Remote Schooling and Mothers' Employment During the COVID-19 Pandemic by Race, Education, and Marital Status

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Public schools in the United States saw unprecedented reductions to in-person instruction during the 2020–2021 school year. Using the Elementary School Operating Status database, the American Community Survey, and the Current Population Survey, we show remote instruction was associated with reduced employment among mothers compared with fathers and women without children. The gender gap in employment between mothers and fathers grew as much as 5 percentage points in areas with remote instruction. Compared to women without children, mothers' employment fell by as much as 2 percentage points under remote schooling. Employment disparities among mothers deepened by race, educational attainment, and marital status. We show employment disparities endured through spring 2021, even as many school districts returned to in-person instruction.

Keywords: employment, race and ethnicity, gender, education, COVID-19

During the COVID-19 pandemic, U.S. public schools experienced widespread closures and schedule disruptions. These upheavals left many parents with unprecedented care demands and limited alternative care arrangements. Mothers picked up much of this added work—for some, even at the expense of their employment (Calarco et al. 2021; Collins et al.

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2021; Landivar et al. 2022; Zamarro and Prados 2021). One in three U.S. women who left their jobs early in the pandemic cited childcare demands as a primary reason for their departure (Heggeness and Fields 2020). More than a year into the COVID-19 crisis, 1.3 million fewer mothers of prime working age (twenty-five through fifty-four) were employed than before the pandemic (Collins, Ruppanner, and Scarborough 2021).

Using the Elementary School Operating Status (ESOS) database—the most comprehensive data on public elementary school instructional modes available for the 2020–2021 school year (Landivar et al. 2022)—combined with the 2020 American Community Survey (ACS) and 2018–2021 Current Population Survey (CPS), we assess how school operating status was associated with mothers' employment relative to fathers within the same household and to women without children. We offer three key findings. First, we show remote instruction was associated with reduced maternal employment, both relative to fathers and to women without children. Second, we uncover important differences by race, education level, and marital status. Among couples with less than a bachelor's degree, the gender gap in employment grew substantially, as mothers were an additional 5 percentage points less likely to be employed than fathers in areas with remote instruction. Comparing mothers with women without children, remote schooling was most detrimental to Black, Hispanic, and less than college-educated mothers' employment compared with White mothers and mothers with a bachelor's degree. Third, we show that the association between employment and remote schooling was persistent, because less-educated mothers who lived in remote-instruction districts in fall 2020 remained less likely to be employed in spring 2021 even as many schools reopened. Collectively, our results underscore the importance of schools as a critical family and care support and highlight the necessity of a robust care infrastructure in pandemic recovery efforts.

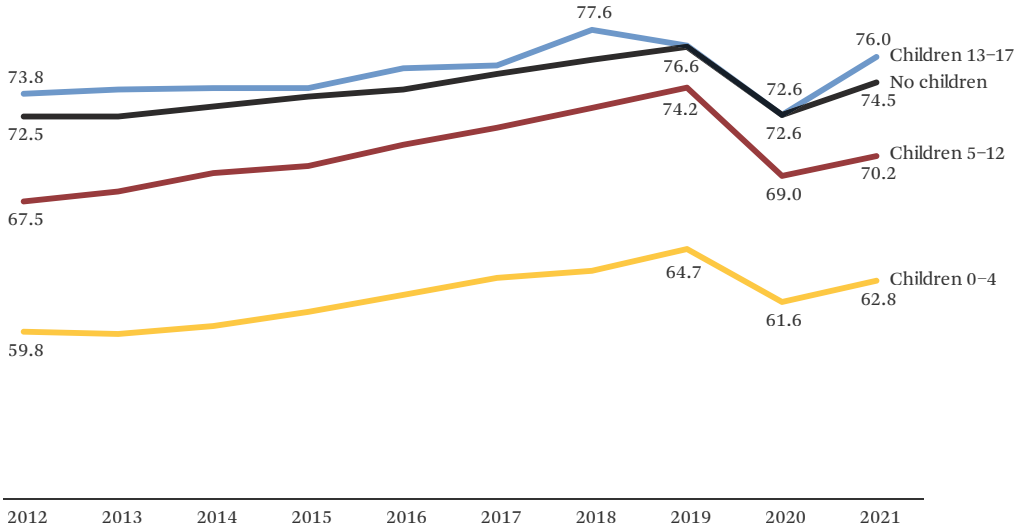
MATERNAL EMPLOYMENT BEFORE AND DURING THE COVID-19 PANDEMIC

Before the pandemic, maternal employment had been on a gradual upward trend following more than a decade of stagnation or slight decline (Women's Bureau 2021). Up through 2018, employment had been declining among women with lower levels of educational attainment (Abraham and Kearney 2021). Some evidence, though, indicates that in the few years just before the pandemic, employment increased among mothers with younger children and less educational attainment (Goldin 2022). Because of their shorter job tenure, weaker employment attachment, and lower earnings, these labor force entrants were particularly vulnerable to job loss. As the pandemic started, employment losses were more highly concentrated among mothers in service occupations, with less educational attainment, and with children under the age of thirteen (Landivar and deWolf 2022).

Evaluating employment losses by age of children before and during the pandemic, we show that employment reductions were largest among women with young school-age children (figure 1). Between 2019 and 2020, employment fell by 7 percent among mothers whose youngest child was between ages five and twelve, 4.8 percent among mothers whose youngest child was four or younger, and 5.3 percent among mothers of children ages thirteen to seventeen.[1] By 2021, employment losses remained highest for mothers of children ages five to twelve at 5.4 percent; mothers of the youngest children were 2.9 percent below their 2019 employment levels; and mothers of children ages thirteen to seventeen had nearly recovered to pre-pandemic levels. Maternal employment likely remained much lower for mothers of young school-age children because school closures were more extensive and prolonged than formal and informal childcare provider closures. This limited mothers' ability to return to work while children remained out of school and in need of educational assistance and supervision (Petts, Carlson, and Pepin 2021;

1. Derived estimates are presented as a percentage rather than percentage point to account for differing employment levels across these groups.

Figure 1. Mothers' Employment Rate by Presence and Age of Youngest Child



Source: Authors' calculations based on Current Population Survey, 2012–2021 (Flood et al. 2022).

Zamarro and Prados 2021). Given these trends, we focus on elementary school closures and its association with maternal employment in this article.

PUBLIC SCHOOLS AS CHILDCARE INFRASTRUCTURE SUPPORTING MATERNAL EMPLOYMENT

Never before had schools closed to the extent or duration observed during the COVID-19 pandemic. Scholars are only beginning to assess what the loss of in-person education means for parents' work outcomes. Early research has shown that the transition to remote and hybrid instruction during the pandemic was associated with reductions in maternal employment, both in relation to fathers who usually perform less childcare and women without children who are not directly influenced by the loss of in-person schooling (Landivar et al. 2022). Because mothers provide the bulk of family caregiving, transitions to remote learning during the pandemic were particularly detrimental to maternal employment. Yet the experience of remote schooling was not uniform across the country because states and local school districts varied widely in instructional modes (Collins et al. 2021; Landivar et al. 2022). Furthermore, some mothers may have been more vulnerable to the impacts of remote schooling than others. In the following section, we examine these possibilities by focusing on race, education, and marital status as key characteristics that may moderate the relationship between remote instruction and maternal employment. We also consider whether remote schooling had an enduring effect on mothers' employment persisting months after schools returned to in-person instruction.

