Minimum Wage, Worker Quality, and Consumer Well-Being: Evidence from the Child Care Market

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Abstract

We study the impact of the minimum wage on service quality and consumer well-being within the child care market. Although child care firms increase teacher pay in response to minimum wage reforms, we find no impact on employment. Instead, providers respond by implementing other revenue-enhancing and cost-saving practices, such as raising prices, increasing child-to-staff ratios, and serving fewer publicly-subsidized children. We also show that service quality increases: staff turnover declines, teachers are more likely to make human capital investments, and teacher-child interactions improve. Despite the increase in quality, parents report that they are less satisfied with their child care provider.

Keywords: Child care, child care quality, minimum wage

JEL Codes: J13, J15, J21, K39

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1 Introduction

Although a substantial literature assesses the impact of minimum wage reforms, much of it focuses on outcomes related to employment and earnings, primarily within the restaurant and retail sectors (e.g., Belman and Wolfson, 2014; Brochu and Green, 2013; Congressional Budget Office, 2019; Dube et al., 2010, 2016; Neumark et al., 2014). However, firms may adjust to minimum wage increases on other margins as well—such as raising prices and modifying quality—and these non-employment margins may be particularly important for consumer well-being (Ashenfelter and Jurajda, 2022; Ruffini, 2022).

In this paper, we study the impact of the minimum wage in a large and differentiated market where quality can have important consequences for individuals' short- and long-run well-being: child care (Barr and Gibbs, 2022; Baker et al., 2019). The child care services industry provides care for 13 million preschool-age children and employs 4.7 million workers across multiple sectors with heterogeneous quality (Bassok et al., 2016; Brown and Herbst, 2022; NICHD ECCRN, 2000).[1] Within this context, our paper examines not just the employment effects of minimum wage reforms; it is one of the first to assess direct measures of worker quality and job performance as well as consumer well-being. As with other service sector firms, child care is a setting in which many low-wage individuals are employed, worker productivity is difficult to quantify, and managers cannot easily substitute away from labor inputs in the production process. Therefore, results from this study—while restricted to the child care industry—may have broad applicability.

We begin by combining nearly 20 years of state and federal minimum wage changes with data from the Quarterly Workforce Indicators (QWI) database to examine child care workers' earnings, employment, and turnover. We revisit these outcomes here to confirm that the minimum wage binds in the child care market, as is likely given that over 30% of such workers receive a wage that is within 10% of the minimum wage.[2] Child care centers may be limited in their ability to adjust employment in response to the minimum wage due to legal requirements for a maximum child-to-teacher ratio, but facility closures would decrease aggregate employment in child care.

[1] Recent estimates suggest that 2% of working-age women are employed in the child care industry, compared to 0.9% in retail clothing stores and 5% in restaurants (Brown and Herbst, 2022).

[2] Statistic based on authors' calculations from the Current Population Survey for the years 2015 to 2019. In addition, the median hourly wage ($13.22) is the 14th lowest out of 753 occupations. This number is based on the authors' analysis of the May 2021 Occupational Employment and Wage Statistics (OEWS) survey. By comparison, Dube et al. (2010) estimate that 33% of restaurant workers are within 10% of the minimum wage.

Furthermore, documenting any changes to turnover is particularly important in light of recent work linking higher teacher turnover to worse child outcomes (Markowitz, 2019). Staff turnover rates in the industry are comparatively high, with one recent study estimating that 46% of child care teachers leave their program from one year to the next (Bassok et al., 2021b).[3] Nevertheless, there is emerging evidence that even temporary increases in compensation can substantially reduce turnover (Bassok et al., 2021a). Thus there are reasons to suspect that raising the minimum wage will bind in the child care industry, increasing employee earnings and potentially reducing turnover as a result.

We then provide evidence on the price pass-through of minimum wage increases, which has received less attention in previous research (e.g., Aaronson, 2001; Aaronson et al., 2008; Allegretto and Reich, 2018; Ashenfelter and Jurajda, 2022; Leung, 2021; Renkin et al., 2022). Our analysis relies on price data from market rate surveys of child care providers. These surveys are administered periodically by states to establish subsidy payment amounts under the Child Care and Development Fund (CCDF), the nation's largest means-tested child care subsidy program. Our main analysis uses market rate data from California, and we conduct supplementary analyses using newly-available data from the National Database of Childcare Prices. Once again, the child care industry is an important setting for this analysis. It is extremely labor intensive, with labor costs estimated to account for 70% of business expenses (Helburn and Howes, 1996). In addition, most child care businesses are sole proprietors, whose profit margins are less than one percent.[4] Such liquidity constraints suggest that providers may respond to minimum wage increases by a full price pass-through to consumers. However, parents with young children are also liquidity constrained, given that they are in the early years of their earnings history, when child care expenses consume a relatively large share of the family budget (Herbst, 2023). It is not surprising, then, that families' child care choices are moderately sensitive to the price of care (Borowsky et al., 2022). Thus it is unclear a priori whether providers will engage in a pass-through of any labor cost increases or seek adjustments on other margins.

For example, another way providers might offset increased labor costs is to serve fewer children receiving subsidies through the Child Care and Development Fund (CCDF). The CCDF reimburses providers for offering subsidized slots up to the federally recommended 75th percentile of the local price distribution. However, many states do not meet this recommendation, and it is widely acknowledged that reimbursements would have to be

[3] Another recent study by Brown and Herbst (2022) estimates a quarterly turnover rate of 12%, which is significantly higher than that within elementary/secondary schools.

[4] Although national child care chains exist, they serve a small share of all children in non-parental arrangements (U.S. Department of the Treasury, 2021).

significantly higher to cover the full cost of producing high-quality services (Workman, 2018).[5] The CCDF also imposes documentation and other requirements that can be administratively burdensome to providers (Slicker and Hustedt, 2022). As a result, providers, in an attempt to raise revenue and reduce costs, might respond to minimum wage increases by serving fewer subsidized children (or none at all) and replacing those slots with families who pay the full cost of care out-of-pocket.[6] To test this, we construct a state-by-year panel of CCDF participants over the years 2000 to 2019 to estimate the impact of minimum wage reforms on the number of children receiving a subsidy as well as the number and composition of providers serving such children.

In the final set of analyses, we study two issues that have received considerably less attention in the minimum wage literature: service quality and consumer satisfaction. We first provide evidence on whether increased wages improve the quality of child care service delivery, where quality is proxied by improvements in teacher credentials, the quality of teacher-child interactions, and the number of providers accredited by the National Association for the Education of Young Children (NAEYC). Data on teachers come from the Birth cohort of the Early Childhood Longitudinal Survey (ECLS-B), while the data on accreditations are drawn from the market research firm AggData. Service quality might improve if more productive workers are attracted to child care employment, worker effort increases, or worker stress decreases. However, quality could also decline if high-skilled workers are laid off to reduce costs or providers substitute toward less productive non-labor inputs. Indeed, two recent studies of the nursing care sector highlight these conflicting possibilities. Ruffini (2022) shows that U.S. minimum wage increases led to fewer inspection violations, lower rates of adverse resident health conditions, and lower resident mortality, while Giupponi and Machin (2018) find that a UK-based wage increase produced lower firm-level ratings of care quality.[7]

Second, we study the impact of minimum wage increases on consumer well-being, as measured by the extent of parents' satisfaction with their child care provider. Here we rely on a dataset of consumer reviews of providers scraped from the website Yelp. This analysis, together with our assessment of service quality, is important because a significant share of children attend low- to mediocre-quality providers, a problem often attributed to the market's informational frictions (NICHD ECCRN, 2000). Parents are not able to accurately assess the quality of their

[5] Given that 73% of center-based providers in 2019 had in the past year turned families away or used a waitlist due to lack of space, providers may be able to fill spots used by CCDF children with private-pay children whose parents pay full tuition (Council of Economic Advisers, 2022).

[6] Such changes would be consistent with how nursing homes selectively admit non-Medicaid patients instead of Medicaid patients when they are near capacity (Gandhi, 2020).

[7] Nevertheless, the evidence from other low-wage sectors shows workforce improvements, both because existing workers become more productive and firms are more likely to hire better-credentialed workers (Clemens et al., 2021; Coviello et al., 2022; Ku, 2022).

child's program, and their level of satisfaction is uncorrelated with many dimensions of quality (Bassok et al., 2018; Herbst et al., 2020; Mocan, 2007). In the market for child care services—where consumer monitoring of caregivers is costly—it is not clear whether an increase in the minimum wage would improve quality, nor is it clear whether consumers would recognize an increase in quality if it occurred. If consumers possess imperfect information about quality, or have weak preferences for quality, an increase in the minimum wage might reduce consumer satisfaction if prices rise. However, if minimum wage reforms improve the quality of child care, and consumers recognize and sufficiently value the increase, consumer satisfaction is expected to increase, irrespective of whether prices rise. Our paper is one of the first to shed light on these questions by studying measures of both producer and consumer well-being.

Our main results can be summarized as follows. Using both two-way fixed effects and contiguous county, cross-state border designs, we find that minimum wage increases bind in the child care industry, raising monthly earnings for new hires between 1.0% and 1.3% for a 10% increase in the minimum wage. These magnitudes are consistent with Ruffini (2022)'s analysis of nursing home assistants, Dube et al. (2010)'s analysis of restaurant workers, and Dube et al. (2016)'s analysis of teenagers. We find no impact on employment levels, which is also consistent with some previous work (e.g., Cengiz et al., 2019; Dube et al., 2016; Ruffini, 2022).[8] Furthermore, minimum wage increases improve the stability of the child care workforce by reducing staff turnover. Our estimates imply that a 10% increase in the minimum wage reduces the turnover rate by 1.1% overall using the county border specification, where the minimum wage is more binding. Although the reduction in turnover is larger among young workers (1.8%)—a result that has been documented in other industries (Brochu and Green, 2013)—we show that such effects apply to older workers and across much of the education distribution.

Our results also suggest that child care providers pass-through the increase in labor costs to consumers. Relying on a two-way fixed effects model and local minimum wage reforms, the estimates from California's price data suggest that a 10% increase in the minimum wage raises center-based market prices between 4.2% and 8.1%, depending on the age group. We find similar results using the National Database of Childcare Prices along with a contiguous county border design. Our estimates are larger than recent studies of McDonald's restaurants (1.2% to 1.4%)

[8]It should be noted, however, that other recent studies find negative effects of minimum wage increases on employment (Clemens and Wither, 2019; Clemens and Strain, 2021; Gopalan et al., 2021; Harasztosi and Lindner, 2019; Jardim et al., 2022). Furthermore, an extensive review of the recent literature concludes that "there is a clear preponderance of negative estimates in the [employment] literature" (Neumark and Shirley, 2022). These effects occur through reductions in hiring and hours of work, and primarily among younger and less experienced workers and low-skilled workers.

(Ashenfelter and Jurajda, 2022), San Jose's restaurants (0.58%) (Allegretto and Reich, 2018), and grocery stores (0.4% to 0.8%) (Leung, 2021; Renkin et al., 2022), which is likely due to a much higher labor share in child care as compared to grocery stores and restaurants.

In addition, we uncover at least two other margins along which child care providers adjust to the increase in labor costs. First, using the ECLS-B, we show that center-based program enrollments and child-to-staff ratios increase significantly. In particular, enrollments rise 5.6% and ratios rise 4.7% after a 10% increase in the minimum wage. Second, such wage reforms induce providers to alter their participation in the child care subsidy system (i.e., CCDF). Fewer center-based providers serve subsidized children (-12.2%), but more home-based caregivers do (+27.9%). Given that center-based workers are more likely to be exposed to minimum wage reforms—home-based providers are largely sole proprietors—we interpret these findings as evidence that such providers are in need of alternative revenue sources. Altogether, we find that minimum wage increases modestly reduce the number of children receiving a CCDF subsidy, by 2.9%, though this result is not statistically significant at conventional levels.

