms (Bick and Blandin, 2021). There is also emerging evidence that women are managing to perform less employment tasks from home than men as the time spent in household production by women is differentially greater (Adams-Prassl et al., 2020). In this paper, the focus is on the relationship between remote work, temporary child health issues and racial differences in female wage losses prior to the pandemic. However, the findings should be relevant for assessing the differential costs of social distancing by race for females both in the present and foreseeable future.

The CYA dataset is particularly useful in this context because it contains assessments of the health of all biological children born to female respondents in the NLSY79. This

allows construction of the child health instrument. The logic of the instrument is that a sudden and temporary child health problem increases the desirability of remote work so that a mother can more flexibly deal with disruption in childcare needs. The IV results add to the OLS and FE evidence to the extent that the temporary child health problem is not a direct burden on work-task completion beyond that caused by the change in work venue alone. Note that OLS and FE estimates are also of considerable value in themselves given the very limited evidence that currently exists on racial gaps in female remote-work wage losses.

The main results of the study indicate that there is a wage penalty to work from home which is substantial in magnitude and statistically significant for both races, and there is a large racial gap in which black women are penalized more than white women. According to our preferred specifications, OLS estimates indicate that working from home leads to a decrease in the mean hourly wage of 18 percent for black women and 8 percent for white women. The 10 percentage point race gap is equivalent to a 55.5 percent difference using the black wage penalty as a base. FE estimates, which take advantage of the longitudinal aspect of the data, yield a wage penalty for black women of 15.5 percent and a wage penalty for white women of 11.8 percent. The race gap of 3.7 percentage points implies a 23.9 percent increase. IV estimates that include fixed effects and exploit the child health instrument produce larger wage penalties for both races, reaching 86 percent for black women and 77 percent for white women. The race gap of 9 percentage points is equivalent to a 10.5 percent deficit. The absolute magnitudes of the wage penalty are clearly larger in the IV procedure while the percentage difference is attenuated compared to OLS and FE estimates.

In order to assess the extent to which differential remote-work wage penalties

contribute to the overall female racial wage gap, a Blinder-Oaxaca wage decomposition is performed. Using the IV estimates, the decomposition shows that the differential wage penalties to remote work account for 6.63 percent of the overall racial wage gap. In comparison, differential rates of pay in professional, technical and managerial jobs account for 7.65 percent of the female racial wage gap. Thus, racial differences in female wage rates for remote work are of similar importance to differential pay in high-skilled occupations. This is an interesting new finding of the study.

One of the main reasons that the IV estimates of the wage penalties are larger than those found using OLS and FE procedures is that they are local average treatment effects (LATE) as opposed to average treatment effects. LATE estimates pertain to working mothers who are just on the margin of working exclusively on-site or working some hours from home, and who are induced to work from home solely due to the temporary child health problem. The larger IV estimates, relative to OLS and FE, implies that these latter women (the compliers) have higher unobserved earnings potential and there is positive selection into working from home.

The co-existence of positive selection and a substantial wage penalty to remote work, combined with the results of additional reduced-form regressions, suggest that certain mechanisms are more likely to drive these findings than others. The results are more consistent with promotion bias, women performing less "valuable" work assignments from home, and having less productive social interactions with colleagues, than they are with employee shirking, a reduction in hours worked, or occupational changes to lower paying jobs that are more conducive to remote work. The problems of promotion bias, task re-assignment and loss in social capital appear to be differentially worse for black women.

The rest of the paper is structured as follows. Section 2 describes the data. Section 3 presents OLS and FE estimates of the wage penalty and the racial gap. Section 4 describes the temporary child health problem instrument. Section 5 explains the IV estimation framework and reports reduced form and IV results for the wage penalty and racial gap. Section 6 discusses the magnitudes of the estimates, the potential mechanisms underlying the wage penalty, assesses the validity of the instrument through two different validity tests and computes the relative importance of the differential remote-work wage penalty for the female racial wage gap in general. The last section summarizes and concludes.

2 DATA

The NLSY79 is a large nationally representative sample of American men and women who were 14-22 years old when they were first surveyed in 1979. Data is available at an annual frequency until 1994. The survey became biannual from 1994 onwards. The NLSY79 follows the same individuals over time, gathering event histories related to the respondent's labor market experience, education, family background and wages.[1] This study focuses on black and white females. We exclude Hispanic and Latino females as well as military personnel due to the relatively small number of observations and non-representativeness in these latter subgroups.

The NLSY79 introduced questions on the number of hours per week usually worked at home starting in 1988. This determines the starting year for the analysis. The sample

[1]The sample originally included 12,686 respondents. It contained a cross-section of 6,111 individuals of which 3,108 were women (2,279 white, 405 black, 226 Hispanic or Latino and 178 white disadvantaged). There was also a set of supplemental samples designed to increase the representation of civilian Hispanics or Latinos, Blacks and the economically disadvantaged non-Black/non-Hispanic youths (5,295 in total of which 2,719 were women - 751 Hispanic or Latino, 1,067 black and 901 white disadvantaged), as well as a military oversample designed to increase the representation of those serving in the military as of September 30, 1978 (1,280 in total). In 1985, the military sample was discontinued (1,079 members of the military sample were dropped). In 1991, all members of the economically disadvantaged non-black/non-Hispanic oversample were dropped as well. More information on NLSY79 can be found here. More information on NLSY79 sample design can be found here.

is limited to employed females who are 24 to 55 years old between the years 1988 and 2012. Since fixed-effects regressions are estimated, more than one year of employment attachment for each female in the sample is required. After implementing additional standard sample exclusion restrictions, the estimation sample consists of 888 black women with 9,764 women-year observations and 1,607 white women with 17,385 women-year observations. While including male workers would allow interesting gender-based comparisons, the CYA surveys contain information on the children of NLSY79 female respondents only.[2]

In the CYA surveys, children are assessed and interviewed every two years since 1986. For consistency with the NLSY79, children are followed only after 1988 when the remote work questions were introduced. Information about a child's health is first provided by the mother. After the age of 15, the health information becomes self-reported by the child. The questions on temporary health conditions in the CYA enable the creation of health histories for the children of NLSY79 female respondents which are used in the instrumental variables analysis.

Various questions in the CYA that refer to the time a specific health problem occurred are used to build a continuous health history for each child and assess the permanent or temporary nature of the health issue. The questions pertain to how long the child has had limitations, date of most recent accident/injury and other more specific questions about the child's health status in the last 12 months. Temporary health problems include limiting health conditions, accidents and injuries requiring medical attention or hospitalization, emotional and behavioral problems, as well as utilization of specialized

[2]The additional sample exclusion restrictions are as follows. Only women who have finished their education are included in the sample. Women with incomplete observations on their marital status and fertility history, inconsistent schooling information, and missing information on occupation (missing census code) and wages are excluded. Self-employed women are also excluded. While self-employed women can often flexibly choose working time, place, and pay, they do not report their hourly wage in the NLSY79 which is the main outcome of interest in this analysis. See also Budig and Hodges (2010).

medical equipment and services. The number of children of black women in the sample is 1,850 and the number of children of white women is 3,028.