Racial Differences in Maternal Employment and Remote Schooling

Few studies have directly examined the relationship of remote schooling to maternal employment by race, but some evidence indicates that Black and Hispanic mothers may have been more vulnerable to these shifts in schools' operations. Black and Hispanic mothers are overrepresented in frontline service-sector jobs that continued on-site during the pandemic and they are underrepresented in positions with telecommuting and other flexible work options that helped mothers balance competing care and employment demands during remote schooling (U.S. Bureau of Labor Statistics 2019; Pirtle and Wright 2021; Yavorsky, Qian, and Sargent 2021). Schools were also more likely to operate remotely in areas with a greater concentration of Black and Hispanic families

(Landivar et al. 2022). Because alternative care arrangements became more difficult to secure and more expensive during the pandemic, Black and Hispanic mothers may have been more vulnerable to job loss given that they were overrepresented in inflexible jobs with lower wages (Frye 2020).

Even as Black and Hispanic mothers may have been at high risk to the detrimental effects of remote schooling on employment, countervailing forces within households depend on these mothers' employment. More than 70 percent of Black mothers and 40 percent of Hispanic mothers are primary earners in their homes, relative to just under 25 percent of White mothers (Glynn 2019). Furthermore, Black and Hispanic families disproportionately experienced employment insecurity (Bitler, Hoynes, and Schanzenbach 2023, this issue; Ybarra and Lua 2023, this issue), including disproportionate job loss and unemployment among Black and Hispanic men (Falk et al. 2021). These disparities reflect the pandemic's differential impact on sectors with a higher percentage of workers from marginalized communities and disparities in unemployment insurance and other social safety net benefit access (Lee and Parolin 2021; Bell et al. 2023, this issue; Ybarra and Lua 2023, this issue). Combined, these patterns may sustain Black and Hispanic mothers' employment because their families relied on their income and, among those married, the husbands were less likely to be working and therefore more available to help with childcare.

Collectively, research suggests that Black and Hispanic mothers may be particularly challenged by remote schooling, but that families may also rely on their employment for financial stability and receive greater support from Black and Hispanic fathers. We therefore do not expect remote schooling to worsen gender gaps in employment among Black and Hispanic parents as it did among White parents. Instead, the negative association between remote schooling and Black and Hispanic mothers' employment will be observed primarily in comparison with Black and Hispanic women without children who are not directly affected by reductions to in-person instruction.

Educational Differences in Maternal Employment and Remote Schooling

Across gender and race, those with less educational attainment have had poorer employment outcomes during the pandemic (Kim et al. 2022). This pattern matches previous recession trends. One key difference, however, is that the COVID-19 pandemic was also a care crisis that resulted in added burdens for mothers who lost access to in-person public education for their children. Workers with less education are more likely to hold jobs that require physical contact and in-person presence and to lack the employment security and benefits (such as remote work and paid leave) provided to employees with more education (Dey et al. 2020; Kim et al. 2022; Schneider and Harknett 2022). Women with children in these jobs faced the added challenge of maintaining work and caregiving through pandemic-related school closures and requirements of in-person work attendance with little flexibility. We argue that remote instruction will be particularly detrimental to less-educated mothers, both relative to fathers and to women without children who are not directly affected by remote schooling.

Single Mothers' Employment and Remote Schooling

The final group likely affected by prolonged remote learning is single mothers. One in four children in the United States live with a single mother (Kramer 2019). During the pandemic, these mothers reported more extensive challenges balancing childcare and work than their married counterparts (Radey et al. 2022; Yip et al. 2022). Single mothers are overrepresented in jobs that provide less flexibility, security, and telework options (Blau, Koebe, and Meyerhofer 2020). For example, 20 percent of single parents worked remotely in 2020, versus 40 percent of married parents (Karageorge 2020). Consequently, single parents have fewer employment resources to balance competing work and care demands as well as fewer family supports, particularly during periods of social distancing, when extended family members were unable to provide supplemental care (Barroso and Kochhar 2020; Kalenkoski and Pabilonia 2020; Yavorsky, Qian, and Sargent

2021). At the same time, single mothers also bear significant financial responsibility for their families, a potentially strong driver of sustained employment even under the difficult conditions of remote schooling. Despite these countervailing pressures, we expect that remote schooling will reduce employment among single mothers.

THE ENDURING IMPACTS OF REMOTE SCHOOLING ON MATERNAL EMPLOYMENT

By spring 2021, most U.S. school districts had returned to in-person instruction. Yet maternal employment remained below pre-pandemic levels (Collins, Ruppanner, and Scarborough 2021). Reduced days or hours of operation (such as four-day weeks, school days shorter than pre-pandemic days) or intermittent periods of remote instruction in response to COVID-19 infection peaks continued to make it difficult for parents to return to work. Loss of employment may also entail a protracted job search to find a position with similar wages and working conditions (Meekes and Hassink 2020). Another barrier are negative perceptions among employers toward applicants who have employment gaps for caregiving reasons (Weisshaar 2021) making it more difficult for mothers to become employed again. Mothers who left work in 2020 in response to remote schooling may, therefore, face challenges to re-entry well after schools return to in-person instruction. Further, the influx of cash from the federal government—stimulus payments and the Child Tax Credit—may have allowed mothers to be more selective in their employment re-entries. Using new data from the Elementary School Operating Status database, we test for these enduring effects of remote schooling across two periods.

DATA AND METHODS

We use a series of linear probability models to test whether the relationship of remote schooling to employment differs between mothers and fathers as well as between mothers and women without children. Our strategy follows the hierarchical linear probability model outlined in equation (1):

$$y_{ij} = \gamma_{00} + \beta_1 m_{ij} + \beta_2 c_j + \beta_3 (c_j \times m_{ij}) + \lambda R_{ij} + \lambda D_j + U_{0j} + \varepsilon_{ij} \quad (1)$$

where i indexes respondents and j references districts. Focal to our model, we predict employment (y), measured by whether an individual is currently working,[2] with motherhood status (m), whether school districts operated remotely in fall 2020 (c), the interaction of motherhood and operating status ($c \times m$), as well as individual-level (R) and district-level (D) control variables. In analyses comparing fathers and mothers, the referent for m is fathers, whereas when comparing nonmothers and mothers the referent for this variable is women who do not have children. The coefficient for the interaction, $c \times m$, estimates the difference in the effect of remote schooling on respondents' probability of employment for mothers relative to fathers and women without children. Linear probability models violate the assumption of homoscedasticity in standard least squares regression, but provide consistent estimates for the partial effects of covariates on binary outcomes and are well suited for group comparisons, aims central to our study (Breen, Karlson, and Holm 2018). All results are confirmed with logistic regression models from which we calculated average marginal effects on the probability of employment.

Individual-level controls, R, in equation (1) include: age, race (White, Black, Hispanic, other race), education (bachelor's degree or less than bachelor's degree), marital status (married or not married), family income (by quintile), whether respondents received any form of public assistance, and whether co-resident grandparents assisted with children's basic needs. District-level controls, D, include COVID-19 prevalence (cases per hundred thousand residents in September 2020), percentage voting Republican in the 2020 presidential election, geographic locale (city, suburban, or rural), and school district racial composition (percentage White). Last, equation (1) includes

2. We omit those who are unemployed but seeking work because it is difficult to assess the role of school operating status for this group who would become employed if offered a job.

a varying intercept, *U*, to account for the hierarchical structure of our data. When testing differences in employment between parents, household-level residuals are estimated from the intercept separately from the individual-level error term. When testing differences in employment between mothers and women without children, these residuals are estimated at the district level.