Regarding service quality, we find that minimum wage reforms do not influence the number or share of child care providers that are NAEYC-accredited. However, our analysis of the ECLS-B uncovers striking evidence of improvements in teacher quality. Specifically, teachers are more likely to have made a variety of human capital investments, including taking courses or completing certifications in early childhood education (ECE) and related fields. Teachers also participate more intensively in several education-related activities with children (e.g., reading), and they engage in higher-quality interactions with children. Specifically, we find that minimum wage increases improve teacher scores on the Arnett Caregiver Interaction Scale (CIS), a widely-used measure of child-caregiver interactions. Our estimates imply that a 10% increase in the minimum wage raises teachers' overall Arnett score by 2.4%, or 0.1 standard deviations. These improvements in interaction quality occur despite the previously-mentioned increases in the average number of children per teacher. Although we are not able to definitively test whether these quality improvements derive from encouraging more productive workers to enter child care employment or better job performance from existing workers, our results—showing reductions in turnover—imply the latter could be the primary driver.

Despite the increase in worker productivity, we find that consumers are less satisfied with their child care provider, as measured by parents' Yelp ratings. For example, a 10% increase in the minimum wage reduces consumer

(star) ratings by 0.03 points (on a scale of one to five). Furthermore, these reductions persist across providers located in low- and high-income markets. To probe whether the increase in market prices might explain consumers' growing dissatisfaction with their child care provider, we analyze the extent to which consumers discuss issues related to the cost of care in the open-ended Yelp reviews. We find strong evidence that comments about pricing increase following the enactment of a minimum wage reform. In contrast, there is no evidence that consumers are more likely to discuss issues related to children's interactions with their teachers, providers' learning and academic environment, and other proxies for quality.

Although research on the minimum wage is voluminous, much of it focuses on teenagers or workers in the restaurant or retail sectors. Like Ruffini (2022) and Giupponi and Machin (2018), who study the market for nursing care services, our paper focuses on a critical, though overlooked, service industry. Our results paint a complicated picture about the impact of the minimum wage on the child care market. On the one hand, we show that workers' earnings and job performance increase, and that turnover declines for many categories of workers. The improvement in teacher qualifications and teacher-child interactions is particularly noteworthy in light of the evidence that such inputs are among the most important predictors of child care quality (Blau, 2001; Pianta et al., 2009). Furthermore, the reduction in staff turnover is consistent with results in Bassok et al. (2021a), who find that randomizing short-term cash payments to child care teachers substantially reduces turnover. The increased stability in the workforce may be beneficial to children if it reinforces the warm and stimulating teacher-child relationships that are shown to be important to child development (Hamre, 2014; NICHD ECCRN, 2002).

Our results also suggest, however, that some providers respond by increasing prices, serving fewer low-income children receiving subsidies, and increasing child-to-staff ratios. Furthermore, it appears that consumers are less satisfied with their provider, with the increase in prices being a plausible explanation. This uncertainty is particularly apparent and consequential as it relates to the question of whether minimum wage reforms can improve overall child care service quality and, as a result, child well-being. There is evidence from both the child care market (Blau, 2001) and the K-12 system (Britton and Propper, 2016; Hendricks, 2014; Loeb and Page, 2000) that teacher compensation is related to child outcomes. Thus our finding of wage-driven improvements in teachers' job performance bodes well for these outcomes. However, if providers also substitute toward less productive inputs—by increasing child-to-staff ratios—the net increase in service quality may be lessened.

The remainder of the paper proceeds as follows. Section 2 provides a brief overview of how the child care market is organized. Section 3 introduces the key data sources and discusses the empirical models. Results are presented in Section 4, and we provide a discussion of the results in Section 5. Section 6 concludes the paper.

2 Overview of the Child Care Market

Children ages 0 to 4 in the U.S. generally participate in private-sector child care services that take place in center- or home-based environments. Center-based programs—which are generally for-profit and nonprofit institutions, places of worship, and community-based organizations—are licensed and regulated, and they operate out of either stand-alone buildings or are co-located with other entities. Most center-based programs are organized into classrooms that serve children of different ages (i.e., infants, toddlers, older preschoolers, and school-age children), and classrooms typically include a lead or head teacher as well as an assistant teacher. The best available evidence suggests that the center-based sector contains 129,000 programs employing approximately 1 million teachers and serving nearly 7 million preschool-age children (National Survey of Early Care and Education Project Team, 2013).

Home-based child care takes place in the home of the provider or in the child's home. Throughout the paper, we refer to the former as "home-based" care and the latter as "private household" care. Home-based providers are also licensed and regulated, and function as small, independent businesses that operate out of the caregiver's home. Private household providers are typically relatives, friends, or neighbors of the child, as well as nannies, au pairs, or babysitters who are hired through word-of-mouth networks or child care job websites (e.g., Care.com). It is important to note that family, friend, and neighbor (FFN) care can also take place in the caregiver's home, but for the purposes of this paper we refer to these arrangements as private household care. Those in the private household sector are referred to as either "informal" or "unlisted" caregivers because they are unlicensed and unregulated and cannot be found on state-maintained lists of providers. In addition, such caregivers are either unpaid or paid directly by parents at a negotiated rate. Altogether the home-based sector includes 3.8 million workers who care for over 7 million children (National Survey of Early Care and Education Project Team, 2016).

Relative to all other workers, those employed as child care workers are younger, more likely to be black and Hispanic, and more likely to have preschool-age children (Brown and Herbst, 2022). Child care workers also have fewer years of education, with 23% having a four-year college degree compared to 33% among non-child

care workers. Nevertheless, there is important heterogeneity across the care sectors in worker skill: fully 23% of center-based employees have a college degree, followed by 17% among private household workers, and 13% among home-based workers. Among center-based teachers with a college degree, over half (55%) majored in early childhood education (ECE) and another 20% majored in an education-related field (Herbst, 2023). Finally, in-field professional qualifications are common among center-based teachers, with 27% having a Child Development Associate (CDA) credential and 43% having a state teaching certificate.

As discussed in Section 1, the child care industry is characterized by high staff turnover and low wages. Recent national estimates suggest that the center-based departure rate, or the share of workers who left a given program in the last year, is 17%. However, some state-specific studies find substantially higher turnover rates. For example, a study of Louisiana's programs estimates a turnover rate of 37%, and that most turnover is a departure from the ECE profession entirely (Bassok et al., 2021b). As for home-based providers, longevity is fairly short, with approximately 46% of businesses in operation for no more than five years. The evidence also suggests that turnover is countercyclical, rising during times of economic expansion and falling when the economy is in recession (Brown and Herbst, 2022). These workforce challenges stem mainly from the low pay received by child care workers. The median hourly wage of child care employees is $10.80, compared to $17.97 for all other female workers (Herbst, 2023). Another analysis finds that child care workers earn 23% less than those in other occupations after controlling for age, education, and other demographic characteristics (Gould, 2015). Nearly 15% of caregivers reside in families with an income below the poverty line, compared to 7% of those in other occupations (Gould, 2015).

3 Data Sources and Identification Strategy

3.1 Data Sources

Our empirical work relies on multiple data sources. First, to study the impact of the minimum wage on earnings, employment, and turnover we use information from the Quarterly Workforce Indicators (QWI) database. (Abowd, 2011).[9] The QWI is the product of a partnership between the U.S. Census Bureau and the state Labor Market Information entities, connecting individual-level earnings data from Unemployment Insurance records, firm-level

[9]We conduct additional analyses on earnings and supply using the American Community Survey (ACS) and the Quarterly Census of Employment and Wages (QCEW). Refer to Appendix B for a description of the data sources and results.

characteristics from the Quarterly Census of Employment and Wages (QCEW), and demographic information from the Decennial Census, Social Security Administration records, and individual tax returns.[10] Such linkages allow for analyses disaggregated by industry, employees' educational attainment, and other characteristics. Our analysis focuses on five key outcomes in the Child Day Care Services industry (NAICS code: 624410): monthly earnings, total (beginning-of-quarter) employment, turnover, new hires, and separations.[11] Each outcome is measured separately for the child care industry overall as well as for workers in five education categories (less than high school, high school/GED, some college, college or more, and those under age 25). For the county border specification, the unit of analysis is the county-quarter combination, and for the two-way fixed effects analysis, it is the state-quarter combination, between 2001 and 2019.[12] In the county border specification, we limit the sample to all contiguous counties in the continental U.S. that are on opposite sides of a state border. Of the 3,108 eligible counties, 1,184 are located along a border with another state, providing 1,308 county-pairs.[13] Because the QWI suppresses data when cell size is too small, we may be concerned that missing data could be endogenous to minimum wage changes if minimum wage changes decrease employment, hires, and/or separations. Therefore, we only include counties where neither county in the border pair has any missing observations for that variable.[14]

To assess providers' responses to minimum wage reforms, we first examine the question of price pass-through, drawing on data from state-administered child care market rate surveys. To receive CCDF funding from the federal government, states are required to conduct a child care market rate survey at least every two years. These price data are then used by states to evaluate and set reimbursement amounts for providers serving low-income families in the subsidy system. Our main analysis is conducted using the market rate surveys from one state—California—which are available from 2010 to 2018. California provides a useful setting for this analysis because its data are collected frequently and several local jurisdictions within the state enacted minimum wage reforms over this period. The price data are reported at the county-level for center- and home-based providers, and within each provider-type, for children ages 0 to 23 months and those ages 24 to 47 months.

[10] Sometimes demographic information is not available for a particular worker, in which case it is imputed.

[11] Employment is defined as the number of jobs that are held on the first day of the quarter. The turnover rate is calculated as one-half of the sum of the number of new hires and separations in a given quarter divided by the total employment in that quarter. New hires is defined as the number of workers employed at a given firm in the reference quarter who were not employed there in any of the previous four quarters. Separations is defined as the total number of workers whose job with a given firm ended in the specified reference quarter.

[12] Although all states and the District of Columbia participate in the QWI, they entered the data-sharing agreement in different years, with most states participating as of the early-2000s.

[13] The number of county pairs is larger than the number of border counties because each county can be part of more than one pair.

[14] A county has zero missing observations if there are observations for that variable for all quarters from the first quarter the county is in the data until the last. This may be less than the full time series due to changes in county organization.

We conduct auxiliary price analyses using the National Database of Childcare Prices (NDCP) (Brown et al., 2022). The NDCP compiles all of the state-specific market rate data into a county-level dataset of median weekly (full-time) prices by provider-type (i.e., center- and home-based) and child-age for the years 2008 to 2018.[15] In order to provide consistent and complete data across counties, a non-trivial share of the NDCP data was imputed for a variety of reasons.[16] For example, for the variable representing center-based prices for children ages birth to five months, 18% of county-year cells required zero imputations, 40% required one imputation, and the remaining required two or more imputations. Therefore, to maintain a higher level of data quality, our NDCP regressions include observations with no imputations or only one imputation.

We then examine whether child care providers respond to minimum wage increases by serving fewer low-income children receiving subsidies through the CCDF. The federal Office of Child Care maintains state-by-year lists of the average monthly number of children and families receiving a subsidy, as well as the number of providers that accept CCDF funds to offer subsidized slots.[17] The provider data are reported for regulated and unregulated providers (for select years) and across multiple sectors (e.g., center- and home-based services and family, friend, and neighbor (FFN) care). These data are organized into state-year cells for the years 2000 to 2019, and we construct two set of outcome variables. First, we examine the log number of children receiving CCDF subsidies and the log number of providers serving subsidized children, overall and disaggregated by sector. We then examine whether the composition of providers changed, calculating the share of subsidy-accepting providers that are centers, homes, and FFNs.