Weekly employment histories in the NLSY79 are used to construct total annual hours worked. The survey questions ask respondents (i) the total hours usually worked per week at a specific job; and (ii) the hours per week usually worked at this specific job at home. Total annual hours worked for each female in the sample is defined as the sum of weekly hours worked on site (job location is outside of the home) and weekly hours worked at home. A woman is defined as employed if she reports working at least 10 hours per week or 520 hours annually. If the sum of annual hours is less than 520, she is also determined to be employed if she worked more than 260 hours in total and reported more than 30 hours weekly. For wages, the hourly rate of pay at the time of the interview is used.[3]

The overwhelming majority of women in the sample do not work exclusively at home. The distribution of remote work hours shows that 87.4 percent of black women and 91.8 percent of white women work at home less than 1,560 hours per year (30 hours per week on average), while 70.2 percent of black women and 72.8 percent of white women work less than 520 hours (10 hours per week on average). The mean hours worked at home, excluding zero hours, is 619 for black women and 500 for white women. The means are equivalent to a little more than one day a week of remote work.

Table 1 displays the proportion of women that work at home and the distribution of the number of children under 18 at selected ages of the woman. Pooling over all

[3]Respondents in the NLSY79 can report up to five employers in a survey interview. If more than one employer is identified, only the hourly wage and total annual hours worked at the main job are considered. The main job is defined as the job in which the individual works the most hours in each year. Focusing on the main job is probably not a serious limitation as the annual average multiple job-holding rate for the U.S. was only 4.9 percent in 2012 and had declined gradually or remained flat each year since peaking at 6.2 percent in 1996 (Campolongo, 2013). The highest 1% and the lowest 2% of reported hourly wage observations on the main job are treated as missing. More information on NLSY79 wages can be found here.

ages, the work-at-home rate is 9.9 percent for black women and 17.2 percent for white women. Column (1) shows that the proportion of black women who work at home drops from 9.6 percent at age 25 to a low of 2.3 percent at age 55. Column (4) displays the proportion of white women who work at home. Similar to black women, the proportion drops steadily from a high of 21.7 percent at age 25 to a low of 13.4 percent at age 55. Columns (2) and (5) reveal a u-shape in the proportion of women with no children under the age of 18. For black women, the proportion is 44.6 at age 25, falls to a low of 21 at age 35, and then rises to reach a high of 95.5 at age 55. Similarly, for white women, the proportion of those with no children under the age of 18 is 66.9 percent at age 25, 22.1 percent at age 35, and 92.1 percent at age 55.

Table 1 does not suggest a strong correlation between working at home and the mere presence of children in the household. If this were the case, one would expect to see an increase in the proportion of those working at home (or at least a slower drop) as the proportion with no child under 18 decreases. The proportion of those working at home should also decrease more rapidly as the proportion of women with no child under 18 increases again. Neither of these patterns clearly emerge. This leaves room for other explanations for the propensity to work at home, such as the health status of children, which is developed further below. Table 2 displays sample means by race and work location (at home vs. on site). On average, black women earn 15.3 percent less than white women. Black women are underrepresented in medium and high skilled occupations and overrepresented in low skilled occupations. Black and white women are also different in terms of family structure; a much higher proportion of white women are married, while the spouses of white women earn more in comparison to the spouses of black women.

Table 1: Proportion Working at Home and Distribution of Number of Children < 18 at Selected Ages

	Black Women			White Women		
Age	Work at Home (1)	No Child <18 (2)	*N* (3)	Work at Home (4)	No Child <18 (5)	*N* (6)
25	.096	.446	157	.217	.669	290
30	.114	.277	491	.197	.386	888
35	.097	.210	442	.166	.221	809
40	.107	.294	374	.141	.241	611
45	.076	.505	291	.157	.437	535
50	.125	.745	192	.158	.734	354
55	.023	.955	44	.135	.921	89
Total	.099	.365	9,674	.172	.388	17,385

Note: N is the number of observations at each age. Total refers to all ages between 24 and 55.

The figures illustrate that both black and white women who work at home tend to be more highly educated, are more likely to work in professional, technical or managerial roles, work more hours in total and are more likely to be married. Black women's wages do not differ by work location, while white women who work at home tend to have higher wages on average. The unconditional correlation between hourly wages and work location indicates a 10 percent wage premium to working at home, rather than a wage penalty, for white women only.[4]

3 OLS AND FE ESTIMATES

OLS and FE estimates of the impact of working at home on mean wages by race are presented in Table 3. Columns (1) and (4) include an indicator for working at home

[4]NLSY79 respondents were asked whether their employer has made available flexible hours or work schedule. Black and white women in our sample are offered time flexibility in equal proportions and independently of whether they work at home or not.

Table 2: Sample Means

	Black Women			White Women		
	All	Work at Home	Work on Site	All	Work at Home	Work on Site
	(1)	(2)	(3)	(4)	(5)	(6)
Age	37.10	36.66	37.15	37.05	36.28	37.21
$hgc < 12$	.078	.049	.082	.060	.019	.068
$12 \leq hgc < 16$	.800	.662	.815	.729	.559	.764
$hgc \geqslant 16$	.122	.289	.104	.211	.422	.167
Professional, Technical and Managerial	.214	.475	.186	.337	.561	.291
Sales and Clerical	.332	.222	.344	.358	.229	.384
Services, Craftsmen, Operatives and Laborers	.454	.304	.470	.305	.209	.325
Total Hours$\leqslant 1,040$	.146	.102	.151	.159	.143	.162
$1,040 <$Total Hours$\leq 1,560$	.148	.113	.152	.166	.146	.171
$1,560 <$Total Hours$\leq 2,080$	.500	.212	.532	.448	.219	.496
Total Hours$> 2,080$	.206	.572	.166	.227	.492	.172
Married	.481	.549	.474	.708	.738	.702
Log of Spouse Earnings	10.251	10.468	10.220	10.523	10.646	10.492
Log of Hourly Wage	2.392	2.391	2.393	2.546	2.628	2.528
NT	9,674	961	8,713	17,385	2,994	14,391

Note: The figures are averages. The number of black women is 888 and white women is 1,607. is the number of woman-year observations. hgc is highest grade completed. Total hours is the sum of hours worked on site and at home in a calendar year. Spouse earnings are annual earnings of spouse from all jobs before any deductions. Wages are hourly wages from the main job earned by an employee in a calendar year. Missing spouse earnings are not included. Wages and spouse earnings are deflated using the CPI index with a base year of 2005.

as the sole covariate. This base specification, estimated by OLS, yields a remote-work wage penalty of -.2 percent for black women and a 10 percent wage premium for white women (as expected from the corresponding unconditional correlations in Table 2). The 10 percent average wage premium amongst white women is statistically significant.

