Work Scheduling for American Mothers, 1990 and 2012

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Abstract
American working conditions have deteriorated over the last 30 years. One commonly-noted change is the rise of nonstandard and unstable work schedules. Such schedules, especially when held by mothers, negatively affect family functioning and the well-being and development of children and bear implications for the intergenerational transmission of disadvantage. This paper describes and compares the working schedules—in terms of type, duration, and variability—of American mothers in 1990 and 2012 in an attempt to assess whether nonstandard and unstable schedules are growing more common. Analyses demonstrate that evening work has increased in prevalence for single mothers but not for their partnered peers. Mothers in both single-mother and two-partner households experienced considerably greater within-week schedule variability and higher likelihood of weekend work in 2012 than they did in 1990. These changes resulted from widespread shifts in the nature of work, especially affecting less-educated mothers.

Key Words: Family; Stratification; Maternal Labor Force Participation; Work Scheduling; Demography

Introduction

Nonstandard and unstable working schedules have repercussions for children and families and bear implications for the intergenerational transmission of disadvantage. Mothers who work such schedules report higher levels of stress and depression and experience decreased marital stability (Han, 2005; Presser, 2003). They employ childcare arrangements that are more complex and less developmentally supportive (Carrillo, Harknett, Logan, Luhr, & Schneider, 2017; Hepburn, 2018), and their children experience a range of cognitive, behavioral, and health problems (Dunifon, Kalil, Crosby, & Su, 2013; Miller & Han, 2008). Children whose mothers work such schedules are likely to already be disadvantaged by a number of metrics. Consequences of their mothers' working schedules represent an additional strain on their development and well-being.

While the *consequences* of maternal working schedules have been the subject of considerable attention, little previous work has analyzed changes to the *distribution* of these schedules. Are mothers increasingly working nonstandard and unstable schedules and thereby exposing themselves and their children to the attendant aftereffects? This question has proven difficult to answer for the general population of workers, much less mothers. The general decline of American working conditions—in terms of wages, benefits, oversight, and schedules (Kalleberg, 2011)—provides reason to suspect that more individuals are working nonstandard or unstable schedules, but evidence to support the claim is surprisingly thin. Prior analyses of changes over time to working schedules are both limited in scope and mixed in findings (Hamermesh, 2002; Presser, 2003). None provides a compelling answer to the specific question of whether more mothers are working such schedules.

In this article, I use the National Child Care Survey (NCCS) and the National Survey of Early Care and Education (NSECE) to describe the work schedules of American mothers in two

periods: 1990 and 2012. I bring to bear large-scale, nationally-representative data that provides unusually fine-grained detail about working hours. I analyze the prevalence of nonstandard and variable schedules among all mothers rather than restricting to the percentage of *working* mothers with such schedules. This approach accounts for selection into employment and for the possibility that nonstandard and/or unstable work schedules might encourage or discourage mothers from seeking employment.

Using a combination of sequence analysis and clustering methods, I provide a new, inductive typology of working schedules. This offers an alternative to traditional shift definitions that are increasingly divorced from individuals' actual working patterns (Henly & Lambert, 2005; Lein, Benjamin, McManus, & Roy, 2005). I demonstrate the extent to which (1) the distribution of maternal working schedules has changed and (2) working schedules have grown more variable. Among single mothers, nearly twice as many were working evening shifts in 2012 as in 1990. The percentage of mothers with variable schedules increased by two-thirds between these two periods. One-third more mothers were working on weekends.