The next of set of empirical analyses examine various measures of service quality. We first study the density of providers that are accredited by the National Association for the Education of Young Children (NAEYC). To do so, we obtained a list of all such center-based providers over the period 2011 to 2020 from the market research company AggData. The provider list includes the name and physical address of each business along with its county and state of operation, and we use this information to assign to each one the relevant state and county FIPS identifier. Two versions of the data are prepared: a county-by-year dataset to implement the contiguous county border design

[15] Prices are reported for the following age groups: birth to five months, six to 11 months, 12 to 17 months, 18 to 23 months, 24 to 29 months, 30 to 35 months, 36 to 41 months, 42 to 47 months, 48 to 53 months, 54 months to school Age, and school age.

[16] According to Brown et al. (2022), imputations were required for five key reasons: one or more of the child age groups were missing, the state did not report prices in weekly units, the state did not report prices in the median, state- rather than county-level prices were reported, and the state did not conduct a market rate survey in a given year.

[17] The data can be accessed here: https://www.acf.hhs.gov/occ/data/fy-2019-ccdf-data-tables-final. Thank you to our research assistant Kaleigh Strohl for assistance in collecting this data.

and a state-by-year dataset to estimate the standard TWFE model. For both datasets, the outcomes are the log number of NAEYC-accreditated providers and the share of NAEYC-accreditated providers.[18] As noted previously, obtaining the NAEYC's Early Learning Program (ELP) accreditation is very difficult, and our data suggest that at most 12.8% of center-based providers were accredited during the study period.

We also examine a number of teacher-level measures of skill investment and job performance. These analyses rely on the ECLS-B, a nationally-representative sample of approximately 11,000 children born in 2001. Our sample pools observations from the 24-month and preschool-age waves of data collection, which span the years 2003 to 2006.[19] During these waves, interviews were conducted with the focal child's primary non-parental caregiver, and a subset of providers were observed by trained evaluators to produce ratings of the quality of caregiver interactions with children.[20]. Thus we are able to measure a large number of quality-related attributes, including caregivers' education and skill investments, the kinds of activities they engage in with children, and the nature of their interactions with children.

Specifically, the outcomes related to skill investments focus on whether caregivers have a degree in early childhood education (ECE), take courses in ECE or child development, have an ECE-related certification, and completed recent training in ECE. All of these outcomes are measured through binary indicators. We then study whether and how frequently caregivers engage in a range of educational activities with children, including reading, singing, playing games, and building items, all of which are measured by the log number of times per week the activity is performed. We also measure the frequency of caregivers' engagement in ten activities to teach math and other conceptual skills (e.g., telling time, working with shapes and patterns).[21] Finally, we assess the quality of child-caregiver interactions as measured by the Arnett Caregiver Interaction Scale (CIS). A widely used measure of caregivers' interactions with groups of children, the Arnett CIS includes 26 item-statements that explore four

[18] Note that the numerator for the second outcome comes from the AggData listing of NAEYC-accredited providers, while the denominator comes from the QCEW's data on the number of child care industry establishments.

[19] Although the observation period is relatively brief, the ECLS-B provides the most comprehensive information on child care program quality that we are aware of. Given the long-lasting effects of quality in early education settings, we believe it is critically important to assess such outcomes in the most credible way possible. Assessing quality over a longer time horizon is an important area for future research.

[20] Information about the child's provider was obtained via a 40-minute telephone interview. All provider-types (no matter how formal or informal) were eligible for the interview. Only children currently using non-parental care were eligible to have their provider interviewed, and the provider must have been interviewed first before the observational component could occur. If the focal child was no longer at a given arrangement, a provider was still eligible for the interview as long as it could be conducted within four weeks of the child's departure.

[21] These activities are: count out loud, use geometric manipulatives, use counting manipulatives, play math-related games, use/play music to teach concepts, use movement/creative drama to teach concepts, use measurement instruments, use calendar-related activities, use games and activities to tell time, and work with shapes and patterns

dimensions of interaction quality: detachment, punitiveness, permissiveness, and sensitivity. Each item is rated on a four-point scale ranging from "not at all" to "very much" depending on how much a given statement characterizes the nature of caregivers' interaction.[22] The CIS is an example of *process quality*, which refers to the way in which children experience and connect with the child care environment, including the quantity and quality of activities and interactions with caregivers. Such measures are important because process quality is shown to be a stronger predictor of child development than the regulatable inputs to quality like child-to-staff ratios and staff qualifications (NICHD ECCRN, 2002; Pianta et al., 2009; Sabol et al., 2013). Our analysis examines the log of each domain-specific score as well as the log overall CIS score.

Our final analysis examines the impact of the minimum wage on a measure of consumer well-being (or satisfaction) using a unique dataset of consumer reviews of child care providers from the website Yelp (Herbst et al., 2020). Business and reviewer information in the 40 largest U.S. cities was scraped from pages listing "child care and day care" providers over the years 2005 to 2017. Each firm's physical address was used to geocode the location of all providers so that state minimum wage data could be attached. The dataset includes information on 52,638 unique Yelp reviews of 10,270 child care providers located in 31 states. Yelp provides two opportunities for consumers evaluate businesses: a star rating system, in which consumers rate businesses on a scale of one to five stars, and an open-ended, text-based assessment. The star rating system is our primary measure of consumer well-being. The average Yelp rating in the dataset is 4.3 stars, with about 76% of reviews containing a five-star rating. In a supplementary analysis, we exploit Yelp's text-based narrative reviews to examine the salience of child care costs to consumers' evaluation of the provider. This is operationalized by assessing whether such costs are discussed by consumers in the text reviews. A bank of relevant words and phrases was created (e.g., "price," "cost," "fees," "affordable," and "expensive") searched in the reviews, such that a given review r_i is coded as having discussed a given topical dimension d_j if the intersection of the vectors r_i and d_j is empty. A binary indicator is created equal to one if a given review discusses the topic of child care costs. Over 12% of Yelp reviews contain such a discussion.[23]

[22] An example of an item-statement in each domain is the following: "fails to supervise the children very closely" (detachment); "threatens children in trying to control them" (punitiveness), "exercises firmness when necessary" (permissiveness); and "speaks warmly to the children" (sensitivity). The CIS was completed by trained observers who spent at least two hours in the child care setting assessing quality. Data were collected on the same individual who completed the provider survey and who was identified by the parents as the child's primary non-parental caregiver. Thus, Arnett scores are available for both formal (center-based) and informal (home-based or family, friends, and neighbor) child care arrangements.

[23] An additional search of consumers' discussion of the learning and academic environment was also conducted. Here words such as "curriculum," "learn," "teach," "skills," and "development" were searched. Such topics were discussed in about 74% of the reviews, and a binary indicator for these reviews was similarly constructed.

Finally, we rely on state-level minimum wage data from Vaghul and Zipperer (2021). To move from monthly minimum wage data to quarterly, we take the maximum recorded minimum wage in that quarter, and for analysis relying on an annual minimum wage, we use the maximum recorded minimum wage in that year. For the within-California minimum wage analysis, we rely on data on local minimum wages from the U.C. Berkeley Labor Center (UC Berkeley Labor Center, 2023). Because our analysis is at the county level due to the nature of the pricing data, we aggregate the local minimum wage data to the county level using the maximum minimum wage in effect for non-profit small businesses in that county in a given year.

3.2 Empirical Strategy

We utilize several modelling strategies to estimate the impact of minimum wage policy. To examine earnings, employment, and turnover (QWI); prices (National Database of Childcare Prices); and NAEYC accreditation (AggData), we utilize the generalized case study approach outlined in Dube et al. (2010), which exploits variation in states' minimum wage laws across all contiguous county-pairs that straddle the opposite side of a state border. The contiguous county border approach is a straightforward extension to the standard two-way fixed effects (TWFE) model, in that the analysis is restricted to a comparison of child care business and worker outcomes across two adjacent counties located in different states. Empirically, we estimate the impact on these outcomes for those in counties that experienced an increase in the minimum wage relative to those in an adjoining county that did not experience a minimum wage increase. Although this approach was first used in a limited way over two decades ago by Card and Krueger (1994) and then later expanded by Dube et al. (2010), this approach remains an important methodological tool in the minimum wage literature.

Relative to the standard two-way fixed effects (TWFE) model, which relies on a large and diverse group of areas as counterfactuals, the contiguous county border approach uses adjacent counties (in different states) that are more demographically and economically similar than (interior) counties located far away from one another (Allegretto et al., 2013; Dube et al., 2016; Ruffini, 2022). Such concerns with the TWFE approach are highlighted in Dube et al. (2010), who find that states with higher minimum wages experience lower employment growth rates, and in Allegretto et al. (2013), who show that such states experience more severe recessions and have more polarized labor markets. Furthermore, in a comparison of contiguous border counties and non-contiguous pairs, the former is found

to be better balanced on a range of demographic, labor market, and firm characteristics (Ruffini, 2022). Therefore, the outcome differences that emerge from a comparison of bordering counties may more credibly be attributed to differences in minimum wage policy than a comparison of counties that are located in potentially distant states.

Limiting the samples to county-pairs that are separated by a common state border, the model is specified as follows:

$$Y_{cst} = \alpha + \beta_1 Log(MinWage)_{st} + \theta X'_{cst} + \xi_c + \eta_p \times \zeta_t + \varepsilon_{cst}, \quad (1)$$

where Y_{cst} denotes some outcome for county c located in state s in quarter t. The variable $Log(MinWage)_{st}$ is the log state-level minimum wage, and the coefficient of interest is β_1, which we interpret as the change in a given outcome for a 10% increase in the minimum wage. The vector X'_{st} represents controls for the log county population and total employment. The model includes a set of county fixed effects, ξ_c, which accounts for all time-invariant characteristics across counties that are correlated with differences in the minimum wage. Importantly, the model also includes a set of county-pair fixed effects interacted with time fixed effects, $\eta_p \times \zeta_t$. The interaction absorbs all unobserved time-varying shocks that are specific to a given county-pair, and its inclusion in the model ensures that the coefficient β_1 is identified only by contiguous-county comparisons of cross-state minimum wage differences.[24]

For two reasons, we supplement county border analyses with a standard TWFE design that takes advantage of minimum wage changes in all geographic units. First, the credibility of the county border approach has recently come under scrutiny (Jha et al., 2022; Neumark et al., 2014). For example, several studies highlight the possibility of cross-border labor spillovers in response to minimum wage increases (Jardim et al., 2023; McKinnish, 2017). Therefore, we examine the QWI outcomes (i.e, employment, earnings, and turnover) using a dataset of all states along with a TWFE model to test the robustness of the county border design. Second, some of our datasets do not include information on county identifiers, precluding us from implementing the contiguous county border methodology. For example, the CCDF administrative data on subsidy participants are reported at the state-level, and the ECLS-B data on teacher quality contain only state identifiers. In other cases, county *and* state identifiers are available, thereby allowing us to use an alternative empirical strategy to test the robustness of the county border approach (e.g., the data on NAEYC accreditation (AggData) and child care establishments (QCEW)). Our

[24]Implicit in this statement is that only the contiguous county-pairs with exposure to different minimum wage amounts are used to generate the estimates.

TWFE model takes the general form:

$$Y_{ist} = \alpha + \beta_1 Log(MinWage)_{st} + \theta X_{st}^{'} + \xi_s + \zeta_t + \varepsilon_{ist}, \tag{2}$$

where Y_{ist}, $Log(MinWage)_{st}$, and $X_{st}^{'}$ are defined in the same manner as above with time t now defined at the annual level. The subscript i on the outcome applies only to the datasets that are organized at the individual level (e.g., CPS, ACS, and the ECLS-B); all other data sets are aggregated to the state- or county-level. For the aggregated data, the subscript s on the outcome refers to the state or county. All analyses using the ECLS-B control for caregivers' gender, age, race/ethnicity, education level, self-reported health status, self-reported smoker status, number of years of child care work experience, whether the spoken language is non-English (when caring for children), and provider-type fixed effects. The ξ_s and ζ_t denote a set of state and time fixed effects, respectively. As an additional robustness check, in some analyses, following Allegretto et al. (2011), we replace the time fixed effects with Census division by time fixed effects, which account for any region-specific time-varying unobservables that are correlated with the outcomes. Conceptually, these fixed effects are equivalent to the border-pair interactions included in the previous model, and are intended to restrict comparisons to (potentially) more similar geographic areas.