To estimate equation (1), we combine data from the 2020 American Community Survey with spatial data measuring schools' operating status. The ACS is the largest household survey in the United States, providing a sufficient sample to analyze labor force and family characteristics at small levels of geography. We obtained ACS data through the Integrated Public Use Microdata Series (IPUMS) (Ruggles et al. 2022). The pandemic posed significant challenges to ACS data collection, including sampling bias in the 2020 data (Rothbaum et al. 2021; U.S. Census Bureau 2021). The Census Bureau released 2020 estimates as an experimental data release, unlike prior years, and recommends against combining 2020 data with prior ACS samples. However, 2020 data remain appropriate for group comparisons within the same year when using the accompanying experimental weights (U.S. Census Bureau 2021). We therefore rely on cross-sectional data from 2020 for our district-level analysis using equation (1). Our universe restrictions generate two samples. In comparing the relationship of school operating status between mothers and fathers, our sample includes 693,944 married parents in prime working ages of twenty-five through fifty-four with at least one elementary-age child, between five and twelve years old. Within this sample, we analyze differences between mothers and fathers by race and education. In these subgroup analyses, we include only married parents holding the same race or education to isolate the differential effect of remote schooling on mothers and fathers. Second, to compare mothers with women without children, our sample consists of 1,450,229 women age twenty-five through fifty-four who either have at least one elementary-school-age child or have no children. In these second analyses, we explore patterns by race and education, as well as marital status where we compare single mothers with single women without children.

To measure districts' operating status, we developed the Elementary School Operating Status database. ESOS is the most comprehensive database on school district operating status for elementary-age students (kindergarten to grade 6), covering all public school districts that serve a minimum of five hundred students.[3] This includes 9,195 districts, covering 72 percent of all public school districts and 98 percent of elementary school students across all fifty states, the District of Columbia, and Puerto Rico. We collected ESOS data from extensive materials available in the public domain. We located school districts' reopening plans and operating status on school district websites, school social media accounts, local newspapers, and, when available, on state government websites. Data were collected to correspond with the primary operating status during the first grading period (September 2020) and the last (April 2021) of the school year. Districts were coded as operating remotely if they offered zero days of in-person instruction for the majority of elementary school students; hybrid if they provided limited in-person attendance to students on alternating times, days, or weeks; and in person if the majority of students were offered at least four days of in-person instruction per week. For quality assurance, all large school districts were verified by at least two team members, including a lead researcher, and an additional minimum of 10 percent of school districts per

3. For comparison, *Education Week* tracked 900 of approximately thirteen thousand public school districts, Burbio actively monitored 1,200 districts (including the largest two hundred), MCH Strategic Data had an 18 percent response rate to its school operating survey, and the COVID-19 School Data Hub is missing all data for fourteen states. Another effort used cell phone data to infer school operating status (U.S. School Closure & Distance Learning Database), but does not offer the granularity needed to determine which hybrid plans have been implemented and lacks precision in determining the share of students allowed to attend under various learning plans.

state were selected for reverification by a lead researcher.[4]

We linked 2020 ACS respondents to data from ESOS on districts' operating status in September 2020 by geospatially matching PUMAs (Public Use Microdata Areas)—the smallest public-use geographic identifier available in ACS microdata—to districts. In cases where PUMAs straddled the borders of districts, we adopted an approach used in previous research (Autor and Dorn 2013; Dorn 2009; Scarborough and Sin 2020) and weighted respondents based on the likelihood of belonging to a school district, calculated from the proportion of the PUMA population residing in each district, determined at the census-block level with the Geocorr application from the Missouri Census Data Center.[5]

Covariates measuring school district racial composition and geographic locale were obtained from the National Center for Education Statistics (2022). COVID-19 prevalence and percentage voting Republican were obtained from the Johns Hopkins University Novel Coronavirus Visual Dashboard (Dong, Du, and Gardner 2020) and the MIT Election Data and Science Lab (2017), respectively. These sources were measured at the county level and linked to districts. When districts overlapped multiple counties, COVID-19 cases and Republican vote share were weighted by the proportion of district residents residing in each county (see appendix).

Limitations in the 2020 ACS data prevent us from constructing a multiyear dataset to examine how longitudinal changes in schools' operating status related to parents' employment. We therefore use data from the Current Population Survey in an additional set of analyses to examine change from before to during the pandemic and compare the relationship of school operating status with employment in both the fall of 2020 and the spring of 2021. The CPS is the primary source of data for monthly labor statistics in the United States, covering approximately sixty thousand households from all fifty states and the District of Columbia. Repeated monthly, the CPS is well suited for analyzing detailed periods and shifts over time. The smaller sample size relative to the ACS, however, limits our ability to link these data to local school districts. We accordingly use state-level aggregates of school district operating status, measured as the proportion of students in each state who are learning remotely, to examine mothers' employment during the pandemic (fall 2020 and spring 2021) compared with the pre-pandemic years of 2018 and 2019. Our estimation strategy for these analyses is outlined in equation (2):

$$y_{imts} = \gamma_{00} + \beta_1 m_{imts} + \beta_2 c_{ts} + \beta_3 (c_{ts} \times m_{imts}) + \lambda R_{imts} + \beta_4 d_{mts} + w_m + l_t + \alpha_s + \varepsilon_{ij} \quad (2)$$

where i indexes respondents, m survey month, t year, and s states. In this equation, employment (y) is predicted by motherhood status relative to fathers or nonmothers (m), the prevalence of remote schooling in respondents' state (c), and the interaction of these variables ($c \times m$). Equation (2) also includes fixed effects for month of survey (w), year (l), and state (α), which together isolate the effect of β_3 to estimate whether the shift to remote schooling during the pandemic uniquely impacted mothers. Individual controls (R) include age, race, education, marital status, and family income.[6] We also include a control for monthly rates of COVID-19 per hundred thousand residents (d) because the CPS data pool multiple months of data.

State aggregates are less precise measures of whether respondents were directly affected by remote schooling given that school schedules varied by district within many states. We therefore first validate the use of state aggre-

4. For additional ESOS data collection details, technical documentation, and data access, see Landivar et al. 2021.

5. Additional details on the matching of ACS respondents to districts are included in the appendix.

6. We do not include controls for welfare receipt or the presence of grandparents providing for children's basic needs because these variables are not available in the CPS data we analyze.

gates by examining the relationship of employment to remote schooling in the fall of 2020, a period that overlaps with the more detailed district-level analyses conducted with the ACS and discussed above. We then apply equation (2) to assess how remote schooling in the spring of 2021 related to within-state differences in employment relative to spring 2018 and spring 2019. We exclude spring 2020 from these models because the beginning of the pandemic was a period when nearly all schools closed or went remote. In a last set of models, we predict employment shifts in spring 2021 relative to spring 2018 and 2019 with a measure of remote schooling at the state level in fall 2020. Our aim in these analyses is to determine whether the relationship of remote schooling to mothers' employment persisted after most schools returned to in-person instruction.[7] We restricted our sample to respondents age twenty-five to fifty-four. In comparing mothers with fathers, we include only respondents with elementary-age children, age five to twelve years old, resulting in 100,159 respondents for the fall (August through November 2018, 2019, and 2020) and 94,468 for the spring (February through May 2018, 2019, and 2021). Comparing mothers with women without children, we restricted our sample to women who have children ages five to twelve and women with no children, providing 162,675 respondents in the fall months and 151,711 in the spring months. We explore patterns by education but do not report results by race or marital status due to the smaller sample of the CPS.

RESULTS

Figure 2 illustrates elementary school operating status across the United States at two timepoints: September 2020 (panel A) and April 2021 (panel B). Table 1 reports key district characteristics by elementary school operating status. In September 2020, half of school districts provided in-person instruction, a quarter were primarily remote, and about 20 percent operated hybrid schedules (table 1). By student population, 45 percent of elementary school students were attending districts with remote instruction, whereas 38 percent attended in-person districts and 17 percent attended hybrid instruction districts. Remote learning was more common in urban school districts, Black and Hispanic serving districts, districts with higher COVID-19 rates, and districts with a greater share of Democrat voters. By contrast, in-person learning was more common in rural districts, majority White districts, and Republican voting areas.