In columns (2) and (5), confounding determinants of earnings are added, including education, annual total work hours, occupation, marital status, spousal income and number of children. The OLS estimates in columns (2) and (5) now reveal a substantial and statistically significant wage penalty for both races. Working at home is associated with a decrease in mean wages of 18.2 percent for black women and 8 percent for white women. The racial gap in the wage penalty is 10.2 percentage points. This constitutes a 55.5 percent racial difference using the black wage penalty as the base. The estimates in columns (2) and (5) show expected wage effects for level of education, total hours worked, being employed in a professional, technical or managerial occupation, and being employed in a sales or a clerical position.

Columns (3) and (6) report FE estimates which take advantage of the longitudinal aspect of the data. Eliminating time-invariant unobserved individual characteristics and controlling for time-varying observed heterogeneity, precisely estimated wage penalties of 15.5 percent for black women and 11.8 percent for white women are obtained. The racial gap of 3.7 percentage points in the wage penalty decreases compared to OLS but is still a substantial 23.9 percent. The other determinants of earnings which are time-varying are reduced in magnitude in comparison to OLS, though most remain statistically significant for both black and white women.[5]

[5] We have also run regressions which include an additional dummy variable equal to one if spousal income is missing and equal to zero otherwise. The estimates from these latter regressions were not substantially different from those reported.

Table 3: OLS and Fixed Effects Estimates of the Remote-Work Wage Penalty

	Log of Hourly Wage					
	Black Women			White Women		
	(1)	(2)	(3)	(4)	(5)	(6)
Work at Home	-.002	-.182	-.155	.100	-.080	-.118
	(.055)	(.043)	(.031)	(.028)	(.025)	(.019)
$I(12 \leq hgc < 16)$		.199			.164	
		(.033)			(.033)	
$I(hgc \geqslant 16)$		.536			.496	
		(.051)			(.041)	
$I(1,040 <$Total Hours$\leq 1,560)$		.077	.049		.039	.018
		(.022)	(.018)		(.018)	(.014)
$I(1,560 <$Total Hours$\leq 2,080)$		.260	.105		.225	.100
		(.018)	(.016)		(.018)	(.013)
$I($Total Hours$> 2,080)$		.329	.122		.258	.086
		(.024)	(.020)		(.022)	(.016)
Professional, Technical		.338	.086		.389	.147
and Managerial		(.028)	(.020)		(.022)	(.017)
Sales and Clerical		.251	.019		.190	.059
		(.022)	(.017)		(.019)	(.016)
Other regressors	No	Yes	Yes	No	Yes	Yes
Fixed Effects	No	No	Yes	No	No	Yes
Adjusted R^2	.000	.251	.087	.004	.237	.086

Note: Clustered standard errors at the individual level in parentheses. The number of black women is 888; the number of black woman-year observations is 9,674. The number of white women is 1,607; the number of white woman-year observations is 17,385. The dependent variable is the natural log of hourly wage in constant 2005 dollars. Work at home is an indicator for having worked at home during the survey year. *hgc* is the highest grade completed. Total hours refer to the sum of hours worked on site and at home in a calendar year. Other regressors include age, age squared, an indicator for whether the woman is married, spousal income, and an indicator for having children under 18.

4 Temporary Child Health Problems

The OLS and FE estimates of the wage effect of working at home likely suffer from biases due to unobserved omitted variables that change over time and reverse causality. These biases can be reduced by exploiting exogenous variation in the propensity to work at home in an IV procedure. A temporary child health problem is proposed as a source of plausible exogenous variation with this goal in mind. The instrument is meant to capture a woman's sudden and short-term response to an unanticipated increase in childcare responsibilities by choosing to work at least some hours at home rather than on-site.

Children's health problems have been used before as instruments in related contexts. For example, Powers (2001) uses 11 impairment categories to instrument the parental assessment of children's functional disability, assuming that the impairments are important determinants of the child care burden but do not directly interfere with parental labor supply. The study finds that the effect of child disability on maternal labor supply is not significant for married women but negative and more substantial amongst female household heads. The results change dramatically when a child health instrument is incorporated into the analysis.

Zan and Scharff (2018) use a variety of chronic health conditions to instrument the financial and time health-related costs of children under 18 years old. They similarly assume that children's health problems affect mothers' employment only through health-related financial and time caregiving burdens. Estimates that exploit the exogenous variation show that mothers are more likely to participate in the labor market with a higher monetary caregiving burden, and less likely to participate with a higher time care-

giving demand. The effects of caregiving on mothers' employment are underestimated when the instrument is not incorporated into the analysis.

The logic of the instrument in the present case is that a temporary child health shock can increase the desirability of remote work in order to more flexibly care for the child. The key assumption, as in previous uses, is that after controlling for a comprehensive set of standard determinants of earnings and unobserved fixed effects, the temporary child health problem does not affect the mother's earnings beyond inducing her to work more at home, for what might be a limited amount of time. Even assuming instrument validity, IV estimates are likely to represent a lower-bound effect since women who are induced to leave the labor market completely cannot be taken into account (Eckstein and Wolpin, 1989; Francesconi, 2002; Neal, 2004; Olivetti and Petrongolo, 2008; Keane and Wolpin, 2010; Adda et al., 2017).

In constructing the child health instrument, a broad range of health problems causing temporary activity limitations and participation restrictions are considered, as well as injuries and accidents requiring medical attention or hospitalization. Mothers, and later children themselves, are asked in the survey whether the child has a condition that limits school attendance, work and play activities, or requires special equipment. The type and duration of the condition is also specified. Mothers are also asked if children had an accident, injury, or illness requiring medical attention or hospitalization and when the three most recent injuries and accidents occurred. Responses to questions about serious behavioral issues, mental or emotional conditions are used as well for construction of the instrument.

The questions about the duration of limitations and the time of injuries or accidents in the CYA allow creation of a continuous child health history which distinguishes

between a permanent and a temporary health problem of a child. A temporary health problem is defined as one which occurs for one year only. Limitations, accidents, injuries and mental conditions with a duration of more than one year, or health issues that occur in a specific year as a result of a permanent or pre-existing health condition are not considered temporary.

Table 4 presents the proportion of children with a temporary health problem at each child age (less than or equal to 18). A maximum of four children per mother are considered. The overall prevalence of at least one child with a temporary health problem is 7.4 percent for black-mother households and 12.3 percent in white-mother households.[6] According to Table 4, pre-school children (less than 7 years of age) are more likely to experience a temporary health problem. This is consistent with evidence for the U.S. and other countries that pre-school children spend more time at home, and the home is the leading location of accidents for young children (Pauline et al., 2007; Phelan et al., 2011). In the analysis that follows, a temporary child health problem is represented by a dummy variable which equals one if at least one child in the household is temporarily afflicted, and equals zero otherwise. The proportion of black mothers in the sample that have at least one child with a temporary health problem is 11.6 percent. The corresponding proportion for white women is 15.6 percent.