For the analysis of Yelp's consumer reviews, we are able to exploit the fact that child care businesses received multiple reviews during the study period. Therefore, we relate state-level changes in minimum wage laws to within-firm changes in Yelp reviews. Conceptually, we compare a firm's average rating when the state's minimum wage is relatively low to the same firm's average rating when the minimum wage is higher. The estimated model takes the following form:

$$Y_{ist} = \alpha + \beta_1 Log(MinWage)_{st} + \theta X_{ist}^{'} + \xi_i + \eta_m + \zeta_y + \varepsilon_{ist}, \tag{3}$$

where Y_{ist} and $Log(MinWage)_{st}$ are defined in the same manner as above. Here the subscript i denotes a given Yelp review. The $X_{ist}^{'}$ is a set of controls for reviewer characteristics, including a quadratic in friend count, quadratic in review count, whether the reviewer has a profile picture, whether the reviewer attached any photos to the review, whether any individual rated the review as "useful," whether the review contains formal language or slang words,

and whether the review contains swear words. The ξ_i denotes a set of firm fixed effects, while the η_m and ζ_y denote calendar month and year fixed effects, respectively.

4 Results

The discussion of our results proceeds in four steps. We first present estimates for the impact of the minimum wage on child care workers' earnings, employment, and turnover. We then examine several ways in which providers might respond to minimum wage increases, focusing on the price pass-through to consumers, changes in child enrollments and ratios, and providers' willingness to serve low-income children receiving a subsidy. Third, we examine various measures of child care service quality, teachers' skill investments, and teachers' job performance. In the final set of analyses, we provide evidence on consumers' satisfaction with their child care provider, as measured by their Yelp reviews.

4.1 Earnings and Employment

The results presented in Table 1 confirm that minimum wage increases are binding in the child care sector. Panel A presents results on the effect of the minimum wage on the monthly earnings of new hires overall and by education level. Education level is only available for workers age 25 and older, so there is an additional category for workers who are younger than 25 years old. A 10% increase in the minimum wage is associated with a statistically-significant 0.7% to 1.3% increase in monthly earnings for center-based workers depending on the specification [column (1)]. The increase in earnings is largest for the groups for whom the minimum wage is likely most binding: young employees, who have the least experience, and employees with less formal education. New hire child care employees under the age of 25 experience a 1.5% to 2.5% increase in earnings [column (2)], and those without a high school diploma experience a 0.9% to 1.7% increase in earnings for a 10% increase in the minimum wage [column (3)], with all six estimates statistically significant at the 1% level. However, child care workers throughout the education and experience distribution see an increase in earnings, including those with some college education [column (5)] in two of the three specifications. The point estimates for new employees with a college degree are much smaller and not statistically significant.

In Appendix Table A1, we test whether there is an effect on overall monthly earnings, as opposed to new hires' earnings. Across all three specifications, the minimum wage is associated with increased earnings for child care workers under the age of 25. In the county border specification, the minimum wage increases are binding across employees of all education levels, whereas the two two-way fixed effects specifications generate smaller point estimates. Average monthly earnings are lower in the county border sample, which may explain why the minimum wage is more binding in this specification.

The results for monthly earnings can be explained by an increase in wages and/or hours of work. In Appendix Table A2, we use the CPS and ACS to confirm that the hourly wages of center-based workers increase as a result of minimum wage increases. Estimates from these surveys show that wages increase between 1% and 2.7%, depending on the group analyzed. These surveys also allow us to look at other child care sectors, and we see no statistically significant change in wages for child care employees in home-based or private household settings. The lack of statistical significance may be due to the much smaller samples in these two sectors, as the point estimates often indicate economically-meaningful changes in hourly wages, with declines of up to 2.5% in the home-based sector and 1.8% in the private household sector.

Table 2 estimates the effect of the minimum wage on employment in the center-based sector and finds limited detectable effects, although most of the point estimates are positive. It is noteworthy that the estimates are generally small in magnitude and statistically insignificant throughout the education distribution despite the bindingness of the minimum wage. In the two-way fixed effect specification (Panel A), we estimate that a 10% increase in the minimum wage is associated with a 1% increase in beginning-of-quarter employment, which is statistically significant at the 10% level. Estimates in the other two specifications are not statistically significant. The positive point estimates for center-based workers are confirmed in the CPS and ACS, as shown in Appendix Table A3, where the outcome variable is a binary indicator for employment in the center-based sector. The estimates are similar to the ACS, with a 10% increase in the minimum wage associated with a 1.6% increase in center-based employment.[25] As noted above, these surveys allow us to estimate the effect on employment in the home-based and private household sectors, where we also see no detectable effects on employment. Finally, using the Quarterly Census of Employment and Wages (QCEW), we also see no detectable effects of the minimum wage on the number

[25]The ACS point estimates give a change in the probability that a woman is employed in the sector. We find that a 10% increase in the minimum wage is associated with a 0.02 percentage point increase in the probability of working in the center-based sector, from a base of 1.3%, or a 1.6% increase in the probability of employment in the center-based sector.

of center-based establishments, as shown in Appendix Table A4. These null effects are found in models using the standard TWFE design [column (1)], TWFE with division-by-year effects [column (2)], and the contiguous county border design [column (3)].

Table 3 estimates the effect of the minimum wage on turnover within the child care industry. Turnover is defined as one-half new hires plus separations divided by total employment.[26] Our results suggest that minimum wage reforms generally have a stabilizing effect on the child care workforce. In the county border specification (Panel C), we find that minimum wage increases lead to reductions in staff turnover throughout the experience and education distribution. Overall, we estimate a 1.1% reduction in turnover for a 10% increase in the minimum wage on a base quarterly turnover rate of 15% [column (1)]. The reduction in turnover is larger for workers under the age of 25, who were previously shown to be most bound by the minimum wage. For these workers, a 10% increase in the minimum wage is associated with a 1.8% decrease in turnover on a base quarterly turnover rate of 23% [column (2)]. In the two-way fixed effects specification (Panel A), we estimate that a 10% increase in the minimum wage is associated with a 1.3% decline in turnover for child care workers under the age of 25. Estimates for other workers are smaller and not statistically significant, and estimates become more attenuated with the addition of Census division-by-year fixed effects (Panel B). Overall, we find evidence that turnover declines when the minimum wage is increasingly binding, as is the case in the county border sample.

4.2 Firm-Level Adjustments

The results presented above suggest that workers employed in center-based child care settings experience an increase in earnings following an increase in the minimum wage. It is therefore important to examine the ways in which providers respond to the increased labor costs. The results presented Tables 4 and 5 examine two key revenue sources: market prices charged to families and whether providers accept children using CCDF vouchers. The decision to accept subsidized children is an important margin to study because low-income families rely on these subsidies to defray the cost of child care. Such expenses are an important obstacle to low-income families' employment (e.g., Tekin, 2007), while the receipt of a CCDF subsidy is shown to increase the likelihood of employ-

[26] We created this turnover rate variable because we want to estimate the effect of the minimum wage in this quarter on employee churn in this quarter. The QWI-provided turnover rate is calculated as one-half new hires from *last quarter* plus separations from *next quarter* divided by employment.

ment and human capital investments (e.g., Herbst and Tekin, 2011, 2016). Despite the CCDF's importance, the reimbursements paid to providers for serving subsidized children are typically far less than the market price and do not cover the cost of providing high-quality services (Workman, 2018). Thus there are reasons to believe that some providers may opt out of the CCDF if their operating costs increase.

Table 4 estimates the price pass-through of the minimum wage to consumers using California's market rate surveys. We find that for children under age two, a 10% increase in the minimum wage is associated with a 4.2% increase in median center-based market prices. For children ages 24 to 47 months, a 10% increase in the minimum wage is associated with an 8.1% increase in prices. We uncover similar evidence of price pass-through in the home-based sector in California: for home-based providers, a 10% increase in the minimum wage is associated with a 4.7% increase in the market price for children under age two and a 5.0% increase for two- to four-year-olds. As noted earlier, given the dramatically different methodologies for collecting market rate data and data quality across the states, our main analyses rely on local minimum wage changes and price data from one state. For estimates using market rate surveys from all states (along with the contiguous county border design), see Appendix Table A5. For center-based care, the results are quantitatively similar at younger ages but smaller and no longer statistically significant at older ages. For home-based care, the point estimates are smaller and not statistically significant.

For most of our analyses, we are not able to provide event-study plots because clean pre- and post-policy reform periods are not available. However, the first minimum wage changes in California occur in 2015, providing several years where market rate survey data is available before any local minimum wage increases. Thus it is possible to conduct an event-study analysis of child care prices using the California data. This analysis confirms that pre-period coefficients are not statistically different from zero, and the price increases occur only after the minimum wage increases, as shown in Figure 1. Such results support the appropriateness of our identification strategy.

Table 5 presents estimates of the effect of minimum wage changes on child and provider participation in the CCDF. Generally speaking, the results indicate that minimum wage increases reduce the number of children and providers involved with the child care subsidy system. In particular, the first two rows reveal that a 10% increase in the minimum wage reduces the number of child subsidy recipients by 2.9% and the number of provider participants by 5.0%, although neither estimate is statistically distinguishable from zero. However, we find a shift in the provider-types participating in the program. Specifically, a 10% increase in the minimum wage reduces by 12%

the number of unique center-based provider recipients and increases by 28% the number of home-based provider recipients of CCDF funds. The remaining rows in Table 5 shows how the composition of provider-recipients changes by calculating the share of CCDF recipients that are of a particular provider-type. Similar results emerge. For example, we find that a 10% increase in the minimum wage is associated with a 2.2 percentage point decrease in the share of CCDF providers that are center-based facilities. Together, these patterns suggest that higher labor costs lead some center-based providers to stop accepting children using CCDF vouchers, which typically pay less than what the provider would receive for a private-pay family. Families then shift to using their CCDF vouchers for home-based providers, which are less exposed to minimum wage changes.

4.3 Service Quality and Teacher Productivity

The next set of results examines changes in quality at the facility and teacher levels. We begin with the results presented in Table 6, which estimates the impact of minimum wage reforms on NAEYC accreditation rates. Irrespective of the methodological approach or the way local NAEYC density is measured, we find no detectable effects on the number of center-based child care providers that are accredited. As an additional check on these results, Table 7 uses the ECLB-B's provider survey to examine the likelihood of obtaining *any* quality accreditation. Again, we find little change in the share of accredited providers. However, we uncover evidence that child care services—in addition to raising prices and serving fewer subsidized children—make some cost-saving adjustments that may have implications for quality. As shown in Table 7, we find that providers increase total enrollments by 5.6% and child-to-teacher ratios by 4.7% for a 10% increase in the minimum wage. These results, together with those presented in Table 2, suggest that the increase in ratios is driven entirely by the decision of child care providers to increase child enrollments, rather than by reducing the number of teachers.

In Table 8, we examine the effect of the minimum wage on teacher-level proxies of quality and productivity. We begin in Panel A, which shows various measures of teacher skill investments. Generally speaking, our results suggest that minimum wage reforms lead to child care teachers having more training on average, either through up-skilling or a change in the composition of the workforce. A 10% increase in the minimum wage is associated with an increase in the probability that a teacher completed an early childhood education (ECE) certification by 2 percentage points [column (2)], any ECE college coursework by 4 percentage points [column (3)], and any child

care-related coursework by 2 percentage points [column (4)]. Panel B explores the frequency with which teachers engage in a variety of education-related activities with children. Again, we find that higher minimum wages induce teachers to engage more frequently in these activities. A 10% increase in the minimum wage is associated with a 2.5% increase in the number of times teachers read with children [column (1)], a 2.9% increase in the number of times teachers build things with children [column (4)], and a 1.3% increase in the number activities teaching math and other conceptual skills [column (5)]. There are no detectable effects on singing or playing games, although the point estimates are positive.