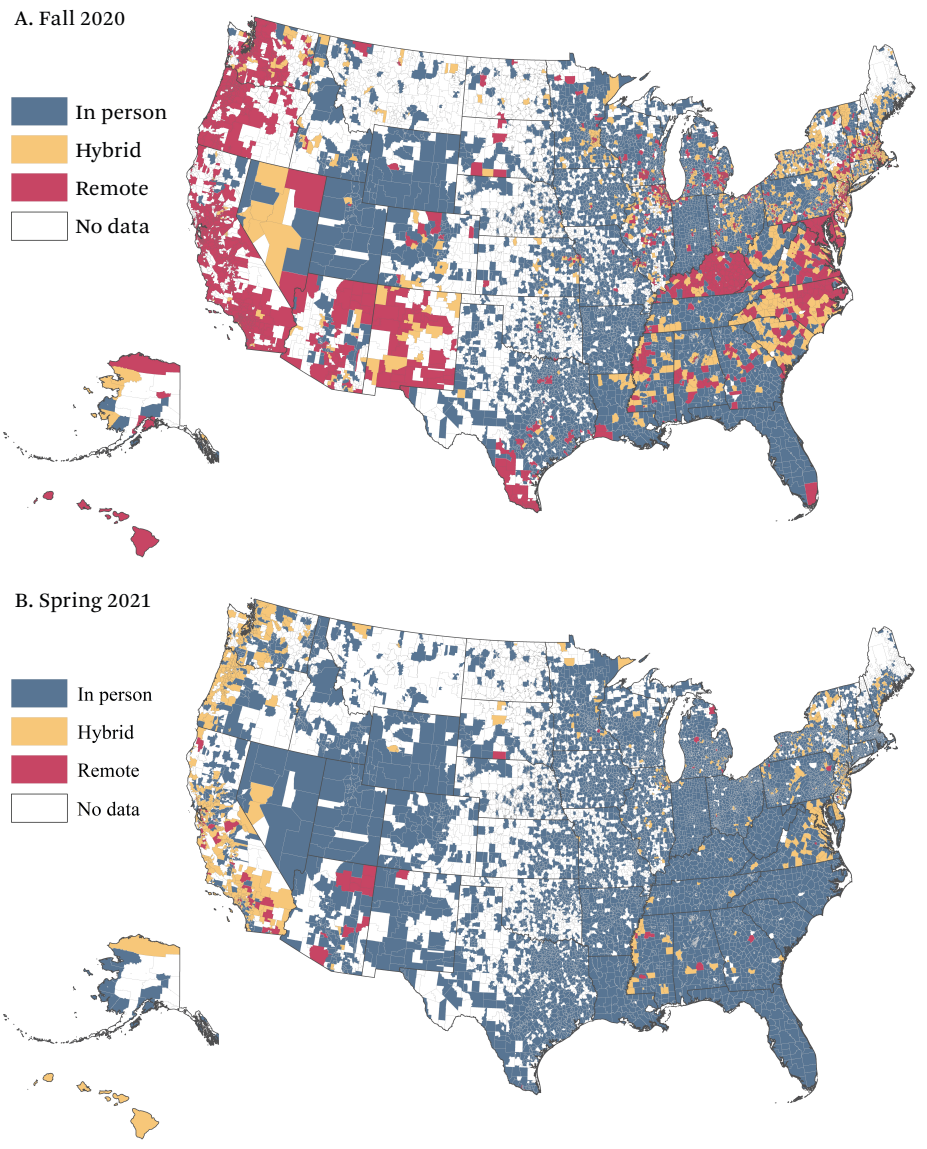
By April 2021, 86 percent of all districts serving about 76 percent of students returned to in-person instruction; only 1.2 percent of districts remained fully remote. These districts were more likely to be in cities and places with higher rates of COVID-19, have higher Black and Hispanic student enrollment, and have a smaller share of Republican voters. Although the percentage of districts in remote learning declined by the spring, those operating remotely at this time had similar characteristics as those operating remotely the previous fall.

Descriptive Employment Patterns

In table 2, we report employment rates from the 2020 ACS for our three comparison groups: mothers, fathers, and women without children. Overall, mothers are about 14 percentage points less likely to be employed than fathers and 2 percentage points less likely than women without children. Employment gaps between mothers and fathers are observed across race and education, but are substantially smaller for Black respondents and absent between single mothers and fathers. Differences in employment between mothers and women without children showed greater variability by race and education. White, Hispanic, college-educated,

7. In analyses not presented, we examined both fall and spring operating status in the same model. Fall operating status fully mediated the effects of spring operating status. These two measures are highly correlated (r = 0.6) because nearly all districts remote in spring 2021 were also remote in fall 2020. Three-way interactions between motherhood, fall operating status, and spring operating status were nonsignificant. We analyze fall and spring operating status separately to underscore that remote schooling in the spring posed an ongoing challenge to mothers' employment.

Figure 2. Elementary School Operating Status by District



Source: Elementary School Operating Status waves 1 and 2 (Landivar et al. 2022).

and married women without children were more likely to be employed than mothers with similar characteristics. In contrast, Black, single, and (to a lesser extent) less than college-educated mothers had higher rates of employment than their counterparts without children. To explore whether these employment patterns are affected by remote schooling, we report the results of our analyses testing whether mothers were uniquely affected by these changes experienced during the pandemic.

Mothers' and Fathers' Employment and Remote Learning

Table 3 presents the results of equation (1) testing the relationship of remote schooling in the fall of 2020 to mothers' and fathers' employment. Our results confirm a substantial employment gap between mothers and fathers in 2020 across all regions, but also indicate that this gap grew more in areas with remote schooling. In districts that implemented remote instruction in the fall of 2020, the gap

Table 1. School District Characteristics by Operating Status

	Fall 2020			Spring 2021		
	In-Person	Hybrid	Remote	In-Person	Hybrid	Remote
Share of all districts (%)	55.7	19.7	24.6	85.9	12.9	1.2
Share of all students (%)	38.2	17.1	44.8	76.1	21.8	2.1
Average elementary student population	1,818	2,310	4,850	2,355	4,498	4,551
Geographic locale						
Urban	30.9	15.1	54.2	73.7	23.0	3.3
Suburban	32.8	31.1	36.1	78.2	20.1	1.7
Rural	69.6	14.9	15.5	91.0	8.3	0.7
District racial composition (%)						
≥25% Black students	41.5	20.2	38.4	81.1	15.9	3.0
≥25% Hispanic students	37.5	12.4	50.1	71.5	24.7	3.7
≥75% White students	68.2	21.1	10.7	93.5	6.3	0.1
Average cumulative COVID-19 cases per 100,000 residents	1,833	1,737	2,003	9,882	8,643	10,515
Republican vote in 2020 presidential election (%)	64.0	50.1	43.8	58.7	42.4	36.6

Source: Authors' calculations based on Elementary School Operating Status waves 1 and 2 (Landivar et al. 2022); Johns Hopkins University Novel Coronavirus Visual Dashboard (Dong et al. 2020); and MIT Election Data and Science Lab (2017).

Table 2. 2020 Employment Rates

	Mothers	Fathers	Women Without Children
Overall	76.5	90.6	78.5
By race			
White	77.1	95.3	79.9
Black	84.3	91.3	72.4
Hispanic	60.8	94.6	77.1
By education			
Less than college	68.3	92.7	67.7
College or more	77.7	97.2	90.7
By marital status			
Married	74.3	92.2	81.0
Single	82.3	82.0	76.9

Source: Authors' calculations based on American Community Survey 2020 (Ruggles et al. 2022).