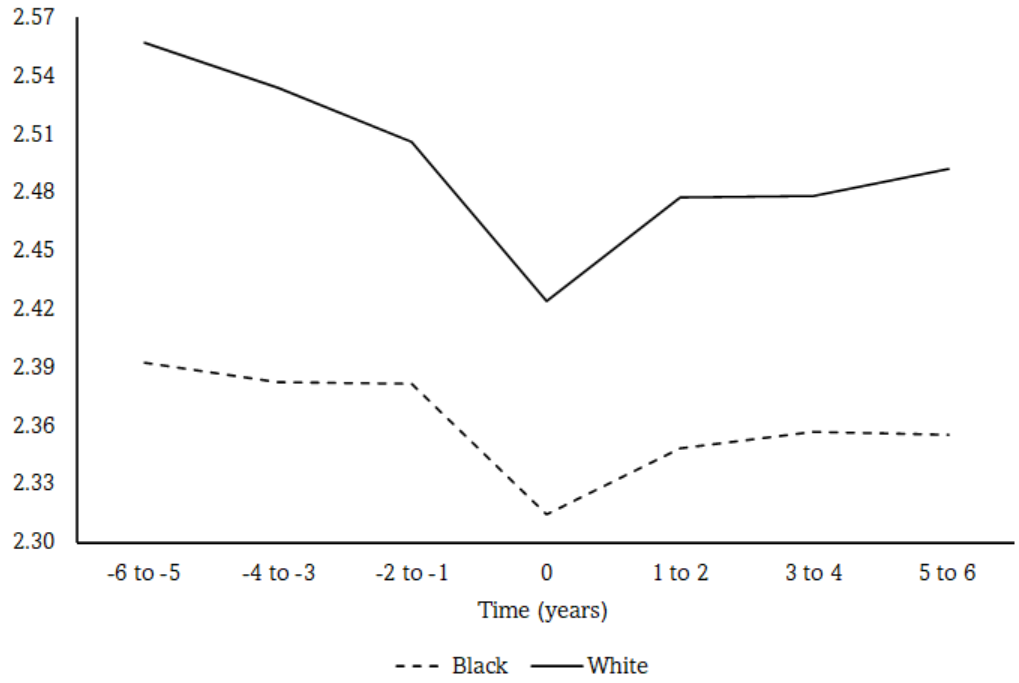
[6] In epidemiology, prevalence (or prevalence rate) is defined as the proportion of persons in a population who have a particular condition over a specified period of time. The prevalence rate of both permanent and temporary health conditions in this dataset is 35 percent. Different reports use different data and criteria to define the level of limitation or disability. According to Bethell et al. (2011), who use data from the 2007 National Survey of Children's Health, in children younger than 17, the prevalence of chronic conditions is 43 percent and reaches 49.9 percent for moderate or severe conditions (as rated by parent greater than mild). Data from Survey of Income and Program Participation (SIPP) show that the prevalence of non-severe and severe disability, as defined by the difficulty performing a specific set of functional and participatory activities, for children under 15 is 8.4 percent in 2010. Approximately 50 percent of children with disability were classified with severe disabilities (see Current Population Report). Child Trends use National Health Interview Survey data for 1998 - 2013 and a set of questions related to limitations in normal physical activities due to health conditions and impairments, difficulty seeing, difficulty hearing, diagnosed learning disabilities, or difficulty bathing or showering without assistance and find that the proportion of children aged 5 to 17, whose parent or other adult household member reported as having at least one limitation, remained relatively constant from 1998 to 2013, fluctuating between 17 and 20 percent.

Table 4: Proportion of Children with a Temporary Health Problem by Mother's Race and Child's Age

Child's Age	Black Women		White Women	
	Health Problem	*N*	Health Problem	*N*
0	.061	670	.079	1,503
1	.198	744	.267	1,666
2	.136	836	.266	1,832
3	.126	946	.213	2,025
4	.100	1,047	.188	2,192
5	.088	1,153	.174	2,333
6	.100	1,269	.164	2,484
7	.085	1,376	.140	2,622
8	.082	1,481	.144	2,741
9	.067	1,570	.118	2,833
10	.072	1,635	.110	2,870
11	.068	1,683	.106	2,912
12	.070	1,729	.086	2,914
13	.066	1,758	.102	2,908
14	.065	1,772	.079	2,872
15	.043	1,760	.062	2,816
16	.039	1,734	.056	2,739
17	.040	1,701	.067	2,650
18	.041	1,656	.045	2,565
Total	.074	26,520	.123	47,477

Note: N is the number of children observations at each age.

Figure 1: Mean of Mother's Log Hourly Wage Before and After a Temporary Child Health Shock



Note: The natural log of hourly wage is in constant 2005 dollars. Time 0 is the year in which a temporary child health problem occurs.

Figure 1 shows the relationship over time between a child's temporary health problem and the mean of the mother's log hourly wage by race, both before and after the temporary child health shock. A temporary child health shock has a clear negative impact on the mean hourly wage at the time the health problem occurs ($t=0$). Mean hourly wages remain at lower levels in the years that follow the temporary health problem compared to the years before the health issue occurs. Mean wages for both races subsequently recover but only partially. The patterns are suggestive of persistent wage losses due to the temporary health problem of the child and the transition to remote work.

5 IV Estimates

5.1 Estimation Framework

The temporary child health problem instrument is exploited within the framework of a two-stage least squares model that estimates a linear relationship between the log of the hourly wage of woman i at time t, $Y_{i,t}$, and working from home at time t, $F_{i,t}$,

$$Y_{i,t} = \alpha_i + \beta_1 F_{i,t} + \beta_2 X_{i,t} + u_{i,t}, \tag{1}$$

where α_i is an unobserved individual fixed effect, $X_{i,t}$ is a vector of time-varying individual characteristics including hours of work, age, age squared, marital status, the existence of children in the household, spousal income and different occupational categories. $u_{i,t}$ is an individual-specific productivity shock in each year t. This is the same set of controls used to produce the OLS and FE results presented earlier.

The first stage equation in the two-stage least squares procedure is

$$F_{i,t} = \gamma_i + \delta_1 H_{i,t} + \delta_2 X_{i,t} + \upsilon_{i,t}, \tag{2}$$

where γ_i is an unobserved individual fixed effect, $H_{i,t}$ is the temporary child health problem instrument and $\upsilon_{i,t}$ is an individual-specific error term in each year t that may be correlated with $u_{i,t}$ in Equation 1.

As mentioned previously, the key assumption in the IV procedure is that a child's temporary health issue increases the propensity to work at home but does not otherwise influence wages beyond the change in work venue, after controlling for a comprehensive set of observable determinants of wages as well as unobservable time-invariant characteristics. The main challenge to a causal interpretation of the effect of remote

work on wages in this framework is the possible impact of a temporary child health shock on wages through alternative channels such as the choice of working hours and occupation, mental health of the mother and time-variant unobserved determinants of earnings contained in $u_{i,t}$. In order to address these threats to causality, flexible specifications for hours worked are included in the regressions as well as indicators for different occupational categories. Moreover, the results of two validity tests and alternative first-stage regressions that examine the direct effect of the temporary child health shock on hours worked, job changes and the mental health of the mother are also presented below.

5.2 Reduced Form Results

Table 5 presents reduced form results by race of the effect of a temporary child health problem on the propensity to work at home and on the log of hourly wages. Columns (1), (2), (5) and (6) of Table 5 display the first-stage results for two-stage least squares, without and with fixed effects for black women and white women, respectively.