In the final set of results, shown in Panel C, we study domain-specific Arnett CIS scores [columns (1) through (4)] as well as the total Arnett score [column (5)] measuring the nature of teacher-child interactions. Looking at the total score, we find that minimum wage increases improve teachers' interaction with children. The point estimate implies that raising the minimum wage by 10% increases teachers' total Arnett score by 2.4%, or about 0.1 standard deviations. The change in real minimum wages from 2005 to 2019 would predict an increase in Arnett scores of one-fifth of a standard deviation. This effect is approximately equivalent to the estimated increase in scores from moving from a typical child care teacher with at most a high school degree to one with at least some college education. Although most of the individual components for the score are not statistically significant, the coefficients imply improvements of 1.5% to 3.1%.

4.4 Consumer Satisfaction

The results discussed above suggest that increases in the minimum wage induce child care providers to increase market prices while also improving teachers' job performance. Both changes may have implications for consumer satisfaction (albeit in different ways) depending on the relative preferences for lower-cost versus lower-quality services. On the one hand, the increase in teacher quality and teacher interactions could generate an improvement in consumer satisfaction. However, if consumers care more about the cost of child care, an increase in prices might reduce satisfaction. As shown in Table 9, we find that an increase in the minimum wage reduces consumers' satisfaction with their child care provider. Indeed, the estimates imply that raising the minimum wage by 10% is associated with a *within-center* 0.031-point decrease in the average Yelp rating on a five-point scale [Panel A, column (1)], and a 1.4 percentage point decrease in the probability of giving the highest possible rating [Panel

B, column (1)]. As shown in columns (2) and (3), such declines persist across providers located in lower- and higher-income communities.

To shed light on whether the increase in market prices may be responsible for the reduction in consumer satisfaction, we examine whether parents are more likely to discuss cost-related topics in the open-ended Yelp reviews. We find that the frequency of such discussions does in fact increase following a change to minimum wage law. As shown in Panel C, column (1), a 10% increase in the minimum wage is associated with a within-center 1.5 percentage point increase in the probability that the consumer discusses prices in the review. Columns (2) and (3) again reveals the symmetry across those in lower- and higher-income communities: the salience of cost-related topics increases for both groups following an increase in the minimum wage. As a placebo test for our hypothesis that the decline in satisfaction is driven by prices, Panel D examines whether there is a change in the probability that a review discusses the provider's learning environment, and we find no effect.

5 Discussion and Interpretation

Our analysis has uncovered four main findings. First, although the minimum wage is binding in the child care sector, there is no discernible effect on employment. Second, child care providers instead respond to the minimum wage by making changes to increase revenue: increasing prices, enrollment, and child-to-teacher ratios and sometimes no longer accepting child care vouchers. Third, higher minimum wages are likely to be associated with higher-quality care due to lower turnover, an increase in the likelihood that teachers take ECE coursework, and improved teacher-child interactions. Finally, although most measures point to increases in quality, parents' satisfaction with their provider is lower, likely driven by increased prices. In this section, we briefly contextualize and discuss potential mechanisms for our findings and implications for policy.

5.1 Mechanisms for Effects on Employment and Quality

We find that, as expected, the minimum wage binds in the child care market: a 10% increase in the minimum wage is associated with a 0.7% to 1.3% increase in monthly earnings for new employees. Given downward-sloping labor demand curves, we might expect to see declines in employment. However, if anything, there is an increase in

employment in the child care sector as the minimum wage increases. This is consistent with previous research that has found little to no employment responses to the minimum wage even in industries where the minimum wage binds (Card and Krueger 1994; Dube et al. 2010; Cengiz et al. 2019; Ruffini 2022).

There are likely several forces at work. First, turnover is high in the child care sector, with estimates of one in eight teachers leaving in a given quarter and one in three leaving in a given year, and we find that minimum wage increases significantly reduce turnover rates (Brown and Herbst, 2022; Bassok et al., 2021b). Reductions in turnover may result in fewer open positions, thereby increasing point-in-time employment. This is consistent with models that allow for search frictions in the labor market, which find that higher minimum wages can improve recruitment and retention, reduce vacancy rates, and lower turnover-related costs (Schmitt 2013; Dube et al. 2016). Second, single mothers increase their labor force participation when the minimum wage is raised, which may increase the demand for child care, leading to an increase in employment in the sector (Godøy et al., 2021). Third, the child care industry is heavily regulated and must comply with child-to-staff ratio requirements. Nearly all states verify compliance with child care regulations, including ratios, through unannounced annual inspections, with some states publicly posting violations (Office of Child Care, 2014). For providers that remain open, this may leave little room to adjust employment in response to minimum wage changes and remain in compliance with state regulations. Given these constraints, it is perhaps not surprising that providers adjust by increasing revenue through higher prices, accepting fewer child care vouchers, and increasing enrollments.

We also see that higher minimum wages lead to increases in teachers' formal ECE training, in the number of learning-related activities they perform with children, and in their Arnett scores, a scale measuring teacher-child interactions. There are two possible mechanisms: a change in the composition of child care teachers or the upskilling of existing teachers (or a combination). Although we are not able to distinguish between these two mechanisms, given the reduction in turnover, it seems likely that higher wages allow individuals to remain in child care positions when they otherwise may have been forced to leave for higher-paying positions in other sectors. Another piece of evidence in favor of this explanation is our finding that higher minimum wages are associated with an increased probability that teachers enroll in ECE courses: a 10% increase in the minimum wage is associated with a 0.4 percentage point (or 8%) increase in the probability of having taken any ECE college coursework. Higher wages may allow individuals who are better matched to and more interested in caregiver roles to remain in the child

care sector. Because they are better matched, their productivity is higher, as shown by spending more time in educational activities and having better interactions with children. In addition, low wages can cause financial stress, which may spill over into job performance and teachers' interactions with children (Meuris and Leana, 2015). Indeed, one recent study finds that increased compensation reduces child care teachers' stress (Bassok et al., 2021a), and this stress reduction may have positive spillovers for the children in their care. It is interesting that these improvements in teacher-child interactions occur *despite* increases in the average number of children per teacher. That interaction quality increased, not decreased, suggests that the positive effects of higher wages on teacher composition and/or disposition outweigh any negative effects from higher ratios. If ratios had not increased, perhaps teacher-child interactions would have increased even more.

5.2 Mechanisms for Changes in Child Care Subsidy Receipt

We find that a 10% increase in the minimum wage is associated with a 12% decrease in the number of center-based providers and a 28% increase in the number of home-based providers receiving CCDF-funded child care subsidies. These changes could be due to centers' unwillingness to accept vouchers or to parents shifting from center- to home-based care. Providers have both revenue-enhancing and cost-saving motives for not accepting vouchers. On the revenue side, the CCDF offers reimbursements to providers capped at the lesser of the private-pay tuition and the maximum reimbursement amount. The maximum reimbursement amount is typically less than what they would have received from a private-pay family (Slicker and Hustedt, 2022). In addition, unlike private-pay families, the CCDF pays based on attendance—not enrollment—so, for example, providers are not paid for days when subsidized children are out sick. Thirty-seven states allow providers to charge parents the difference between the voucher and the private-pay rate (Schulman, 2019), although it is unclear how common it is for centers to do so given that providers in those states still cite the lower reimbursement rates as a reason for not accepting subsidized children (Rohacek and Adams, 2017). But if increased labor costs from the minimum wage lead providers to charge subsidized families the tuition balance or increase market prices, it could induce families to shift away from center-based care.[27] Furthermore, many families using a subsidy are required to contribute a co-payment, and some providers report challenges with collecting those payments. Such challenges reduce revenue if the family does

[27]Note that our data includes the number of centers serving at least one child using vouchers, so all children using vouchers would need to leave a center in order for it to no longer be included in the count.

not pay and may lead to substantial administrative and time costs from attempting to collect the money (Rohacek and Adams, 2017). Finally, providers report that navigating the subsidy system is administratively burdensome, so no longer accepting vouchers may be one way to reduce costs elsewhere when faced with rising labor costs (Slicker and Hustedt, 2022).

A reduction in the availability or accessibility of center-based providers (who are less likely to accept vouchers) presents several challenges for low-income families. First, such families may have to choose a less-preferred child care arrangement if their preferred option is no longer available because it does not accept vouchers. In addition, center-based care is rated to be of higher quality than home-based care, on average (Bassok et al., 2016). Therefore, a shift from center- to home-based settings likely means that disadvantaged children receive less exposure to high-quality care environments. High-quality care is important for child development (Barr and Gibbs, 2022), and lower-quality care can have negative effects that reach into adulthood (Baker et al., 2019). The reduction in the number of center-based providers receiving CCDF-funded subsidies is particularly concerning in light of the decline in the number of providers participating in the subsidy system in recent years. From 2010 to 2019, the number of participating center-based providers declined by over 20%, from 92,980 to 71,490. Our estimates imply that minimum wage increases over this period account for 27% of this decline.

5.3 Contextualizing the Magnitude of the Price Elasticities

Using price data from California (merged with county-level minimum wage changes), we find a price elasticity of 0.42 with respect to the minimum wage for center-based care for children under 24 months of age. The estimated elasticity for older children is even larger at 0.81. Estimates using national data range from 0.16 (not statistically significant) to 0.57 depending on the age range. Some of these estimates appear large, so it is useful to compare them to estimates from the literature. Ashenfelter and Jurajda (2022) provide estimates of pass-through in the fast food industry, estimating that the price elasticity of McDonald's Big Macs with respect to the minimum wage is 0.14. The fast food and child care industries have substantial shares of workers bound by the minimum wage, but one important difference is the labor share: the labor share in fast food restaurants is about 30% (Ashenfelter and Jurajda, 2022), whereas it is about 70% in the child care industry (Helburn and Howes, 1996).[28] Accounting

[28] Although the restaurant and child care industries overall have similar fractions of workers bound by the minimum wage, the fast food industry may be lower paying than the restaurant industry as a whole. Ashenfelter and Jurajda (2022) find a wage elasticity with

for the difference in labor shares would suggest a child care price elasticity of 0.33, which is within the range of our estimates. The high labor share can lead to a higher price elasticity with respect to the minimum wage.[29]

We can also calculate the fraction of the rise in families' child care expenses over the past decade that is explained by increases in the minimum wage. Herbst (2023) estimates that in 2019 dollars, median hourly child care expenses rose from $4.18 per hour in 2005 to $5.96 in 2019, a real increase of 43%. The population-weighted minimum wage increased by 20% in real dollars during that time. Applying the price elasticity of 0.42, we estimate that 20% of the increase in families' child care expenses over the past decade is due to increases in the minimum wage.

5.4 Implications for Policy

Our findings are relevant for a number of recently proposed or implemented policies affecting the wages of child care workers. Most directly, they speak to the potential implications of the "Fight for $15" movement, which advocates for raising the minimum wage to $15 per hour for all workers. Our paper is highly relevant to such a policy, and we expect that many of our key findings would materialize—including the increase in teacher wages and market prices, the reduction in turnover, and the improvement in service quality—if it were to be implemented. However, there are other policies, such as those stemming from states' experimentation in the child care sector using funds from the American Rescue Plan Act of 2021 (ARPA), that might cause only a subset of these effects to occur.

One program within ARPA is the Child Care Stabilization Program, which aims to provide financial assistance and support to the child care sector in the wake of the Covid-19 pandemic. By providing much-needed financial stability, the Child Care Stabilization Program seeks to increase the resilience of the child care industry while facilitating greater access to affordable, high-quality child care. The program offers grants to child care providers to help maintain their operations, and the funds can be used for a variety of purposes, including personnel wages or bonuses, rent or mortgage payments, utilities, and cleaning and sanitation supplies. Several states are using these funds to provide stipends or bonuses to child care providers. Our paper can speak to some possible effects of raising teacher compensation, although we would not expect the effects to be identical because the money for the

respect to the minimum wage of 0.70 for McDonald's workers, compared to the 0.13 that we estimate for child care workers.