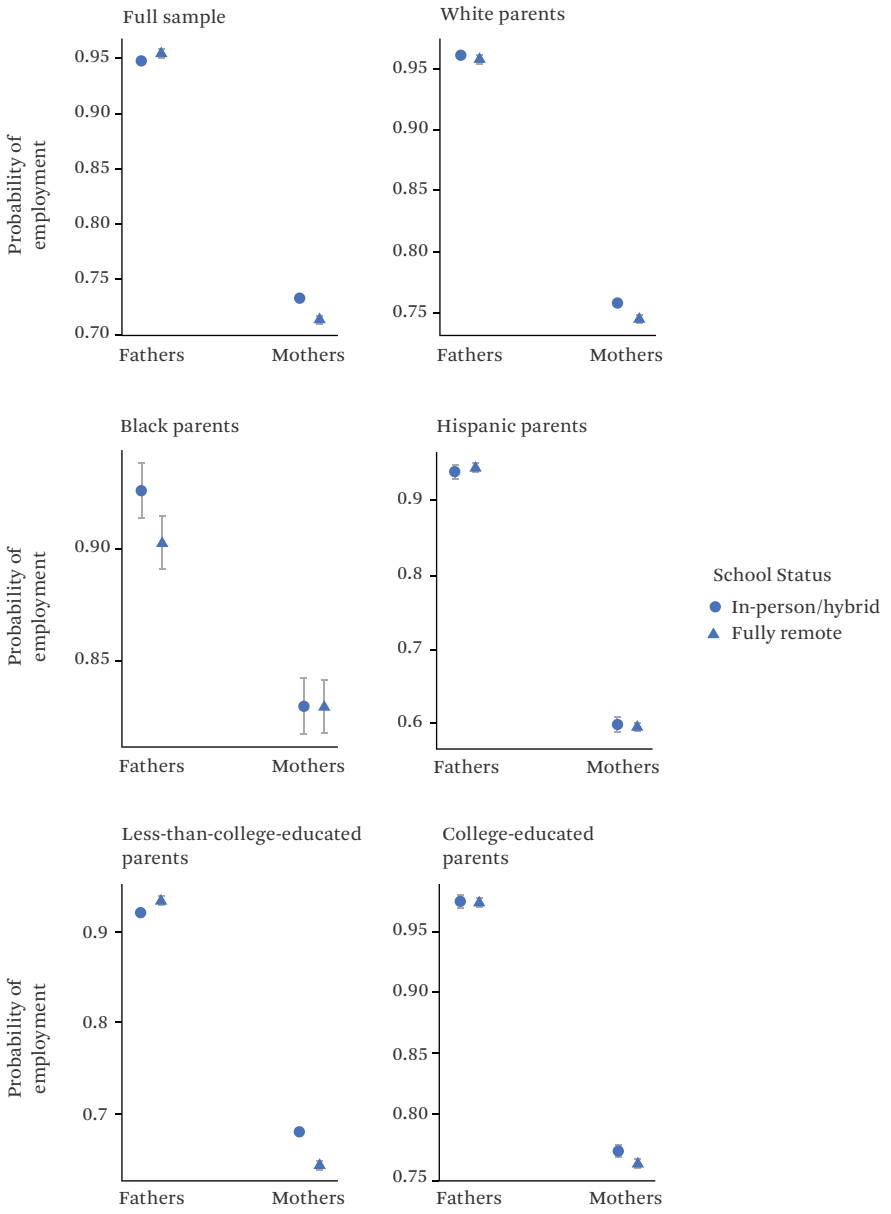
between mothers' and fathers' employment was larger by about 2.6 percentage points than in districts that maintained in-person instruction ($p < .001$). This pattern is illustrated in figure 3, where we plot predicted probabilities of employment calculated from equation (1) for the full sample and across respondent race and education. For the full sample, fathers' probability of employment remained around 0.95 regardless of schools' operating status,

Table 3. Results, Linear Probability Models Predicting Gender Differences in Parents' Employment

	Full Sample	White Household	Black Household	Hispanic Household	Less than College Household	College-Educated Household
Gender (Fathers)						
Mothers	−0.215***	−0.202***	−0.097***	−0.347***	−0.241***	−0.203***
	(0.001)	(0.001)	(0.007)	(0.005)	(0.002)	(0.002)
School district is remote, fall 2020	0.006***	−0.004*	−0.023**	0.006	0.013***	−0.0003
	(0.002)	(0.002)	(0.009)	(0.006)	(0.003)	(0.003)
Mothers * remote schooling	−0.026***	−0.010***	0.023*	−0.006	−0.050***	−0.010***
	(0.001)	(0.002)	(0.009)	(0.006)	(0.002)	(0.002)
Controls	age, race, education, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, education, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, education, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, education, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, race, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, race, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition
Constant	0.689***	0.700***	0.686***	0.711***	0.711***	0.763***
	(0.006)	(0.007)	(0.033)	(0.018)	(0.009)	(0.014)
SD of intercept (by household)	0.152	0.147	0.140	0.158	0.158	0.145
N	693,944	486,718	13,930	57,792	299,882	212,084

Source: Authors' calculations based on American Community Survey 2020 (Ruggles et al. 2022).
Standard errors in parentheses.
*$p < .05$; **$p < .01$; ***$p < .001$

Figure 3. Parents' Predicted Employment



Source: Authors' calculations.

whereas mothers' probability of employment was predicted to be 0.73 when in-person schooling was available and 0.71 under remote schooling.

Comparing racial groups, we find that White mothers' probability of employment declined by an additional percentage point relative to White fathers' employment in districts with remote schooling ($p < .001$), leading to a worsening of the gender employment gap. Figure 3 shows that White fathers' employment is predicted to fall from 0.96 when in-person schooling is available to 0.95 under remote schooling, a nonsignificant difference. The relationship of remote schooling to employment is roughly 2 percentage points for White moth-

ers, whose probability of employment is 0.76 with in-person schooling and 0.74 under remote schooling.

We observe opposite trends for Black mothers and fathers. Illustrated in figure 3, remote schooling was associated with a 2.3 percentage point reduction in Black fathers' probability of employment and null for Black mothers, whose probability of employment remained at 0.83 regardless of schools' operating status. Among Hispanic parents, we find that remote schooling was not associated with mothers' or fathers' employment, which remained at similar levels regardless of whether schools were remote. Thus, among married parents with elementary-age children, remote schooling widened gender gaps in employment for White but not for Black or Hispanic couples.

Across education levels, we find that remote instruction was associated with a 5 percentage point increase in the employment gap between mothers and fathers without a bachelor's degree, a pattern driven by a substantially negative relationship of remote schooling to less-educated mothers' employment ($p < .001$). Among less-educated respondents, mothers' probability of employment is 3.7 percentage points lower when districts were remote (0.64 probability of employment) than in person (0.68), whereas fathers' probability was predicted to be higher under remote learning (0.93) than when in-person instruction was available (0.92). The gender gap in parents' employment was also larger under remote learning for college-educated parents, but to a smaller extent than observed among the less educated. The probability of college-educated fathers' employment was 0.97 regardless of schools' operating status, whereas similarly educated mothers' employment was predicted to be about a percentage point lower under remote learning ($p < .001$), at 0.76, relative to 0.77 when in-person instruction was available.

Overall, our models provide evidence that remote schooling was associated with a reduction in mothers' employment relative to fathers. This relationship is strongest among White parents and parents with less education.

Mothers' and Women Without Children's Employment and Remote Learning

In table 4 we report our results from equation (1) applied to our sample of mothers and women with no children. In addition to exploring patterns by race and education, we also examine differences between single mothers and single women without children. Focusing first on the full sample, we find that mothers' probability of employment was lower by 1.3 percentage points relative to nonmothers' in districts that instituted remote instruction in fall 2020 relative to districts that offered in-person or hybrid instruction ($p < .001$). This is illustrated in figure 4. The probability of employment for both women without children and mothers was lower in districts with remote schooling, but this pattern was more pronounced for mothers. Whereas nonmothers' employment was predicted to be lower by 1 percentage point in places with remote schooling (from a probability of 0.78 to 0.77), mothers' employment fell by about 2 percentage points (from an employment probability of 0.77 to 0.75).