The coefficient for a temporary child health problem is large in magnitude and statistically significant for both races with or without fixed effects. A temporary child health problem substantially increases the probability to work at home for both black and white women. The increase in the probability is 4.2 percent without fixed effects and 4 percent with fixed effects for black women. Since the proportion of black women working at home in the sample is 9.9 percent, the point estimates correspond to increases in the probability of working at home of 42.4 percent and 40.4 percent, respectively. For whites, the increase in the probability is 5 percent without fixed effects and 3.1 percent with fixed effects. As the proportion of white women who work at home in the

sample is 17.2 percent, the point estimates correspond to increases in the probability of working at home of 29.1 percent and 18 percent, respectively. The *F*-statistics in column (1), (2), (5) and (6) illustrate that the instrument is both relevant and strong.

Columns (3) and (4) and (7) and (8) present the reduced form effect of a child health problem on mean hourly wages with and without fixed effects. With fixed effects included, there is a precisely estimated negative effect of a temporary child health problem on mean hourly wages for both races. Mean wages are lower by 3.4 percent and 2.4 percent for black women and white women, respectively. The ratio of the coefficients corresponding to the temporary child health variable in Table 5 indicate that the IV estimates of the wage effect of working at home will be negative and quite substantial in magnitude.

5.3 IV Results

The IV estimates for the effect of remote work by race, with fixed effects, are reported in Table 6. As in the FE regressions, education indicators are dropped as controls since they do not vary over time. As previewed by the ratio of coefficients in the reduced form results, the IV estimates of the wage penalty are large in magnitude and are also precisely estimated for both races. The wage penalty is 86 percent for black women and 76.7 percent for white women. Possible reasons for much larger absolute wage penalties found in the IV framework, compared to OLS and FE, are discussed in the following section.[7]

[7] No precisely estimated interactions with the indicator for work at home were found, suggesting a lack of substantial heterogeneous treatment effects. These results are not reported for sake of brevity but are available upon request.

Table 5: Reduced Form Estimates

	Black Women				White Women			
	Work at Home		Log of Hourly Wage		Work at Home		Log of Hourly Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Child Health Problem	.042	.040	-.012	-.034	.050	.031	-.029	-.024
	(.012)	(.011)	(.018)	(.015)	(.010)	(.009)	(.015)	(.011)
$I(12 \leq hgc < 16)$	-.006		.200		.057		.160	
	(.018)		(.035)		(.011)		(.033)	
$I(hgc \geqslant 16)$	.091		.519		.208		.479	
	(.028)		(.052)		(.020)		(.041)	
$I(1,040 <$Total Hours$\leq 1,560)$	.003	.011	.076	.047	-.003	.002	.039	.017
	(.010)	(.010)	(.022)	(.019)	(.011)	(.009)	(.018)	(.014)
$I(1,560 <$Total Hours$\leq 2,080)$	-.038	-.005	.267	.105	-.063	-.031	.229	.103
	(.009)	(.009)	(.019)	(.016)	(.010)	(.009)	(.018)	(.013)
$I($Total Hours$> 2,080)$	.172	.135	.297	.100	.193	.150	.242	.068
	(.019)	(.015)	(.026)	(.020)	(.015)	(.013)	(.022)	(.016)
Professional, Technical	.089	.028	.322	.081	.078	.021	.383	.145
and Managerial	(.017)	(.015)	(.028)	(.020)	(.013)	(.014)	(.022)	(.017)
Sales and Clerical	-.007	-.024	.253	.022	-.020	-.057	.192	.066
	(.010)	(.012)	(.022)	(.017)	(.009)	(.012)	(.019)	(.017)
Other regressors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic	11.76	12.66			24.93	12.22		
	(.001)	(.000)			(.000)	(.001)		
Adjusted R^2	.129	.047	.242	.067	.149	.058	.235	.083

Note: Clustered standard errors at the individual level in parentheses. The number of black women is 888; the number of black woman-year observations is 9,674. The number of white women is 1,607; the number of white woman-year observations is 17,385. The dependent variable in Columns (1), (2), (5) and (6) is a dummy indicating having worked at home during the survey year. The dependent variable in Columns (3), (4), (7) and (8) is the natural log of hourly wage in constant 2005 dollars. hgc is the highest grade completed. Total hours worked is the sum of hours worked on site and at home in a calendar year. Other regressors include age, age squared, an indicator for whether the woman is married, spousal income, and an indicator for having children under 18. The F-statistic is for the test of excluded instruments with the p-values for the F-statistic in parentheses.

Table 6: IV Estimates of the Remote-Work Wage Penalty

	Log of Hourly Wage	
	Black Women	White Women
	(1)	(2)
Work at Home	-.860	-.767
	(.424)	(.387)
$I(1,040 <$Total Hours$\leq 1,560)$	.056	.019
	(.019)	(.015)
$I(1,560 <$Total Hours$\leq 2,080)$	.101	.080
	(.016)	(.019)
$I($Total Hours$> 2,080)$	.216	.183
	(.061)	(.059)
Professional, Technical	.105	.161
and Managerial	(.024)	(.019)
Sales and Clerical	.001	.022
	(.020)	(.027)
Other regressors	Yes	Yes
Fixed Effects	Yes	Yes

Note: Clustered standard errors at the individual level in parentheses. The number of black women is 888; the number of black woman-year observations is 9,674. The number of white women is 1,607; the number of white woman-year observations is 17,385. The dependent variable is the natural log of hourly wage in constant 2005 dollars. Work at Home is an indicator for having worked at home. Total hours worked is the sum of hours worked on site and at home in a calendar year. Other regressors include age, age squared, an indicator for whether the woman is married, spousal income, and an indicator for having children under 18.

5.4 INSTRUMENT VALIDITY

The first-stage estimates in Table 5 illustrate that the child health instrument is relevant and strong. Evidence for the exogeneity of the instrument is clearly more difficult to establish, especially in the absence of over-identification (multiple instruments). Nonetheless, in this subsection an attempt is made to justify instrument exogeneity, and hence the validity of the instrument by performing two validity tests.

The first validity test is a placebo test where the temporary child health problem is "falsely" assigned to be two years before it actually occurred, and then the same IV procedure with fixed effects is performed as in Columns (1) and (2) of Table 6. The results of the placebo test are presented in Table 7. The effects are quite different from what is obtained in Table 6. The coefficients for remote work are negative for black women and positive for white women. Note that these coefficients are opposite in sign and very imprecisely estimated. Thus, there is little evidence for anticipation of the temporary child health shock, a type of reverse causality, which could bias our IV estimates of the wage penalties.

The second validity test estimates the direct effect of a temporary child health problem on wages in the subsample of women who chose not to work remotely either before or after the temporary child health shock. In this subsample, it is not possible to estimate a first-stage regression since there is no variation in remote-work status. However, one can estimate the reduced form effect of the temporary child health problem on mother's wages. Confidence in instrument exogeneity is strengthened when there is no substantial reduced form effect (see Altonji et al. (2005); Angrist et al. (2010)). The subsample is further divided into married and non-married women since married women might be able to respond differently to increased childcare responsibilities.