[29] There is also some evidence that labor shares are higher for lower-priced centers as compared to higher-priced centers (Borowsky et al., 2022), so another explanation for the high elasticities may be that the median price elasticity is higher than the mean price elasticity. In addition, as noted above, the minimum wage can increase demand for child care due to more parents entering the labor force (Godøy et al., 2021), which is another mechanism for price increases.

additional compensation is coming from the government instead of child care providers.

Our results suggest that there are two main effects of the minimum wage on the child care market: higher wages may affect the composition and productivity of employees, and higher labor costs may lead centers to find ways to increase revenue or decrease costs in other areas. Policies like the ARPA stabilization grants that increase compensation for child care workers with government funds would only affect the composition and productivity of employees without putting cost pressure on firms. Separating the effects into those due to employees' (or potential employees') responses to the minimum wage and into firms' responses is speculative as we do not have direct evidence on the drivers behind each result, but many results can logically be attributed to one or the other. Higher wages may allow teachers to stay in child care if they desire, reducing turnover and improving the match between the employee and the firm. Given that minimum wage reforms may increase wages at teachers' potential outside employment options, our estimates on the reduction in turnover and the increase in child care quality should be interpreted as a lower bound for what might be expected if wages increased only in the child care sector. As long as wage enhancements or bonuses are fully funded, as is the case with ARPA, we would not expect centers to experience increased cost pressure. Given that such pressure is the likely driver behind the increase in market prices, enrollment, and ratios and the decrease in subsidy participation, we would not expect these outcomes to be affected. In addition, since higher market prices are likely responsible for the decline in consumer satisfaction, we would also not expect to see a reduction in Yelp ratings as long as teacher compensation programs are fully funded.

6 Conclusion

In this paper, we find that increases in the minimum wage have important implications for the quality of care provided in the child care market as well as for equitable access to high-quality care. These findings underline the usefulness of investigating effects of the minimum wage that go beyond the employment margin. The implications of our findings for child care quality are complex: while lower turnover, increased teacher credentials, and improved teacher-child interactions improve quality, increases in the number of children per teacher may decrease quality. Furthermore, parental satisfaction with care depends not only on its quality but also its perceived value, and we find that satisfaction declines, likely driven by the increase in prices.

Our paper contributes to a small but growing minimum wage literature that examines firms outside the fast

food and restaurant industries and that assesses outcomes related to service quality and consumer well-being. In particular, our paper complements recent work by Giupponi and Machin (2018) and Ruffini (2022), who study these outcomes in the nursing care sector. Although some previous papers examine the price pass-through of minimum wage increases (e.g., Aaronson et al., 2008; Allegretto and Reich, 2018; Ashenfelter and Jurajda, 2022; Renkin et al., 2022), we extend this literature by studying a variety of other strategies firms employ to adjust to the increase in labor costs. Finally, our work is relevant to a set of papers studying the impact of minimum wage reforms on parental labor supply (Godøy et al., 2021) and time investments in children (Gearhart et al., 2022) and children's cognitive development (Regmi, 2020). This work finds that raising the minimum wage increases the employment of parents with children ages 0 to 5, while also increasing the amount of time parents spend in enriching activities with children. In addition, minimum wage increases appear to reduce children's test scores. Our paper, which shows potentially conflicting effects on non-parental care quality as well as a possible shift among subsidized families from the center- to the home-based sector, may shed light on test score results.

Based on the discussion above, there are multiple avenues for future work to explore. First, it seems important to study the impact of minimum wage reforms on the demand for child care, the time spent in care, and families' care expenses. Assuming that a more generous minimum wage represents a positive income shock and that child care is a normal good, one might expect the demand for non-parental care services to increase, and that those already consuming such services to purchase more or to consume different service-types. Along these lines, a second avenue for future work is to understand how minimum wage increases affect the demand for child care quality. If quality is a normal good, the demand for higher-quality services is expected to increase. However, our results—which show a reduction in consumer satisfaction—indicate that any price increases that accompany a minimum wage expansion might instead induce families to shift into lower-quality care.

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Table 1: Effect of Minimum Wage on Log of Monthly Earnings of New Hires

	(1) All	(2) Age < 25	(3) LTHS	(4) High School	(5) Some College	(6) College
Panel A: Two-Way Fixed Effects						
Log(Min. Wage)	0.104***	0.195***	0.117***	0.088***	0.076***	0.022
	(0.018)	(0.036)	(0.016)	(0.023)	(0.020)	(0.031)
Dep. Var. Mean	7.11	6.89	7.14	7.17	7.22	7.35
Mean Level	1,161	945	1,217	1,246	1,314	1,474
Level of Data	State	State	State	State	State	State
N	3,661	3,661	3,661	3,661	3,661	3,661
Panel B: Add Census Division-by-Year Fixed Effects						
Log(Min. Wage)	0.073**	0.150***	0.091***	0.058	0.030	-0.006
	(0.034)	(0.041)	(0.033)	(0.035)	(0.031)	(0.045)
Dep. Var. Mean	7.11	6.89	7.14	7.17	7.22	7.35
Mean Level	1,161	945	1,217	1,246	1,314	1,474
Level of Data	State	State	State	State	State	State
N	3,654	3,654	3,654	3,654	3,654	3,654
Panel C: County Border Design						
Log(Min. Wage)	0.126**	0.253***	0.165***	0.124**	0.106*	0.013
	(0.055)	(0.059)	(0.053)	(0.053)	(0.053)	(0.083)
Dep. Var. Mean	7.11	6.92	7.19	7.18	7.23	7.36
Mean Level	1,286	1,049	1,387	1,409	1,488	1,701
Level of Data	County	County	County	County	County	County
N	70,797	47,271	29,922	52,818	54,353	38,342

Notes: Table provides estimates from an OLS regression of the log of monthly earnings for new hires in the child care industry (NAICS code 6244) on minimum wage using data from the Quarterly Workforce Indicators (QWI) at the quarterly level for years 2001 to 2019 using three different specifications. The outcome of interest for all regressions in the log of monthly earnings for stable new hires. Panel A presents estimates using state-level data and a two-way fixed effects design, Panel B adds Census division-by-year fixed effects, and Panel C uses county-level data with a county border design, as in equation 1. All regressions include geography fixed effects (state in Panels A and B and county in Panel C), log of population, and log of employment. Panel B adds Census division-by-year fixed effects. Panel C includes county border pair by year-quarter fixed effects. Observations in Panel C are only included in the regression if there is full data availability on employment for both counties in the border pair. Full data availability is defined as no missing observations in the county from the first quarter the county is in the data set through the last quarter the county is in the data set. Note that due to data availability, we restricted to full data availability of stable employment rather than of new hire monthly earnings. Regressions are weighted by population. Standard errors in Panels A and B are clustered at the state level, and in Panel C, they calculated using two-way clustering at the state and border segment levels are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: Effect of Minimum Wage on Log of Beginning-of-Quarter Employment

	(1) All	(2) Age < 25	(3) LTHS	(4) High School	(5) Some College	(6) College
Panel A: Two-Way Fixed Effects						
Log(Min. Wage)	0.100*	0.097	0.173	0.181***	0.093	0.032
	(0.060)	(0.068)	(0.105)	(0.062)	(0.059)	(0.055)
Dep. Var. Mean	10.09	8.574	7.820	8.537	8.797	8.306
Mean Level	15,676	3,609	1,687	3,372	4,291	2,716
N	3,752	3,752	3,752	3,752	3,752	3,752
Panel B: Add Census Division-by-Year Fixed Effects						
Log(Min. Wage)	0.008	0.015	0.031	0.051	-0.030	-0.013
	(0.073)	(0.081)	(0.138)	(0.081)	(0.077)	(0.067)
Dep. Var. Mean	10.09	8.574	7.821	8.537	8.797	8.307
Mean Level	15,676	3,609	1,687	3,372	4,291	2,716
N	3,751	3,751	3,751	3,751	3,751	3,751
Panel C: County Border Design						
Log(Min. Wage)	0.111	0.196	0.064	0.081	0.075	0.063
	(0.105)	(0.119)	(0.110)	(0.096)	(0.102)	(0.118)
Dep. Var. Mean	7.228	5.847	5.163	5.700	5.941	5.684
Mean Level	578	145	79	124	156	130
N	72,286	55,158	42,046	68,574	69,052	53,098

Notes: Table provides estimates from an OLS regression of the log of beginning-of-quarter employment for child care workers (NAICS code 6244) on minimum wage using data from the Quarterly Workforce Indicators (QWI) at the quarterly level for years 2001 to 2019 using three different specifications. The outcome of interest for all regressions in the log of beginning-of-quarter employment. Panel A presents estimates using state-level data and a two-way fixed effects design, Panel B adds Census division-by-year fixed effects, and Panel C uses county-level data with a county border design, as in equation 1. All regressions include geography fixed effects (state in Panels A and B and county in Panel C), log of population, and log of employment. Panel B adds Census division-by-year fixed effects. Panel C includes county border pair by year-quarter fixed effects. Observations in Panel C are only included in the regression if there is full data availability for both counties in the border pair. Full data availability is defined as no missing observations for that outcome in the county from the first quarter the county is in the data set through the last quarter the county is in the data set. Regressions are weighted by population. Standard errors in Panels A and B are clustered at the state level, and in Panel C, they calculated using two-way clustering at the state and border segment levels are in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Effect of Minimum Wage on Log of Turnover

	(1) All	(2) Age < 25	(3) LTHS	(4) High School	(5) Some College	(6) College
Panel A: Two-Way Fixed Effects						
Log(Min. Wage)	-0.059	-0.127***	-0.031	-0.019	0.009	-0.007
	(0.056)	(0.046)	(0.067)	(0.056)	(0.059)	(0.059)
Dep. Var. Mean	-1.867	-1.437	-1.944	-2.063	-2.123	-2.090
Mean Level	0.17	0.25	0.16	0.13	0.13	0.13
Level of Data	State	State	State	State	State	State
N	3,676	3,676	3,676	3,676	3,676	3,676
Panel B: Add Census Division-by-Year Fixed Effects						
Log(Min. Wage)	-0.035	-0.050	-0.049	-0.037	-0.009	0.001
	(0.046)	(0.039)	(0.049)	(0.050)	(0.054)	(0.060)
Dep. Var. Mean	-1.868	-1.438	-1.944	-2.063	-2.124	-2.091
Mean Level	0.17	0.25	0.16	0.13	0.13	0.13
Level of Data	State	State	State	State	State	State
N	3,670	3,670	3,670	3,670	3,670	3,670
Panel C: County Border Design						
Log(Min. Wage)	-0.108**	-0.181***	-0.145	-0.176**	-0.154*	-0.109
	(0.051)	(0.047)	(0.088)	(0.065)	(0.082)	(0.133)
Dep. Var. Mean	-1.953	-1.515	-2.075	-2.192	-2.234	-2.226
Mean Level	0.15	0.23	0.13	0.12	0.11	0.11
Level of Data	County	County	County	County	County	County
N	32,857	18,721	8,484	13,512	14,417	11,747

Notes: Table provides estimates from an OLS regression of the log of indicated measures for child care workers (NAICS code 6244) on minimum wage using data from the Quarterly Workforce Indicators (QWI) at the quarterly level for years 2001 to 2019. The outcome of interest for all regressions in the log of monthly earnings for stable employees. Panel A presents estimates using state-level data and a two-way fixed effects design, Panel B adds Census division-by-year fixed effects, and Panel C uses county-level data with a county border design, as in equation 1. All regressions include geography fixed effects (state in Panels A and B and county in Panel C), log of population, and log of employment. Panel B adds Census division-by-year fixed effects. Panel C includes county border pair by year-quarter fixed effects. Observations in Panel C are only included in the regression if there is full data availability for both counties in the border pair. Full data availability is defined as no missing observations for that outcome in the county from the first quarter the county is in the data set through the last quarter the county is in the data set. Regressions are weighted by county population. Standard errors in Panels A and B are clustered at the state level, and in Panel C, they calculated using two-way clustering at the state and border segment levels are in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Effect of Minimum Wage on Prices