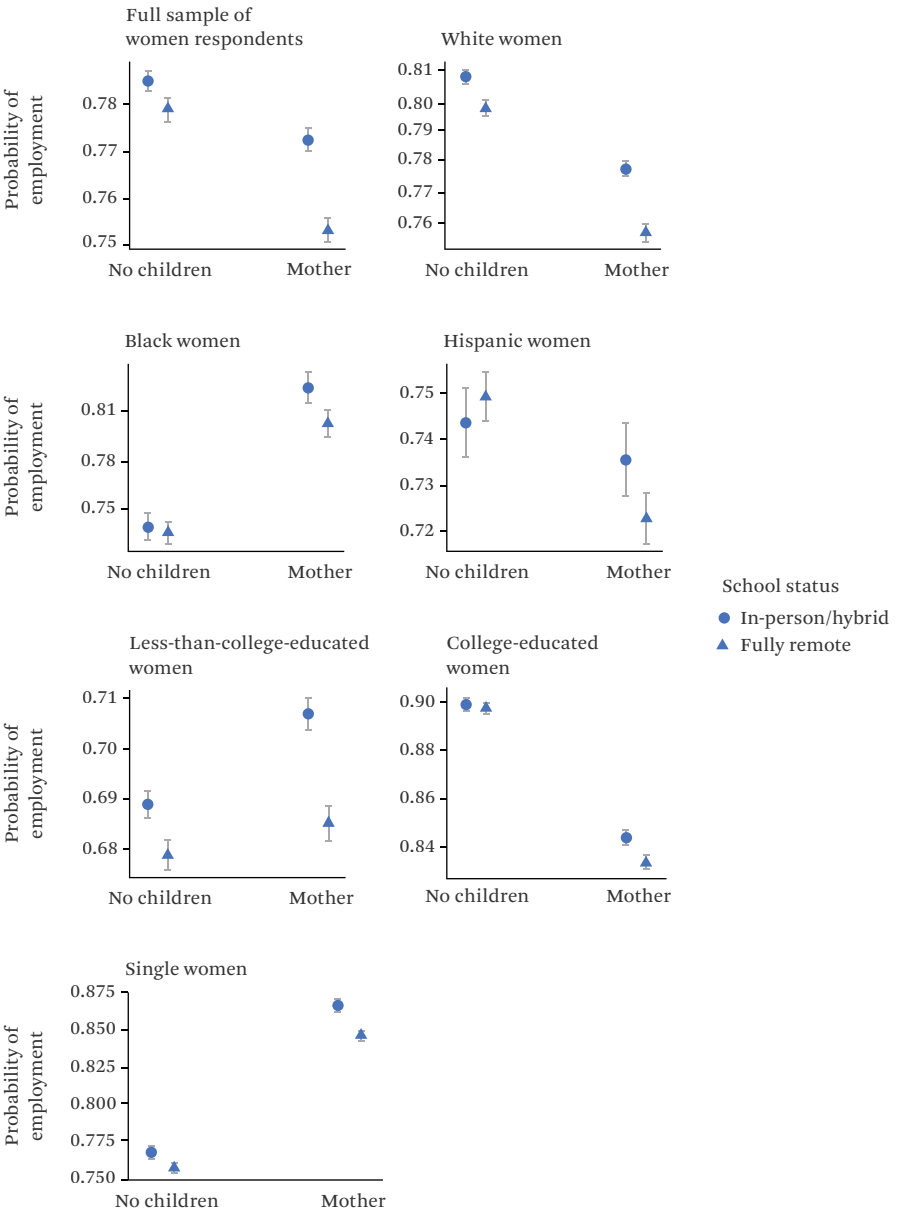
Remote schooling predicted lower probabilities of employment for mothers relative to women without children across all racial groups. Consistent with research (Dow 2019; U.S. Bureau of Labor Statistics 2019), Black mothers were more commonly employed than White and Hispanic mothers as well as Black women without children. Yet our results show that Black mothers' employment was lower by about 2 percentage points in places where schools went remote ($p < .01$). When in-person schooling was available, Black mothers' predicted probability of employment was 0.82 versus 0.80 when schools were remote. In contrast, Black women without children remained employed at similar levels regardless of schools' operating status. Hispanic mothers' employment was also lower under remote schooling, even though overall employment rates were lower than those observed for Black mothers. The probability of employment for Hispanic mothers was 0.74 when in-person schooling was available and 0.72 under remote education, whereas Hispanic women without children saw a negligible increase in employment under remote schooling. In remote districts, White

Table 4. Results, Linear Probability Models Predicting Parental Status Differences in Women's Employment

	Full Sample	White	Black	Hispanic	Less Than College	College Educated	Single Women
Parental status (no children)							
Mother	−0.013***	−0.030***	0.085***	−0.008*	0.018***	−0.055***	0.100**
	(0.001)	(0.001)	(0.004)	(0.004)	(0.001)	(0.001)	(0.002)
School district is remote, fall 2020	−0.006***	−0.010***	−0.004	0.006	−0.010***	−0.002	−0.010**
	(0.002)	(0.002)	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)
Mother * remote schooling	−0.013***	−0.010***	−0.018**	−0.018***	−0.012***	−0.009***	−0.010***
	(0.001)	(0.002)	(0.006)	(0.004)	(0.002)	(0.002)	(0.002)
Controls	age, race, education, marital status, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, education, marital status, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, education, marital status, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, education, marital status, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, race, marital status, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition	age, race, marital status, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent republican, locale status, district racial composition	age, race, education, welfare receipt, family income, grandparent support, COVID-19 prevalence, percent Republican, locale status, district racial composition
Constant	0.579***	0.572***	0.567***	0.617***	0.561***	0.741***	0.568***
	(0.004)	(0.004)	(0.013)	(0.011)	(0.005)	(0.005)	(0.005)
SD of intercept (by district)	0.032	0.036	0.050	0.047	0.042	0.028	0.034
N	1,450,229	1,053,770	85,253	156,266	872,955	577,274	664,545

Source: Authors' tabulation based on American Community Survey 2020 (Ruggles et al. 2022).
Standard errors in parentheses.
*$p < .05$; **$p < .01$; ***$p < .001$

Figure 4. Women's Predicted Employment



Source: Authors' calculations.

mothers' employment was predicted to be lower by 2 percentage points, versus 1 percentage point among White women without children. Collectively, these results indicate that mothers' employment significantly dropped relative to women without children in districts with remote learning.

Table 4 and figure 4 also show patterns by education. Even though college-educated women reported higher rates of employment than those without a college degree, the relationship of remote schooling to mothers' employment relative to nonmothers was consistent across these groups. Relative to women

without children, both college and less than college-educated mothers' employment fell by about 1 percentage point in places with remote schooling relative to areas that continued to offer in-person education ($p < .001$). A similar pattern was observed among single mothers, who reported the highest rates of employment among mothers. When in-person schooling was available, single mothers' probability of employment was predicted to be 0.86, whereas under remote schooling this figure fell by 2 percentage points, to 0.84. The relationship of remote schooling to single mothers' employment was twice as large as what we observed among single women without children.