What accounts for these observed changes? To better-understand why the distribution of work schedules shifted, I used regression methods to analyze changes in the odds of three key outcomes: evening work among single mothers and variable and weekend work among all mothers. The literature on nonstandard work highlights the significance of occupation, education, race, and income as correlates of scheduling (Enchautegui, 2013; Presser & Ward, 2011). I assess how the predictive power of these variables has changed over time, as well as changes to the effects of household structure. Results indicate the stable significance of service sector occupations as a predictor of nonstandard and variable maternal schedules. By contrast, I find an increasing protective effect of education and a decreasing penalty to single motherhood. I use

results from these models to conduct a simple standardization exercise that addresses the counterfactual: if mothers from 1990 were exposed to the working conditions of 2012, what would their schedules have looked like? Here we see the significance of net changes to the associations between economic and demographic variables and the scheduling outcomes under analysis. The picture that emerges is one in which the odds of variable and weekend work—as well as evening work for single mothers—appear to be increasing over time, especially for those with less education.

Background

Nonstandard and Unstable Work as Mechanisms of Stratification

Nonstandard work scheduling typically refers to working a majority of hours outside of the traditional "standard" day shift (often defined as 8 am to 6 pm, Monday through Friday). As of 2010, 28% of all workers were estimated to hold a nonstandard schedule (Enchautegui, 2013). Estimates based on Current Population Survey (CPS) and American Time Use Survey (ATUS) data indicate that nonstandard schedules are more common for men, less-educated workers, lower-paid workers, minorities, younger workers, and those working in the service and retail sectors (Enchautegui, 2013; Presser, 2003; Presser & Ward, 2011). Workers tend to take these jobs not because they prefer nonstandard hours but because such an arrangement was a prerequisite of the job (or no better job was available) (Presser, 2003; Presser & Cox, 1997).

Unstable schedules are those which vary from week-to-week or day-to-day; they are characterized by the limited amount of advance notice that employees are given (to the point where they may be altered mid-shift) (Henly, Shaefer, & Waxman, 2006). Workers with unstable

schedules may exercise little or no control over which hours they work.[1] Analyses to date of unstable work typically focus either on the locus of scheduling control (Gerstel & Clawson, 2014; Lambert, Haley-Lock, & Henly, 2012; McCrate, 2012) or the consequences of unstable schedules (Carrillo et al., 2017; Henly & Lambert, 2014) rather than on the prevalence and correlates of such schedules. Lambert, Fugiel, and Henly (2014) offer an important exception, providing a description of the distribution of several aspects of unstable schedules for one cohort at one point in the life course.

The distribution of nonstandard and unstable shifts and the consequences that they bear for the children of workers serve to perpetuate inequalities across generations. Working mothers with nonstandard and unstable schedules face myriad challenges. Nonstandard schedules have been associated with increased depression, decreased marital stability, and fewer shared meals with or extracurricular activities for children (Han, 2005; Phillips, 2002; Presser, 2003). Such schedules lead parents to employ childcare arrangements that are more complex and less stimulating or developmentally productive (Han, 2004; Hepburn, 2018). Maternal nonstandard work has been linked to cognitive and behavioral problems among young children (Han, 2005; Joshi & Bogen, 2007) and a range of behavioral, relationship, and health problems among adolescents (Dunifon et al., 2013; Han, Miller, & Waldfogel, 2010; Miller & Han, 2008; Strazdins, Clements, Korda, Broom, & D'Souza, 2006).[2] Many of the effects identified for

[1] Unpredictability and lack of worker control are conceptualized as separate dimensions of work schedules in some definitions (e.g., Henly & Lambert, 2014). See below for further discussion.

[2] It bears note that findings on the effects of nonstandard work schedules are generally but not consistently negative across outcomes. The timing of work onset, duration of work, and child and household characteristics may shape the effects of such schedules (e.g., Han, 2005; Joshi & Bogen, 2007; Dunifon et al., 2013).

nonstandard work likely hold for those working unstable schedules. Multiple authors, for instance, have documented associations between mothers' unstable schedules and increased stress and strain (Henly & Lambert, 2014; Zeytinoglu, Lillevik, Seaton, & Moruz, 2004). Unstable work requires parents to have flexible patchworks of care in place and can lead to high reliance on informal care (Carrillo et al., 2017; Henly & Lambert, 2005).