Table 7: IV Estimates of the Remote-Work Wage Penalty - Validity Test 1

	Log of Hourly Wage	
	Black Women	White Women
	(1)	(2)
Work at Home	-.655	.513
	(.635)	(.606)
$I(1,040 <$Total Hours$\leq 1,560)$	.055	.001
	(.022)	(.017)
$I(1,560 <$Total Hours$\leq 2,080)$	.102	.114
	(.017)	(.024)
$I($Total Hours$> 2,080)$	.194	-.017
	(.090)	(.093)
Professional, Technical,	.107	.129
and Managerial	(.025)	(.024)
Sales and clerical	.015	.093
	(.023)	(.040)
Other regressors	Yes	Yes
Fixed Effects	Yes	Yes

Note: Clustered standard errors at the individual level in parentheses. The number of black women is 887; the number of black woman-year observations is 9,203. The number of white women is 1,604; the number of white woman-year observations is 16,488. The dependent variable is the natural log of hourly wage in constant 2005 dollars. Total hours worked is the sum of hours worked on site and at home in a calendar year. Other regressors include age, age squared, an indicator for whether the woman is married, spousal income, and an indicator for having children under 18.

Table 8: Alternative Reduced Form Estimates - Validity Test 2

	Log of Hourly Wage			
	Black Women		White Women	
	Not Married	Married	Not Married	Married
	(1)	(2)	(3)	(4)
Child Health Problem	-.029	-.022	-.046	-.007
	(.019)	(.021)	(.036)	(.015)
$I(1,040 <$Total Hours$\leq 1,560)$	.029	.051	.034	.010
	(.032)	(.028)	(.030)	(.018)
$I(1,560 <$Total Hours$\leq 2,080)$	.099	.086	.110	.095
	(.027)	(.022)	(.028)	(.018)
$I($Total Hours$> 2,080)$	.115	.120	.116	.073
	(.033)	(.025)	(.031)	(.020)
Professional, Technical	.016	.061	.126	.066
and Managerial	(.028)	(.029)	(.043)	(.025)
Sales and clerical	-.029	.015	.083	-.030
	(.029)	(.025)	(.040)	(.022)
Other regressors	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	.061	.092	.065	.081

Note: Clustered standard errors at the individual level in parentheses. The number of black women is 569; the number of black woman-year observations is 5,887. The number of white women is 755; the number of white woman-year observations is 7,618. The dependent variable is the natural log of hourly wage in constant 2005 dollars. Total hours worked is the sum of hours worked on site and at home in a calendar year. Other regressors include age, age squared, an indicator for having children under 18, and spousal income.

As the results in Table 8 show, there are no significant effects of the temporary child health shock in any of the subsamples. That is, no effect for black women or white women, married or not-married. This lends additional support to the key assumption that the temporary child health shock does not have a direct effect on wages but is rather channeled through working from home. Additional analysis related to both validity of the instrument and mechanisms for the effect are discussed in the next section.

6 Discussion

6.1 Magnitudes and Mechanisms

The IV estimates in Table 6 should be interpreted as local average treatment effects (LATE) that capture the change in mean hourly wages amongst the subset of women who are just on the margin between working exclusively on-site and working at least partially at home, and who are induced to work some hours at home as a result of at least one child in the household developing a temporary health issue. This subsample of women, referred to as the "compliers" (see Angrist et al. (1996)), contains the subset of women who would not have worked at home had the child not become ill.

The LATE estimates reported in Columns (1) and (2) of Table 6 are much larger in magnitude compared to the corresponding FE estimates for black and white women in Table 3. The LATE estimates for black and white women are more than 5 to 6 times the magnitude of the corresponding FE estimates for black women and white women, respectively. The pattern of results indicate that OLS and FE estimates are substantially biased toward zero (under-estimated) and there is positive selection.

The sample means in Table 2 are already suggestive of positive selection on unobservables because women who work at home are, on average, more highly educated and more often work in professional, technical or managerial roles. That is, there is clear positive selection on observables so it may not come as a surprise that there is positive selection on unobservables as well. Positive selection of mothers into remote work and flexible jobs was also indicated in the study of the gender earnings gap amongst MBA graduates by Bertrand et al. (2010) and in the study of telecommuting by Glass and Noonan (2016). In contrast to Neal (2004), our estimates reveal that white women are more positively selected into work than black women, albeit in the more limited

context of remote work only.[8]

Note that wage effects of such large magnitudes produced within an IV framework are not unprecedented in the wider literature on flexible working conditions. This is true even for estimates that represent average treatment effects (ATE) as opposed to LATE estimates. Bertrand et al. (2010) find a remote-work wage penalty amongst female MBA graduates of 20 percent. However, the wage penalty amongst women that choose a new job with flexible working hours is much higher, reaching 60 percent. These latter estimates are produced from fixed-effects regressions on a selected sample of highly educated women. The IV estimates with fixed-effects in the present study are derived from nationally-representative data of women that span the education-level spectrum.

In order to further assess validity of the instrument and the extent to which the child health problem is leading to other changes besides a higher propensity to work at home, which could also bring about wage penalties to remote work, alternative first-stage estimates are displayed in Table 9 for black women and in Table 10 for white women. The alternative first-stage estimates examine the effect of the temporary child health problem on job changes, alterations in hours worked, changes in labor force participation, and deterioration in the mother's mental health.

In Columns (1) - (3), employer and occupation information in the NLSY79 is exploited to construct three different measures of a job change (see also Kambourov and Manovskii (2009)). The first definition of a job change is an indicator for a woman switching

[8] Neal (2004) also includes non-employed women in his study by imputing wages. It is not very practical even with imputation methods for wages to include non-employed women in this study. The remote work offer would also have to be imputed in some way adding more noise to the data.

Table 9: Alternative First-Stage Estimates - Black Women

	Job Change Definition 1	Job Change Definition 2	Job Change Definition 3	Decrease in hours	Change in Labor Force Participation	Mother's Mental Health
	(1)	(2)	(3)	(4)	(5)	(6)
Child Health Problem	-.016	.002	.009	.011	.010	-.004
	(.016)	(.012)	(.011)	(.020)	(.012)	(.005)
$I(1,040 <$Total Hours$\leq 1,560)$	.023	.021	.010		-.175	-.013
	(.017)	(.012)	(.012)		(.018)	(.007)
$I(1,560 <$Total Hours$\leq 2,080)$	-.061	-.011	-.016		-.294	-.018
	(.015)	(.010)	(.010)		(.016)	(.006)
$I($Total Hours$> 2,080)$	-.081	-.010	-.018		-.311	-.012
	(.016)	(.012)	(.011)		(.016)	(.007)
Professional, Technical,				-.019	-.005	-.007
and Managerial				(.018)	(.011)	(.007)
Sales and Clerical				-.023	.002	-.011
				(.016)	(.012)	(.006)
Other Regressors	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	0.98	0.02	0.71	0.32	0.64	0.65
	(.321)	(.884)	(.401)	(.572)	(.424)	(.419)
Adjusted R^2	.028	.009	.009	.029	.114	.054