Lingering Effect of School Closures: Mothers' Employment Versus Fathers'

Large-scale data allowing for district-level analysis for 2021 are not yet available. We therefore use state-level data from ESOS and the CPS to identify how schools' operating status was associated with mothers' employment in the spring of 2021. We also evaluate a possible lingering effect on maternal employment from school closures in the fall of 2020 carrying into the spring of 2021 even as most schools reopened to in-person instruction. We first examine the relationship between school district operating status in fall 2020 and mothers' and fathers' employment during this time to ensure that our district-level findings are robust at the state level. Results are reported in the first column of table 5. Consistent with the change observed in our district-level analyses, the gap between mothers' and fathers' employment grew in states with more remote learning. For example, in states that implemented fully remote learning in fall 2020 (such as Oregon and Hawaii), the gap between mothers' and fathers' employment grew by about 6 percentage points relative to that in states that had only hybrid or

Table 5. Results, Linear Probability Models Predicting Gender Differences in Parents' Employment

	School Operating Status in Fall 2020 on Employment in Fall 2020		
CPS sample: fall 2020	Full Sample	Less than College Degree	College Degree or More
Gender (fathers)			
Mothers	−0.184***	−0.213***	−0.141***
	(0.003)	(0.004)	(0.004)
Proportion remote in state, fall 2020	0.003	−0.001	0.012
	(0.009)	(0.014)	(0.012)
Mothers * proportion remote in state, fall 2020	−0.063***	−0.066***	−0.065***
	(0.010)	(0.014)	(0.013)
Controls	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence
Fixed effects	year, month, state	year, month, state	year, month, state
Constant	0.882***	0.910***	0.897***
	(0.013)	(0.017)	(0.023)
N	100,159	60,261	39,898

Source: Authors' calculations based on Current Population Survey 2018, 2019, and 2020 (Flood et al. 2022).

Note: Standard errors in parentheses.

*$p < .05$; **$p < .01$; ***$p < .001$

in-person instruction (such as Arkansas and Maine). These patterns were consistent by level of education.

Next we examine the relationship between states' prevalence of remote schooling in the spring of 2021 to parents' employment during this period in table 6. We find that remote schooling has a large and negative relationship to mothers' employment relative to fathers ($p < .001$), but that this pattern is restricted to those with less education. For the spring of 2021, our results indicate that less than college-educated mothers' employment was nearly 8 percentage points lower than that of similarly educated fathers in states where remote schooling was most common—where at least 10 percent of districts were fully remote, such as New Jersey and California—than in states with no remote districts ($p < .001$). Among college-educated mothers, we do not observe a significant relationship of remote schooling in the spring of 2021 to employment during the same period.

To understand the relationship between remote learning in the fall of 2020 and maternal employment in the spring of 2021, the last results in table 6 show that mothers' employment remained about 5.6 percentage points lower than fathers' in states that fully instituted remote instruction in the fall than in states that did not implement remote instruction ($p < .001$)—a large effect lingering into the spring of 2021 even after schools reopened. Examining this pattern across levels of education, however, reveals that it is primarily restricted to those with less education. In states with widespread remote instruction in the fall of 2020, less than college-educated mothers' employment was predicted to be 8.7 percentage points lower the following spring than similarly educated fathers' ($p < .001$). In contrast, remote schooling in the fall of 2020 did not have a significant lingering impact on college-educated mothers' employment relative to college-educated fathers'. In other words, our results suggest that college-educated mothers' employment fell immediately as remote schooling was instituted, but rebounded by the following spring. In contrast, less-educated mothers' employment in the spring of 2021 had yet to fully recover from remote schooling instituted the previous fall.

Mothers' Employment Relative to Women Without Children's Employment

To validate our district-level results, we first examine the relationship between remote schooling in fall 2020 to women without children and mothers' employment during the same period (see table 7). We find that patterns are substantively similar, mothers' probability of employment falling 3.9 percentage points relative to women without children in states where remote schooling was universal versus states that had no remote schooling ($p < .001$). This pattern was consistent across levels of education.

Table 8 presents our analysis of schools' operating status in the spring of 2021. We again find mothers' employment is lower than that of nonmothers' in states where remote schooling was more common. Testing these patterns by level of education, however, reveals that the trend is significant only for less-educated mothers. Less than college-educated mothers were about 3 percentage points less likely to be employed than similarly educated women without children in states where remote schooling was most common (10 percent of school districts were remote) compared to states where there was no remote instruction ($p < .05$). For college-educated mothers, the relative impact of remote schooling on employment was not statistically significant.

Assessing whether school operating status in the fall of 2020 was related to employment the following spring, Table 8 shows that mothers were less likely to be employed than women without children in states with higher rates of remote instruction. Yet these patterns were again concentrated among the less educated. Mothers with less than a college degree were 5.4 percentage points less likely to be employed than similarly educated nonmothers in spring 2021 in states that had widespread remote learning in fall 2020 ($p < .05$). The relationship of remote schooling to mothers' employment was not significant among those with college degrees. These findings lend further evidence that college-educated mothers' employment declined initially when schools went remote, in

Table 6. Results, Linear Probability Models Predicting Gender Differences in Parents' Employment

	School Operating Status in Spring 2021			School Operating Status in Fall 2020		
CPS Sample: Spring 2021	Full Sample	Less than College Degree	College Degree or More	Full Sample	Less than College Degree	College Degree or More
Gender (fathers)						
Mothers	−0.193***	−0.220***	−0.155***	−0.190***	−0.214***	−0.153***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Proportion remote in state, fall 2020				0.027*	0.030	0.029*
				(0.011)	(0.016)	(0.015)
Proportion remote in state, spring 2021	0.278**	0.283*	0.312**			
	(0.085)	(0.122)	(0.110)			
Mothers * proportion remote in state, fall 2020				−0.056***	−0.087***	−0.024
				(0.010)	(0.015)	(0.014)
Mothers * proportion remote in state, spring 2021	−0.515***	−0.778***	−0.192			
	(0.125)	(0.177)	(0.167)			
Controls	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence
Fixed effects	year, month, state	year, month, state	year, month, state	year, month, state	year, month, state	year, month, state
Constant	0.878***	0.903***	0.927***	0.876***	0.899***	0.926***
	(0.014)	(0.018)	(0.023)	(0.014)	(0.018)	(0.023)
N	94,468	56,981	37,487	94,468	56,981	37,487

Source: Authors' calculations based on Current Population Survey 2018, 2019, and 2021 (Flood et al. 2022).

Note: Standard errors in parentheses.

*$p < .05$; **$p < .01$; ***$p < .001$

Table 7. Results, Linear Probability Models Predicting Differences in Employment

	School Operating Status in Fall 2020 on Employment in Fall 2020		
CPS sample: fall 2020	Full Sample	Less than College Degree	College Degree or More
Parental status (nonmothers)			
Mothers	0.005	0.025***	−0.025***
	(0.005)	(0.007)	(0.007)
Proportion remote in state, fall 2020	0.000	−0.005	−0.001
	(0.012)	(0.016)	(0.014)
Mothers * proportion remote in state, fall 2020	−0.039***	−0.034*	−0.036*
	(0.008)	(0.014)	(0.014)
Controls	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence
Fixed effects	year, month, state	year, month, state	year, month, state
Constant	0.627***	0.600***	0.750***
	(0.010)	(0.019)	(0.021)
N	162,675	89,780	72,895

Source: Authors' calculations based on Current Population Survey 2018, 2019, and 2020 (Flood et al. 2022).
Note: Standard errors in parentheses.
*$p < .05$; **$p < .01$; ***$p < .001$

the fall of 2020, but rebounded by the following spring. In contrast, less-educated mothers' employment remained at lower levels several months after states implemented remote schooling.