Younger, less-educated, and low-income workers are over-represented in jobs that require nonstandard or unstable schedules (Enchautegui, 2013; Lambert et al., 2014; Presser & Ward, 2011). The children of such individuals already face an array of disadvantages relative to their peers in higher-income households with more-educated parents: they receive less financial investment (Herbst, 2015; Kornrich & Furstenberg, 2013), parents spend less time caring for them (Guryan, Hurst, & Kearney, 2008; Ramey & Ramey, 2009), and their time that is spent is less targeted to developmental needs (Kalil, Ryan, & Corey, 2012). Nonstandard and unstable schedules—and the attendant consequences—represent a further set of disadvantages that they must face. An increasing portion of children with mothers working such schedules would be cause for concern and potential policy intervention.

Measuring and Explaining Changes in Work Schedules

Analyses of changes over time in working schedules have been both limited and inconclusive. The conditions under which many Americans work—particularly those at the bottom of the labor market—have worsened over the last forty years (Kalleberg, 2011). Benefits and employee tenure have declined, unsafe working conditions have become more common, legal protections have been curtailed, unionization levels have fallen, and there have been increases in stolen wages, forced and unpaid overtime, and illegal dismissal (Doussard, 2013; Shulman, 2005). Changes to working schedules are often presumed to be part and parcel of these trends,

particularly in light of the advent of technologies that facilitate "just-in-time" scheduling strategies. Evidence to support this presumption is, however, hard to come by. Analyses of repeated cross-sectional surveys focus on the schedules of those who have selected into the labor force—or in some cases only a subset thereof—which hampers comparisons between studies and over time; changes in work scheduling are conflated with changes to selection into employment (Hamermesh, 2002; Presser, 2003). Findings from these studies are also mixed. While Presser (2003) argues that nonstandard schedules are on the rise, Hamermesh (2002) suggests that nonstandard work has become more concentrated but not necessarily more prevalent.

This paper offers a first attempt to estimate how many *mothers* are working nonstandard and unstable schedules, and how those numbers have shifted over time. In analyzing maternal work schedules, this paper exploits a special case in which we are able to effectively estimate changes over time without falling prey to selection problems. Even were a temporal trend in the prevalence of such schedules well-established among all workers, those patterns may not reflect equivalent changes for mothers. Given the increased stress and strain that they entail, mothers faced with the possibility of nonstandard or unstable schedules may be more likely to search out different work or select out of the labor market, thereby driving down the prevalence of such schedules. On the other hand, nonstandard work can be a method of minimizing use of non-parental care, especially for partnered women. This is a documented goal for a non-trivial subset of mothers (Chaudry, 2004; Chaudry, Henly, & Meyers, 2010), and as such it is plausible that we see a higher and/or increasing prevalence of such schedule.

What accounts for observed changes in prevalence over time? The previous literature highlights the significance of occupation, education, race, and income in determining the likelihood of nonstandard and, to a lesser extent, unstable work. In addition to these four factors,

I analyze variations between single mothers and those living with a partner (whether married or not).[3]

The U.S. has witnessed the prolonged growth of the service and retail sectors over the last several decades (Lee & Wolpin, 2006). Since the 1980s, the service sector has been the only area of employment growth for low-skilled workers (Autor & Dorn, 2013). Retail and service work are regularly associated with nonstandard schedules and the growth of these sectors could help to account for increased prevalence of such schedules (Presser & Cox, 1997). There is little reason to believe that work scheduling has become more family-friendly in these sectors during the period under analysis. Deregulation, declines in union representation, and public policies aimed at those at the bottom of the labor market—particularly in the form of the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 (PRWORA) and its successors—all served to weaken the position of low-skilled employees vis-a-vis employers and allowed the expansion of worker-unfriendly practices (Collins & Mayer, 2010; Kalleberg, 2011). The advent of algorithmic scheduling technologies has been particularly important in the service and retail sectors, which likely resulted in greater schedule instability for workers in these occupations (Lambert, 2008). As such, I expect that such jobs were as or more likely to entail a nonstandard or unstable schedule in 2012 than in 1990.