	Center-based Care		Home-based Care	
	(1)	(2)	(3)	(4)
	0 to 23 months	24 to 47 months	0 to 23 months	24 to 47 months
Log(Min. Wage)	0.415***	0.804***	0.470***	0.496***
	(0.0575)	(0.0843)	(0.0466)	(0.0615)
Dep. Var. Mean	5.702	5.372	5.257	5.173
Mean Level	302	218	194	178
N	522	522	522	522

Notes: This table reports OLS estimates of the relationship between the log of the county-level minimum wage and the log of median weekly child care prices from California Market Rate Surveys from 2010 to 2018. County-level minimum wages are defined as the highest statutory minimum wage of any municipality in that county in the given year. All regressions include controls for the log of county population, county fixed effects, and year fixed effects. Regressions are weighted by county population. The standard errors are clustered at the county level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Effect of Minimum Wage on Child Care and Development Fund Participants

Outcome	(1) Coeff. (SE)	(2) N	(3) Dep. Var Mean
Log(Child Subsidy Recipients)	-0.285	1,020	31,052
	(0.244)		
Log(Total Provider Recipients)	-0.498	1,010	10,758
	(0.899)		
Log(Center Provider Recipients)	-1.223*	1,006	1,792
	(0.697)		
Log(Home Provider Recipients)	2.789**	1,004	540
	(1.188)		
Log(FFN Provider Recipients)	-0.247	1,006	6,230
	(0.652)		
Share of CCDF Providers: Centers	-0.220**	1,001	0.287
	(0.106)		
Share of CCDF Providers: Homes	0.153**	999	0.059
	(0.059)		
Share of CCDF Providers: FFN	0.075	1,001	0.538
	(0.083)		

Notes: This table reports OLS estimates of the relationship between the log of the minimum wage and the log number of children receiving CCDF child care subsidies, log number of child care providers receiving CCDF funds, log number of center-based providers receiving CCDF funds, log number of home-based providers receiving CCDF funds, log number of friend, family, neighbor (FFN) providers receiving CCDF funds, the center-baed share of all CCDF providers, the home-based share of all CCDF providers, and the FFN share of all CCDF providers, respectively. The data are from the Office of Child Care's CCDF Statistics (available here: https://www.acf.hhs.gov/occ/data/child-care-and-development-fund-statistics), and span the years 2000 to 2019. All models include the log population, log total employment, state fixed effects, and region-by-year fixed effects. Regressions are weighted by the state population, and the standard errors are clustered at the state level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Effect of Minimum Wage on Programs' NAEYC Accreditation

	(1) Num. NAEYC	(2) Frac. NAEYC	(3) Log(NAEYC)	(4) Frac. NAEYC
Log(Min. Wage)	-12.66	-0.090	-0.232	-0.005
	(10.97)	(0.070)	(0.267)	(0.065)
County Level: Border Design	Yes	Yes	No	No
State Level: Division-by-Year FE	No	No	Yes	Yes
Dep. Var. Mean	29.63	0.128	5.12	0.098
N	20,896	15,796	408	357

Notes: This table reports OLS estimates of the relationship between the log of the minimum wage and the number or fraction of NAEYC establishments. Standard errors are clustered at the state level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Effect of Minimum Wage on Program-Level Adjustments

	(1) Enrollment	(2) Child-Staff Ratio	(3) Accred.
Log(Min. Wage)	0.561**	0.465***	-0.299
	(0.274)	(0.151)	(0.181)
Dep. Var. Mean	120.80	6.41	0.453
N	1,718	1,704	1,706

Notes: This table reports OLS estimates of the relationship between the log of the minimum wage and the log number of children attending the sampled center-based program (column (1)), the log child-to-staff ratio in the sampled teacher's classroom (column (2)), and a binary indicators for whether the sampled center-based program has any accreditation. Data come from the 24-month and preschool-age waves of the ECLS-B. All regressions include controls for the total number of teachers in the program, percent of white teachers, percent of white children, percent of children who speak a non-English language, log of annual state total employment, state fixed effects and wave fixed effects. The standard errors are clustered at the state level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: Effect of Minimum Wage on Teacher Skill Investments and Job Productivity

Panel A: Teacher Skill Investments					
	(1)	(2)	(3)	(4)	(5)
	ECE Deg.	ECE Cert.	ECE Course	Oth. Course	ECE Train
Log(Min. Wage)	0.043	0.207*	0.391***	0.230***	0.031
	(0.164)	(0.119)	(0.098)	(0.072)	(0.104)
N	6,753	7,761	3,703	5,472	7,381
Dep. Var. Mean	0.441	0.241	0.474	0.845	0.701
Panel B: Quality of Teacher Activities					
	(1)	(2)	(3)	(4)	(5)
	Reads	Sings	Games	Builds	Edu. Act.
Log(Min. Wage)	0.250*	0.098	0.181	0.291***	0.130*
	(0.135)	(0.296)	(0.130)	(0.098)	(0.066)
N	5,465	5,462	5,457	5,454	5,412
Dep. Var. Mean	6.48	7.37	4.37	3.64	42.55
Panel C: Arnett Scores of Teacher-Child Interactions					
	(1)	(2)	(3)	(4)	(5)
	Detach.	Harsh	Perm.	Sens.	Total
Log(Min. Wage)	0.176	0.150	0.181	0.311*	0.239**
	(0.108)	(0.106)	(0.130)	(0.176)	(0.109)
N	2,902	2,913	5,457	2,910	2,914
Dep. Var. Mean	10.74	24.26	6.90	20.61	62.49

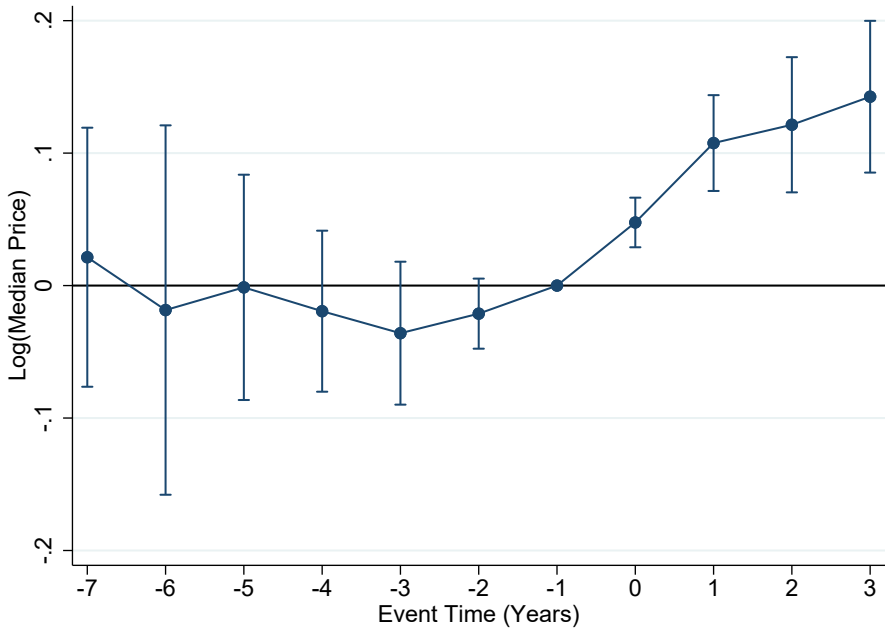
Notes: This table reports OLS estimates of the relationship between the log of the minimum wage and measures of teacher skill investments, teacher activities with children, and Arnett scores of child-teacher interactions. Data come from the 24-month and preschool-age waves of the ECLS-B. In Panel A, the outcomes are binary indicators for whether the sampled teacher has an ECE (college) degree, an ECE certification/credential, done any ECE college coursework, done any child care-related coursework, and done any ECE training in the past year, respectively. In Panel B, the outcomes are the log number of times per week the teacher reads books to, sings songs with, plays games with, and builds something with children as well as the log frequency of math/conceptual activities with children, respectively. In Panel C, the outcomes are the log of teacher's Arnett detachment, harshness, permissiveness, sensitivity, and total score, respectively. All regressions include controls for the teacher's gender, age, race/ethnicity, education level, self-reported health status, self-reported smoker status, number of years of child care work experience, and spoken language is non-English (when caring for child(ren). The models also include log of annual state total employment, provider-type fixed effects, state fixed effects, and wave fixed effects. The standard errors are clustered at the state level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Effect of Minimum Wage on Yelp Consumer Reviews of Child Care Providers

	(1) Full	(2) Low-Inc	(3) High-Inc
Panel A: Average Rating			
Log(Min. Wage)	-0.309*	-0.407*	-0.237
	(0.177)	(0.247)	(0.259)
Dep. Var. Mean	4.29	4.22	4.35
N	49,430	23,505	26,481
Panel B: Highest Rating			
Log(Min. Wage)	-0.142***	-0.123	-0.188**
	(0.054)	(0.077)	(0.078)
Dep. Var. Mean	0.761	0.741	0.779
N	49,430	23,505	26,481
Panel C: Review Discusses Price			
Log(Min. Wage)	0.151***	0.136**	0.177***
	(0.046)	(0.064)	(0.066)
Dep. Var. Mean	0.124	0.135	0.115
N	49,430	23,505	26,481
Panel D: Review Discusses Learning Envir.			
Log(Min. Wage)	-0.030	0.027	-0.083
	(0.053)	(0.075)	(0.075)
Dep. Var. Mean	0.738	0.727	0.740
N	49,430	23,505	26,481

Notes: This table reports OLS estimates of the relationship between the log of the minimum wage and consumer ratings of child care providers on Yelp between 2005 and 2017. In Panel A the outcome of interest is the reviewerâs rating of the provider on a scale from one to five, where five is the best possible rating. In Panel B, the outcome of interest is an indicator that equals one if the reviewer gave the provider a rating of five (the highest rating) and equals zero otherwise. In Panel C, the outcome is an indicator that equal one if the reviewer discussed the price or affordability of the provider and zero otherwise. Column (1) includes the full sample of Yelp reviews; columns (2) is limited to reviews of providers located in low-income counties (below the median of household income); and column (3) is limited to reviews of providers located in high-income counties (at or above the median of household income). All regressions include controls for available reviewer characteristics (quadratic in friend count, quadratic in review count, an indicator for whether they have a profile picture, an indicator for whether they attached any photos to their review, an indicator for whether any individual rated the review as "useful," indicators for whether the review contains formal language or slang words, and an indicator for whether the review contains swear words), year fixed effects, calendar month fixed effects, and firm fixed effects. The standard errors are clustered at the firm level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 1: Event-Study Estimates of the Impact of Minimum Wage Reforms on Child Care Prices



Notes: This figure reports stacked event study coefficients (Cengiz et al., 2019) from estimates of the relationship between the log of the county-level minimum wage and the log of median weekly child care prices from California Market Rate Surveys from 2010 to 2018. County-level minimum wages are defined as the highest statutory minimum wage of any municipality in that county in the given year. Event time zero is the first year that the county had a higher minimum wage than the state minimum wage. Each county-year has four price observations included: infant center-based, preschool center-based, infant home-based, and preschool home-based. All regressions include price type fixed effects as well as controls for the log of county population, county fixed effects, and year fixed effects. Regressions are weighted by county population. The standard errors are clustered at the county level, and error bars represent 95% confidence intervals.

A Appendix Figures and Tables

Figure A1: Median Hourly Wages of Child Care Workers, by Sector, 2005-2019

Source: American Community Survey from 2005 to 2019.
Notes: The term "Private Household" refers to private household child care providers, defined as those employed in the private household services industry and whose primary occupation is a child care worker. The term "Home-Based" refers to workers who are self-employed in the child day care services industry and whose occupation is a child care worker or education administrator. The term "Other Female Workers" refers to women employed in all other (non-child care) industries. All figures are adjusted for inflation to reflect 2019 dollars.