Note: Clustered standard errors at the individual level in parentheses. The number of black women is 888. The number of black woman-year observations is 9,674. Total hours worked is the sum of hours worked on site and at home in a calendar year. Other regressors include age, age squared, an indicator for whether the woman is married, spousal income, and an indicator for having children under 18. The F-statistic is for the test of excluded instruments. The p-value for the F-statistic is in parentheses.

employer during the year the temporary child health issue occurs. The second definition takes into account a change of either employer or occupational category in the time frame of the temporary child health problem. The third definition tracks whether there was a job change as in the second definition, but does not consider the switch to be a change if the employer or occupational category reverts to the previous one in a later period. This third definition avoids biases due to cycling between jobs (see Neal (1999)). The estimates in Columns (1) - (3) do not suggest that there is any substantial job mobility due to a temporary child health issue that is driving the wage penalties for black women or white women.[9]

In Column (4), the relationship between a temporary child health problem and a decrease in hours worked is examined. The results indicate that for both races women do not significantly decrease their hours worked during the year the temporary child health problem arises. The estimates in Column (5) similarly show that the probability a woman leaves the labor market the year after the temporary child health problem is small in magnitude and not statistically significant for both races.

In Column (6), the effect of a temporary child health problem on the mental health of the mother is examined. Mental health is measured by a diagnosis of depression, emotional, nervous or psychiatric problems. A decrease in mental health could lead to less productivity and lower wages. The results do not indicate a significant increase in the probability of such a diagnosis following a temporary child health problem. This holds for both races.

These alternative first-stage regression results rule out the main threats to a causal

[9]For robustness, the same analysis is performed using a finer 3-digit classification of occupations. The occupational classification used to construct consistent occupational codes for the period under consideration is provided in Autor and Dorn (2013). The conclusions are the same.

Table 10: Alternative First-Stage Estimates - White Women

	Job Change Definition 1	Job Change Definition 2	Job Change Definition 3	Decrease in hours	Change in Labor Force Participation	Mother's Mental Health
	(1)	(2)	(3)	(4)	(5)	(6)
Child Health Problem	.003	-.001	.001	.022	.005	.008
	(.012)	(.008)	(.008)	(.014)	(.009)	(.006)
$I(1,040 <$Total Hours$\leq 1,560)$	.032	.015	.011		-.132	.002
	(.012)	(.008)	(.008)		(.012)	(.006)
$I(1,560 <$Total Hours$\leq 2,080)$	-.020	-.011	-.011		-.247	-.001
	(.011)	(.008)	(.007)		(.012)	(.007)
$I($Total Hours$> 2,080)$	-.043	-.032	-.030		-.270	-.007
	(.012)	(.008)	(.008)		(.011)	(.008)
Professional, Technical,				-.019	.012	.007
and Managerial				(.014)	(.009)	(.008)
Sales and Clerical				-.014	.007	.011
				(.013)	(.009)	(.007)
Other Regressors	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	0.07	0.01	0.02	2.28	0.25	2.14
	(.791)	(.913)	(.887)	(.132)	(.614)	(.144)
Adjusted R^2	.020	.009	.008	.026	.098	.111

Note: Clustered standard errors at the individual level in parentheses. The number of white women is 1,607. The number of white woman-year observations is 17,385. Total hours worked is the sum of hours worked on site and at home in a calendar year. Other regressors include age, age squared, an indicator for whether the woman is married, spousal income, and an indicator for having children under 18. The F-statistic is for the test of excluded instruments. The p-value for the F-statistic is in parentheses.

interpretation in the IV procedure. Moreover, these additional results eliminate several of the possible mechanisms that might drive the large wage penalties to remote work. By process of elimination, the most plausible mechanisms driving the remote-work wage penalty are therefore promotion bias, performing less "valuable" work assignments, and a decrease in productive social interactions with colleagues.

Supporting the promotion bias mechanism in particular, Bloom et al. (2015) notes that telecommuting applies to a range of tasks including jobs in sales and secretarial assistance and finds that work from home is associated with reduced rates of promotion of about 50 percent. Note that in this sample a substantial proportion of black women (33.2 percent) and white women (35.8 percent) work in sales and clerical occupations. Golden and Eddleston (2020) also find that the extent of telecommuting is negatively related to promotions. Amongst those working in higher skill jobs, Bertrand et al. (2010) argue that MBA mothers are likely to be forced out, or opt out, of the "fast-track" when they choose more flexible work arrangements. The more there is a tournament or up-or-out structure to the occupation, the more "task-shift" there is likely to be when choosing to work remotely. In the current sample, 21.4 percent of black women and 33.7 percent of white women work in professional, technical and managerial occupations where tournament and up-or-out employment structures are most prevalent.

It is generally thought that promotion requires not only expertise, but also social capital and interaction (Williams, 2000; Blair-Loy, 2006; Golden, 2008; Williams et al., 2013; Allen et al., 2015; Bloom et al., 2015). It can be argued that women especially need to demonstrate their skills and take up more prominent tasks and have access to networks of decision makers that enhance their visibility in order to increase opportunities for workplace progression (Milgrom and Oster, 1987; Hersby et al., 2009; Cristea

and Leonardi, 2019). Remote work may render this much more difficult to achieve.

In addition, racial and gender homophily - the tendency of workers to associate and form ties with similar others - can create substantial divisions and undermine networking and the workplace information that is received (McPherson et al., 2001). A woman's lack of white male connections has been argued to be a reason for worse positioning in job ladders, lower promotion probabilities and wages compared to men (Milgrom and Oster, 1987; Blair-Loy, 2001; Cassidy et al., 2016; Bertrand et al., 2019). Recent evidence confirms that a male-to-male promotion advantage exists, especially in positions where the employee works in close physical proximity to the manager (Cullen and Perez-Truglia, 2021). This emphasizes the crucial role of face-to-face interaction and socialization that may be severely compromised by working from home. The results in this study suggest that the loss of networking and visibility opportunities may hurt black women even more than white women.

6.2 Decomposing the Female Racial Wage Gap

The extent to which differential wage penalties to remote work by race contribute to the female racial wage gap is measured by performing a Blinder-Oaxaca wage decomposition (Blinder, 1973; Oaxaca, 1973). This technique apportions the overall wage gap into a part that is explained by differences in the determinants of wages between the two groups and an unexplained part that is due to differences in estimated coefficients for each wage determinant. Formally, the weighted version of the decomposition is

$$Y_{i,t}^{W} - Y_{i,t}^{B} = (\beta_W - \beta_B)\left(\frac{\bar{X}_W + \bar{X}_B}{2}\right) + \left(\frac{\beta_W + \beta_B}{2}\right)\left(\bar{X}_W - \bar{X}_B\right) \tag{3}$$

where $Y_{i,t}^{k}$, $k = W, B$, is the log hourly wage of woman i of race k at time t, β_k, $k = W, B$ is the vector of estimated IV coefficients for each race taken from Table 6 and $\bar{X}_k$, $k = W, B$ is the vector of wage determinant sample means for each race.