The adult population was better-educated in 2012 than it was in 1990 (Ryan & Bauman, 2016). Those with higher educational attainment have better employment outcomes than their

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[3] Variability in employee preferences must be acknowledged. Some mothers may elect to take work at nonstandard hours. Such work could plausibly allow these mothers to reduce reliance on non-parental care or could be sufficiently better-compensated to make it worthwhile. For couples in which joint leisure is relatively less valuable than availability of parental care, desynchronized work schedules may be a satisfactory equilibrium. I implicitly assume stability in parental preferences over time. I am aware of no evidence suggesting changes in such preferences.

less-educated peers: they hold higher-status jobs, receive higher incomes, and have lower unemployment rates and shorter periods of unemployment (Hout, 2012). Previous analyses indicate that they are also less likely to hold nonstandard schedules after completing their education (Enchautegui, 2013; Hamermesh, 2002; Presser & Ward, 2011). Changes to the educational distribution should yield lower rates of nonstandard or unstable work, unless the association between education and work scheduling weakened. That association could, plausibly, have moved in either direction. As the supply of college-educated workers increased, education may have served as an increasingly significant prerequisite for access to the primary labor market. The increasing precarity of employment, however, has not been limited to the secondary labor market (Hacker, 2006; Kalleberg, 2009). Those with more education may have had access to "better" jobs, but those jobs may not have been as good as they once were.

The racial composition of America has changed over the last 25 years. The non-Hispanic white share of the population has declined and the population of minority groups has increased (Lopez, Passel, & Rohal, 2015). These shifts in racial composition may have been accompanied by changes in associations between race and employment characteristics, but it is unclear in which direction. The greater representation of minorities in the labor market—particularly beyond the secondary labor market—may have led to a weakening of the association between race/ethnicity and nonstandard or unstable schedules. On the other hand, many policies that made receipt of social services contingent on employment were particularly aimed at minority mothers (Collins & Mayer, 2010). If such mothers were forced to take jobs to access the social safety net, they may have been less able to turn down jobs with nonstandard or unstable schedules.

Income inequality has been on the rise over the last half century. The rich receive an ever-larger share of all income and the poor get less (Piketty, 2015). This growing divide between haves and have-nots has been reflected in working conditions. Work at nonstandard hours in particular has shifted over time to those at the bottom of the income distribution (Hamermesh, 2002). This leads me to expect that mothers in households with lower incomes should have been at increasing risk of nonstandard work. A growing body of research implies that schedule variability, by contrast, may be an increasingly common trend, albeit with varying lived implications across the class divide (Gerstel & Clawson, 2014; Lambert et al., 2012). Both low- and high-income jobs involve flexible schedules, but with workers exercising much less control over their schedules in the former (Lambert et al., 2014). This leads to an expectation that household income may not have been an increasingly strong predictor of unstable schedules.

Finally, there have been significant changes to household structure over time. Non-marital fertility rates have increased and a greater portion of children are being raised by single mothers (Vespa, Lewis, & Kreider, 2013; Wu, 2008). Provision of social services for these women has been significantly curtailed over the last several decades, with the goal of making work a prerequisite of receipt (Collins & Mayer, 2010). As such, single mothers may have been less able to opt out of the labor force in 2012 than in 1990 and therefore at increased risk of holding a nonstandard or unstable schedule. The trend may be in the same direction for partnered mothers. A growing segment of cohabiting mothers are unmarried (Bumpass & Lu, 2000); lack of a stable legal contracts with their partners may increase reliance on own wages and thereby reduce selection out of the labor market.