Table A1: Effect of Minimum Wage on Log of Monthly Earnings

	(1) All	(2) Age < 25	(3) LTHS	(4) High School	(5) Some College	(6) College
Panel A: Two-Way Fixed Effects						
Log(Min. Wage)	0.022	0.140***	0.029	0.020	0.010	0.014
	(0.026)	(0.027)	(0.020)	(0.026)	(0.026)	(0.045)
Dep. Var. Mean	7.422	6.976	7.334	7.400	7.507	7.716
Mean Level	1,599	1,028	1,486	1,585	1,757	2,148
Level of Data	State	State	State	State	State	State
N	3,705	3,705	3,705	3,705	3,705	3,705
Panel B: Add Census Division-by-Year Fixed Effects						
Log(Min. Wage)	0.011	0.109***	0.011	0.004	-0.009	0.001
	(0.040)	(0.040)	(0.037)	(0.033)	(0.034)	(0.052)
Dep. Var. Mean	7.422	6.976	7.334	7.400	7.507	7.716
Mean Level	1,599	1,028	1,486	1,585	1,757	2,148
Level of Data	State	State	State	State	State	State
N	3,702	3,702	3,702	3,702	3,702	3,702
Panel C: County Border Design						
Log(Min. Wage)	0.132***	0.230***	0.145***	0.127***	0.123***	0.130*
	(0.049)	(0.049)	(0.051)	(0.037)	(0.044)	(0.076)
Dep. Var. Mean	7.398	6.986	7.330	7.384	7.485	7.687
Mean Level	1,382	970	1,341	1,386	1,521	1,843
Level of Data	County	County	County	County	County	County
N	129,065	76,166	81,396	111,409	115,819	93,705

Notes: Table provides estimates from an OLS regression of the log of indicated measures for child care workers (NAICS code 6244) on minimum wage using data from the Quarterly Workforce Indicators (QWI) at the quarterly level for years 2001 to 2019 using three different specifications. The outcome of interest for all regressions in the log of monthly earnings for stable employees. Panel A presents estimates using state-level data and a two-way fixed effects design, Panel B adds Census division-by-year fixed effects, and Panel C uses county-level data with a county border design, as in equation 1. All regressions include geography fixed effects (state in Panels A and B and county in Panel C), log of population, and log of employment. Panel B adds Census division-by-year fixed effects. Panel C includes county border pair by year-quarter fixed effects. Observations in Panel C are only included in the regression if there is full data availability for both counties in the border pair. Full data availability is defined as no missing observations for that outcome in the county from the first quarter the county is in the data set through the last quarter the county is in the data set. Regressions are weighted by population. Standard errors are in parentheses, and in Panels A and B are clustered at the state level, and in Panel C, they are calculated using two-way clustering at the state and border segment levels.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A2: Effect of Minimum Wage on Child Care Teacher Wages, by Sector

	Center-based		Home-based		Private Household	
	All	Low Ed.	All	Low Ed.	All	Low Ed.
Panel A: Current Population Survey						
Log(Min. Wage)	0.129	0.266**	-0.145	0.111	-0.000	0.115
	(0.088)	(0.108)	(0.789)	(0.872)	(0.243)	(0.275)
Mean Hourly Wage	11.58	9.90	6.96	5.34	9.19	8.34
N	21,116	13,879	1,450	947	4,003	3,135
Panel B: American Community Survey						
Log(Min. Wage)	0.086**	0.111**	-0.254	-0.131	-0.179	-0.119
	(0.036)	(0.047)	(0.307)	(0.384)	(0.114)	(0.137)
Mean Hourly Wage	11.81	10.44	2.13	1.74	6.95	6.63
N	166,422	102,233	10,427	7,113	18,942	13,784

Notes: This table reports OLS two-way fixed effect estimates of the relationship between the log of the minimum wage and the log of the hourly wage of child care teachers using data from the Current Population Survey from years 1992 to 2019 and from the American Community Survey from years 2000 to 2019. “Low education" workers are defined as workers who do not have at least an Associate’s degree. Regressions include state and year fixed effects and use provided person weights. Standard errors are clustered at the state level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Effect of Minimum Wage on Probability of Employment in Child Care, by Sector

	Center-based		Home-based		Private Household	
	All	Low Ed.	All	Low Ed.	All	Low Ed.
Panel A: Current Population Survey						
Log(Min. Wage)	0.00342	0.00392	0.00102	0.00144	-0.00038	-0.00072
	(0.00261)	(0.00292)	(0.00139)	(0.00217)	(0.00107)	(0.00216)
Mean Employment Rate	0.0130	0.0117	0.0050	0.0059	0.0030	0.0032
N	1,589,628	664,798	1,589,628	664,798	1,589,628	664,798
Panel B: American Community Survey						
Log(Min. Wage)	0.00215**	0.00374**	-0.00044	-0.00037	0.00037	0.000395
	(0.00099)	(0.00157)	(0.00090)	(0.00107)	(0.00039)	(0.00050)
Mean Employment Rate	0.0130	0.0137	0.0050	0.0060	0.0020	0.0030
N	15,466,008	9,170,561	15,466,008	9,170,561	15,466,008	9,170,561

Notes: This table reports OLS two-way fixed effect estimates of the relationship between the log of the minimum wage and the probability that a woman is working in one of the listed child care sectors. Data is from women interviewed for the Current Population Survey from years 1992 to 2019 and the American Community Survey from years 2000 to 2019. “Low education" workers are defined as workers who do not have at least an Associate’s degree. Regressions include state and year fixed effects and use provided person weights. Standard errors are clustered at the state level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: Effect of Minimum Wage on the Number of Child Care Industry Establishments

	(1) State-level TWFE	(2) Division-by-Year FE	(3) Border County Design
Log(Min. Wage)	0.114	0.107	-0.056
	(0.116)	(0.132)	(0.119)
Mean Num. Establishments	2,671	2,671	205
Geography	State	State	County
Frequency	Annual	Annual	Quarterly
N	1,428	1,428	85,776

Notes: This table reports OLS estimates of the relationship between the log of the minimum wage and the log number or child care establishments reported in the Quarterly Census of Employment and Wages (QCEW) from 1992 to 2019. All regressions include controls for log of employment and log of annual population at the appropriate geography and are weighted by population. Column (1) includes state and year fixed effects. Column (2) includes state and Census division by year fixed effects. Standard errors in these two columns are clustered at the state level. Column (3) uses the county-pair border identification strategy and includes only counties where both counties in the pair have zero missing observations. The regression includes county fixed effects and county pair-year-quarter fixed effects. Standard errors are clustered two ways by state and border segment.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Effect of Minimum Wage on Weekly Prices

	(1) 0 to 5	(2) 6 to 11	(3) 12 to 17	(4) 18 to 23	(5) 24 to 29	(6) 30 to 35	(7) 36 to 41	(8) 42 to 47	(9) 48 to 53
Panel A: Center-Based Care									
Log(Minimum Wage)	0.519*	0.519*	0.573*	0.444*	0.389	0.164	0.190	0.190	0.285**
	(0.274)	(0.274)	(0.298)	(0.252)	(0.232)	(0.224)	(0.227)	(0.227)	(0.136)
Mean Weekly Price	215	215	210	205	187	185	172	172	170
N	5,339	5,339	5,343	5,343	5,353	5,353	5,357	5,357	5,357
Panel B: Home-Based Care									
Log(Minimum Wage)	-0.064	-0.064	-0.040	0.081	0.126	0.155	0.189	0.189	0.249
	(0.089)	(0.089)	(0.094)	(0.124)	(0.158)	(0.198)	(0.263)	(0.263)	(0.258)
Mean Weekly Price	155	155	152	151	145	144	140	140	140
N	5,246	5,246	5,254	5,254	5,258	5,258	5,262	5,262	5,264

Notes: This table reports estimates of the relationship between the log of the minimum wage and the log of weekly price charged for child care using the county-border discontinuity design. Data are from the National Database of Childcare Prices (NDCP), which includes county-level information on median weekly prices compiled from state Market Rate Surveys for the years 2008 to 2018. In order to provide consistent and complete data across counties, sometimes data in the NDCP is imputed for certain age groups, years, counties, and/or to convert prices to a weekly measure or to estimate the median based on other information about the distribution of prices. In order to maintain a higher level of data quality, regressions only include observations with imputations done on at most one of these margins. All regressions control for county-level log employment and log population as well as county fixed effects and county pair-year-quarter fixed effects. Standard errors are clustered two ways by state and border segment.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B Data Appendix

This section provides information on the data sources used for our supplementary analyses: the Quarterly Census of Employment and Wages (QCEW), the Current Population Survey (CPS), the American Community Survey (ACS), and data on NAEYC providers from AggData.

We use the Quarterly Census of Employment and Wages (QCEW) between 1990 and 2019 to examine the stock of child care workers and establishments. The QCEW is an establishment-level database of employment and wage information for individuals covered by state unemployment insurance laws, organized by six-digit NAICS industry code at the national-, state-, and county-levels. The main outcomes include the (log) number of employees and establishments in the Child Day Care Services industry (NAICS code: 624410). The unit of analysis is either the state- or county-quarter combination, depending on the empirical strategy.

To study employment and wages in various child care sectors, we use individual-level data over the years 2001 to 2019 from the American Community Survey (Ruggles et al., 2022). Our analytic sample includes civilian women ages 18 to 64. Men are excluded because they comprise less than 5% of child care workers. Aside from its large samples, a key advantage of the ACS is it allows us to identify workers in three child care sectors: center- and home-based programs as well as private household settings. To classify workers, we rely on the industry and occupation codes attached to the most recently held primary job (Brown and Herbst, 2022). Center-based workers include non-self-employed individuals who work in the Child Day Care Services industry and whose occupation is a child care worker, preschool (or kindergarten) teacher or assistant teacher, education administrator, or special education teacher. Home-based workers are defined as self-employed individuals working in the Child Day Care Services industry whose occupation is a child care worker or education administrator. Finally, private household child care workers are defined as individuals employed in the Private Household Services industry and whose primary occupation is a child care worker. Our outcome variable is (log) hourly wages, defined as annual earnings in the previous year divided by (typical) hours worked each week multiplied by the (binned) number of weeks of work. To deal with the binned measurement of weeks, we restrict the analysis to those employed 50-52 weeks in the previous year.[30]

To supplement the ACS analysis of wages, we also rely on the March Demographic Supplement to the Current Population Survey (CPS) between 1992 and 2019. We define the sample in the same manner, and we are able to observe workers in the three child care sectors defined above. Although the CPS contains smaller samples, one advantage is that it includes a continuous measure of weeks of employment, thereby allowing us to measure hourly wages more precisely.

To examine the density of center-based providers that are NAEYC-accredited, we rely on lists of such providers obtained from the market research company AggData for the years 2011 to 2020. The listings include the name and physical address of each provider along with its state and county of operation. We collapsed the data into state- and county-year cells, calculating the log number of accredited providers and the share of accredited providers within the state or county.[31] The NAEYC's accreditation, the Early Learning Program (ELP), is considered one of the most rigorous quality accreditations available in the child care market. Providers must meet a variety of standards to obtain and retain their accreditation, including the use of an approved education curriculum, meeting requirements for staff training and education, and conducting child development assessments. To show evidence of meeting the standards, providers undergo an initial four-step evaluation—which includes a site visit—as well as annual follow-up evaluations that require considerable effort and resources (Xiao, 2010).

[30] The ACS interviews individuals throughout the calendar year. The questions on earnings pertain to the 12 months preceding the time of interview. Unfortunately we cannot ascertain when a given individual was interviewed, which means that the 12-month window differs dramatically across individuals.

[31] The numerator for the latter outcome comes from the AggData listing of NAEYC-accredited providers, while the denominator comes from the QCEW's data on the number of child care industry establishments.