The first term on the right-hand side of Equation 3 represents the proportion of the wage gap that is attributable to differences in coefficients between the races ($\beta_W - \beta_B$). This is referred to as the coefficient effect or the unexplained component of the wage gap. The coefficient effect is evaluated at the average of the covariate means for white women and black women ($\frac{\bar{X}_W + \bar{X}_B}{2}$).

The second term in Equation 3 represents the proportion of the wage gap attributed to differences in the means of wage determinants between white women and black women $\left(\bar{X}_W - \bar{X}_B\right)$. This is referred to as the endowment effect or the explained component of the wage gap. The endowment effect is evaluated at the average of the coefficients for white women and black women ($\frac{\beta_W + \beta_B}{2}$).[10]

Table 11 presents selected results obtained from the decomposition. The first column shows the coefficient effect associated with remote work as well as the coefficient effects for being employed in a professional, technical or managerial occupation and a sales or clerical occupation. The second column shows the corresponding endowment effects. Note that the sum of coefficient effects over all variables shown in the bottom row, .196, implies a female racial wage gap of 19.6 percent. This adjusted wage gap is larger than the 15.3 percent sample mean difference in wages between the races. Summing the total endowment effect of -.043 and the total coefficient effect in the bottom row yields

[10] In a standard unweighted Blinder-Oaxaca decomposition, $\bar{X}_B$ is used for the coefficient effect instead of ($\frac{\bar{X}_W + \bar{X}_B}{2}$) and β_W is used for the endowment effect instead of $\frac{\beta_W + \beta_B}{2}$. Use of the averages adjusts for what has been called an identification problem in the literature (Oaxaca and Ransom, 1999; Yun, 2005), i.e. the values of the explained and unexplained components vary with the choice of the reference group (white or black). See Reimers (1983); Neumark (1988); Oaxaca and Ransom (1994; 1999) for a more detailed discussion on the weighted approach to the decomposition. The results obtained with the weighted approach do not differ substantially from the unweighted method, and the base group chosen in the unweighted approach makes little difference.

the 15.3 percent raw difference in wages.

The third column in Table 11 calculates the percentage of the adjusted wage gap (.196) due to remote work and the two occupational categories. The differential wage penalties between the races accounts for 6.63 percent of the gap. Differential rates of pay in professional, technical and managerial jobs, and sales and clerical jobs account for 7.65 percent and 3.57 percent of the gap, respectively. Thus, racial differences in wage rates for remote work and racial differences in wage rates in high-skilled occupations are of roughly similar importance in their contribution to the overall female racial wage gap. This is an interesting new finding of the study. The previous literature on racial and gender wage gaps has concentrated mostly on differences in hours and occupations (see Huffman and Cohen (2004); Alonso-Villar et al. (2012); Gicheva (2013); Cha and Weeden (2014); Goldin (2014); Del Rio and Alonso-Villar (2015); Erosa et al. (2021)).

Table 11: Female Racial Wage Gap Decomposition

	Coefficient Effect (1)	Endowment Effect (2)	% Wage Gap due to Coefficient Effect (3)
Work at Home	.013	-.059	6.63
Professional, Technical and Managerial	.015	.016	7.65
Sales and Clerical	.007	.000	3.57
Total	.196	-.043	100.00

Note: The number of black women is 888 and the number of black woman-year observations is 9,674. The number of white women is 1,607 and the number of white woman-year observations is 17,385. The log hourly wage is in constant 2005 dollars. Work at Home is an indicator for having worked at home. Other wage determinants include indicators for the sum of total hours worked on site and at home in a calendar year, age, age squared, an indicator for whether the woman is married, spousal income, and an indicator for having children under 18.

7 Conclusion

In this paper, the racial gap in remote-work female wage penalties is studied by linking pre-pandemic data on women in the National Longitudinal Study of Youth (NLSY79) to their children in the NLSY79 Child and Young Adult Survey (CYA). It is the first study that focuses exclusively on racial differences in remote-work wage penalties and the data allow one to provide a range of estimates, including Ordinary Least Squares (OLS), Fixed Effects (FE) and Instrumental Variables (IV) results. The findings should be relevant for assessing the differential costs of social distancing by race for females both in the present and the foreseeable future.

OLS estimates indicate that working from home leads to a decrease in the mean hourly wage of 18 percent for black women and 8 percent for white women. This is equivalent to a 55.5 percent higher wage penalty for black women. FE estimates, which take advantage of the longitudinal aspect of the data, yield a wage penalty for black women of 15.5 percent and a wage penalty for white women of 11.8 percent, implying a 23.9 percent gap. IV estimates that include fixed effects and exploit the child health instrument produce wage penalties of 86 percent for black women and 77 percent for white women. The percentage difference in the wage penalty is 10.5 percent. The IV procedure produces larger absolute magnitudes in the wage penalty but a smaller (yet still large) percentage increase in the wage penalty for black women compared to OLS and FE estimates.

Using the IV estimates, a Blinder-Oaxaca wage decomposition shows that the differential wage penalties to remote work account for 6.63 percent of the overall female racial wage gap. In comparison, differential rates of pay in professional, technical and

managerial jobs account for 7.65 percent of the female racial wage gap. The similar importance of racial differences in female wage rates for remote work and in high-skilled occupations is an interesting new finding of this study.

The larger IV estimates, relative to OLS and FE estimates, implies positive selection into working at home. The co-existence of positive selection and a substantial wage penalty to remote work, combined with the results of additional reduced-form regressions, suggest that the most likely mechanisms underlying the wage penalties are promotion bias, women being assigned less "valuable" work assignments, and women having less productive social interactions with colleagues. The problem of promotion bias, task re-assignment and loss in social capital appears to be differentially worse for black women. Why that may be the case requires further research. The results in this study suggest that the loss of networking and visibility opportunities may be the main mechanisms explaining why black women are hurt relatively more than white women. Better data would enable a more precise disentangling of the various mechanisms and a further comparison to alternative possibilities such as negative signaling, screening and statistical discrimination.

Regardless of where one stands on the extent of the validity of the instrument, the OLS, FE and IV estimates in this study offer rare evidence on the racial gap in remote-work wage penalties. Only similar future attempts can help establish a body of evidence that would allow for a more accurate assessment of the plausibility of the range of estimates in this particular study. Note that the results are likely to be lower-bound estimates since it is not straightforward to take into account women who are induced to leave the labor market completely as a result of a temporary child health shock. These latter woman may experience more severe losses in human capital and earnings.

In closing, it is also important to note that public discussions and policy proposals involving remote work often center around how to increase the supply of work-from-home opportunities, rather than directly addressing the wage penalty. The results in this study suggest that wage penalties should also become a major focus. As new technologies for remote work are unveiled, including the emerging metaverse, it will be important to monitor how race and gender inequality continue to evolve due to the increased prevalence of working from home.

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