Observed changes over time in the prevalence of nonstandard and unstable schedules can be accounted for by a combination of structural and relational changes in these factors. Structural

changes are shifts in the characteristics of the population and economy: changes to the availability of jobs, an increasingly well-educated labor force, more diversity, a shifting income distribution, and changes to household structure. Relational changes pertain to the nature and quality of work: how well does a given structural factor predict holding a bad schedule? For example, if the well-documented relationship between service sector employment and nonstandard schedules grew *stronger* over time, then we would expect more individuals to be working such schedules even if the share of mothers with jobs in the service sector did not change.[4]

Some of the structural and relational changes discussed above represent likely protective effects (e.g., more education) while others tend toward decreasing job security or quality (e.g., more employment in the service and retail sectors). One way to assess the *net* effect of these patterns is in terms of a counterfactual: if the population of mothers from 1990 were exposed to the working conditions of 2012, would more or less of them be working nonstandard or unstable shifts? The differences between the counterfactual rate and the observed rates (in both 1990 and 2012) allow for assessment of the net structural and relational changes over time.

Data and Methods

This paper uses data from two nationally-representative childcare studies to analyze the working schedules of American mothers in households with children under age 13 at two points in time: 1990 and 2012. The first, the National Child Care Survey (NCCS), was conducted in late 1989 and early 1990. It consisted of five studies: a survey of parents with children under age 13, a survey of the childcare providers used by those parents, a separate survey of individuals who

[4] Change over time *could* be attributed entirely to structural or relational changes. In practice, the result is likely to fall somewhere between these extremes.

provided childcare in their homes, and two sub-studies of select parents: those with low household incomes (less than $15,000) and those in the military. I make use of the parent study and the low-income sub-study here; combined, these data were gathered from 4,777 households. These studies collected extensive data on childcare arrangements, employment schedules of parents, and family characteristics. The second data source is the 2012 National Survey of Early Care and Education (NSECE). The study was comprised of four surveys which collected data from households with children under the age of 13, center-based childcare providers, individual workers at those centers, and providers of both formal and informal home-based childcare. I make use of the household survey, which gathered data from 11,629 households from 755 communities across all 50 states and the District of Columbia.

These two surveys are, in many ways, highly comparable. The NSECE collected data on many of the same topics as the NCCS, often with identical or near-identical questions. Both surveys collected data from a single respondent, most often the mother of a child under the age of 13. Recall problems may pertain, but they should be the same problems across the surveys. The primary focus of this analysis is work schedules, which in both cases were collected for a full seven-day week for all parents in the household. In both surveys respondents were asked to report work start and end times, but in the NSECE they were instructed to include time spent commuting to and from work. I developed a method (described in Methodological Appendix A) to trim reported working hours in the NSECE on the basis of related covariates so as to account for commuting and improve data commensurability. There was also a mode difference in data collection. The NCCS was conducted via computer-assisted telephone interviewing, while the NSECE data were collected primarily via computer-assisted in-person interviews (with a minority completed via computer-assisted telephone interviewing). Interpretation of the findings

presented below must be tempered by an appreciation that the data are drawn from separate sources. Ultimately, however, I argue that the similarities between these sources are sufficient to allow for meaningful comparison.

I imposed a number of sample restrictions on the data. First, to ensure the comparability of scheduling data, I removed all interviews conducted with a respondent who was not either a biological or adoptive parent of a child in the household (n=114 in the NCCS and n=730 in the NSECE). Second, because mothers are my focus, I dropped all single-father households (n=71 in the NCCS and n=370 in the NSECE). Third, I removed all same-sex two-partner households (n=23 in the NCCS and n=80 in the NSECE); same-sex male households contained no mothers and same-sex female households were too rare in these data to allow systematic analysis. Fourth, I removed a set of cases that were missing or had apparently erroneous maternal schedules (n=121 in the NCCS and n=80 in the NSECE). This left a sample of 14,638 cases: 916 single mothers and 3,352 partnered mothers from the NCCS and 2,780 single mothers and 7,590 partnered mothers from the NSECE.[5]

Describing Work Schedules

Presser and Ward wrote that "defining a nonstandard work schedule is inherently arbitrary—and thus problematical" (2011, p. 5). In a bid to reduce arbitrariness, I employed an inductive, data-driven approach to the detailed scheduling data available in these two surveys. This process yielded a new typology of maternal working schedules and a measure of the within-week variability of work schedules.