DISCUSSION AND CONCLUSION

Our analyses provide further evidence that remote instruction is detrimental to maternal employment, but with important variation across subgroups. In general, we find that maternal employment fell relative to fathers and women without children in states and school districts that instituted remote learning during the 2020–2021 school year. Expanding on earlier research, we use data from the ACS to test whether this pattern varied across race, education, and marital status. We also use data from the CPS spanning multiple years and to uncover enduring effects of remote schooling taking place several months after many schools returned to in-person learning. Remote schooling in the fall of 2020 predicted not only a contemporaneous reduction in mothers' employment, but also an ongoing negative effect six months later, particularly among less-educated mothers.

The most consistent negative associations between remote learning and employment relative to both fathers and women without children were observed among mothers with less than a college education. The mothers have less access to workplace benefits that would have helped maintain employment (such as paid leave) and not enough income to pay for additional childcare (such as nannies, tutors, and pods) that could have offered critical support during remote schooling. Telecommuting was also a vital benefit to help parents continue paid work during the pandemic (Collins et al. 2021; Landivar et al. 2020) and mothers with less education were less likely to have access

Table 8. Results, Linear Probability Models Predicting Differences in Employment

	School Operating Status in Spring 2021			School Operating Status in Fall 2020		
CPS sample: spring 2021	Full Sample	Less than College Degree	College Degree or More	Full Sample	Less than College Degree	College Degree or More
Parental status (nonmothers)						
mothers	−0.006	0.004	−0.026***	−0.003	0.008	−0.023**
	(0.006)	(0.008)	(0.006)	(0.007)	(0.009)	(0.007)
Proportion remote in state, fall 2020				−0.003	−0.033	0.029
				(0.012)	(0.022)	(0.021)
Proportion remote in state, spring 2021	−0.015	−0.339***	0.305***			
	(0.050)	(0.071)	(0.070)			
Mothers * proportion remote in state, fall 2020				−0.045**	−0.054*	−0.025
				(0.013)	(0.024)	(0.016)
Mothers * proportion remote in state, spring 2021	−0.291***	−0.289*	−0.161			
	(0.067)	(0.119)	(0.148)			
Controls	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence	age, race, education, marital status, family income, COVID-19 prevalence
Fixed effects	year, month, state	year, month, state	year, month, state	year, month, state	year, month, state	year, month, state
Constant	0.615***	0.602***	0.732***	0.613***	0.598***	0.732***
	(0.011)	(0.017)	(0.021)	(0.011)	(0.017)	(0.021)
N	151,711	84,877	66,834	151,711	84,877	66,834

Source: Authors' calculations based on Current Population Survey 2018, 2019, and 2021 (Flood et al. 2022).

Note: Standard errors in parentheses.

*$p < .05$; **$p < .01$; ***$p < .001$

(Crowley, Doran, and Ryan 2021). In short, less-educated mothers had the fewest individual resources to overcome the challenges posed by remote schooling on care demands. Remote schooling posed an immediate challenge to their employment, but evidence also indicated enduring negative effects several months later. Less-educated mothers were less likely to be employed by the spring of 2021 when they lived in states where remote learning was common the previous fall.

On average, Black and Hispanic mothers have fewer workplace resources than their White counterparts, such as access to telecommuting, that support mothers balancing work and childcare during periods of remote schooling (Pirtle and Wright 2021; Yavorsky, Qian, and Sargent 2021). Reflecting these differences, remote schooling had a larger negative association with Black and Hispanic mothers' employment than White mothers' relative to women without children. To this end, we find evidence that remote schooling was harmful for Black and Hispanic mothers' work attachment, particularly considering that these individuals were also four to five times more likely to live in districts that implemented remote instruction (Landivar et al. 2022). Although Black and Hispanic mothers may have had less access to workplace resources, research also suggests that they provide a larger share of their household's income. In addition, Black and Hispanic men were more vulnerable to unemployment during the pandemic (Falk et al. 2021), and may have taken on added caregiving while out of work. Studies show that recently unemployed men contributed more to childcare early in the pandemic (Petts, Carlson, and Pepin 2021; Ruppanner et al. 2021). These patterns may explain why remote schooling did not increase the gender gap in Black and Hispanic parents' employment but did widen it in White parents' employment. Whereas caregiving inequalities among White parents worsened under remote learning, Black and Hispanic fathers may have contributed more and supported Black and Hispanic mothers' employment.

If responses to remote learning are moderated by access to workplace and family resources, they may be influenced by financial necessity as well. We found that remote schooling predicted a reduction in single mothers' probability of employment relative to single women without children. This pattern reflects the difficulty sole caregivers face when a major source of childcare during working hours is removed. Yet the effect size of remote instruction on single mothers was smaller than observed for the full sample. This pattern likely reflects the financial necessity of single parents' employment. Along with being sole caregivers, they are also likely to be sole providers (Glynn 2019). Under these circumstances, it is likely that single mothers endured tremendous challenges to remain employed. Our results reflect both the cost of remote learning to these mothers' employment as well as their resilience in overcoming the challenges posed by remote work to remain employed, albeit at lower rates under remote schooling.

This study includes several notable limitations. Our analysis of the 2020 ACS data is necessarily cross-sectional due to data restrictions stemming from sampling issues during the pandemic (Rothbaum et al. 2021; U.S. Census Bureau 2021). Our comparison of mothers' employment to fathers' and women without children's employment is intended to identify the distinct impact of remote schooling on mothers who commonly shoulder the majority of childcare and would therefore be more directly affected. Nonetheless, our results are still vulnerable to omitted variable bias related to unmeasured factors that may also shape mothers' employment. In addition, although we identify an enduring effect of remote schooling in the fall of 2020 on less-educated mothers' employment the following spring, we are limited in examining the underlying mechanisms behind this pattern. It is possible that less-educated mothers face prolonged job searches or that they are opting out of employment for a longer duration following remote schooling. Additional research formally testing these findings is necessary to identify the causes behind the patterns we have illustrated.

Examining the relationship of remote schooling to mothers' employment by race, education, and marital status, our study revealed

a dynamic set of individual-level resources and necessities shaping how pandemic-related changes affected individuals' lives. Our findings affirm the importance of workplace resources to mitigate negative repercussions associated with the increased childcare requirements, especially for mothers, during remote learning. In addition, our results underscore the value of family resources as an important source of support for Black and Hispanic mothers who were less commonly in telecommuting or flexible occupations. Whereas remote schooling posed a tremendous challenge to these mothers, it did not necessarily increase inequality in their homes. Necessity also shaped responses to remote schooling. For single mothers, some left work in response to remote learning, but a surprising share remained employed despite intense challenges, likely because their family's financial stability depended on it. Collectively, these results highlight the importance of schools as a critical component of care infrastructure in supporting maternal employment and family well-being.

APPENDIX. MATCHING PUBLIC USE MICRODATA SAMPLE RESPONDENTS TO SCHOOL DISTRICTS

We adopted the procedures that David Dorn (2009) outlined and have been used in research (Autor and Dorn 2013; Dorn 2009; Scarborough and Sin 2020) to assign ACS Public Use Microdata Sample (PUMS) respondents to school districts. The most precise geocode for respondents' place of residence in the PUMS data is the Public Use Microdata Area. For each respondent, we calculated the probability that they lived in a school district based on the location of their associated PUMA. For respondents in PUMAs located entirely within school districts (23 percent of the 2020 ACS sample), their associated probability was 1. For those in PUMAs straddling districts or with multiple school districts within their boundaries, their probability of district assignment was determined by the proportion of PUMA residents living in each district. To determine this figure, we used the Geocorr application from the Missouri Census Data Center that calculated the proportion of PUMA residents in each school district using detailed census-block level population estimates. Respondents in PUMAs straddling multiple school districts have a probability between 0 and 1 for more than one district. These respondents are duplicated in the dataset and weighted by their probability of assignment. This approach allows us to retain full information when generating district estimates while accounting for the fact that the Census Bureau keeps precise geocodes for ACS respondents confidential.

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