[5] NSECE disclosure guidelines restrict reports of weighted and unweighted frequencies and results. All numbers presented in this paper have been rounded to the nearest 10 and/or restricted to three significant/leading digits.

Surveys that gather scheduling data typically collect information either from a single specific day (as in the ATUS) or with reference to an abstract "usual" day (as in the May supplement to the CPS). Without repeated schedules covering multiple days we lack a reliable way of assessing variability. Hamermesh acknowledged this problem, noting that, "the ideal, a set of repeated cross-sections of a large numbers of time diaries showing exactly when people are at work for each of a number of days, is simply unavailable in the United States or elsewhere" (2002, p. 603). The NCCS and NSECE do not suffer from this problem and, when combined, represent something approaching the ideal that Hamermesh lays out: each survey collected work schedule data for the respondent and their partner (if present in the household) for a full seven-day week.

To harmonize the NCCS and NSECE data I dropped all scheduling information from men and simplified maternal schedules such that each person-week was broken into 15-minute blocks and each block assigned to either a "work" or "other" state. I made use of sequence analysis and clustering methods to describe and characterize these schedules. The most apparent alternative—a simple categorization following traditional shift definitions—has at least two drawbacks. First, these traditional definitions are less settled than is commonly assumed; what constitutes a standard or nonstandard shift varies from study to study and I have no strong grounds for choosing one of these definitions over the other. Second, there is compelling evidence—central, in fact, to much of the literature on unstable work—that these traditional definitions have become decreasingly good descriptors of the schedules that individuals actually work (Henly & Lambert, 2005; Lein et al., 2005). Sequence analysis and clustering allow for the derivation of schedules directly from the data without imposing any strong prior model of work

scheduling. The steps involved are described in detail in Methodological Appendix A and briefly summarized here.

I divided week-long maternal schedules into a series of days. Following Lesnard (2008, 2010; Lesnard & Kan, 2011), I employed Dynamic Hamming Distance (DHD) matching, a variant of Optimal Matching (OM) in which the cost of transitioning between states varies with time. DHD matching is well-suited to a time-varying process like employment. To establish the necessary multi-dimensional substitution matrix I relied solely on the transition rates between states at each point in time. I used the resulting dissimilarity matrix and employed the non-hierarchical Partitioning Around Medoids (PAM) algorithm to derive clusters from the data (Studer, 2013). The final selection of clusters involved weighing both fit statistics and the descriptive potential of each additional group. I selected more clusters where (1) the additional cluster offered a qualitatively new pattern relative to those already selected and (2) the additional cluster did not result in significantly worse fit statistics.

This first-stage clustering process, when run over all maternal person-days, yielded seven daily schedule types.[6] Figure 1 presents state distribution plots for these clusters. This type of plot gives the distribution of states ("work" and "other") in each 15-minute block over the course of a day. It can be understood as a series of vertical bar plots run up against each other in chronological order. Take as an example the upper-left panel ("Standard"), representing what we would think of as traditional standard work day. At 4:15 nearly all mothers in this cluster were in the non-working "other" state; around 8:00 they began transitioning to the "work" state and the

[6] Silhouette width is a measure of the tightness and separation of clusters; it runs on the interval [-1,1]. Average silhouette width (ASW) allows for evaluation of overall clustering validity. The ASW of these seven clusters was .754, suggesting that a strong structure was identified (Rousseeuw, 1987; Studer, 2013).

vast majority were working over the next eight to nine hours. They began transitioning back to the "other" state around 17:00 (5:00 pm) and only a small percentage were still working at 21:15 (9:15 pm).

FIGURE 1 HERE

In the upper-right panel, "Limited Work" individuals spent all or very nearly all of their time in non-work status. The two clusters below on the right followed the traditional nonstandard evening and night shifts. In addition to the Standard schedule, there were three "off-standard" variants which are displayed on the left-hand side: standard schedules shifted earlier in the day ("Early"); shortened days with work falling entirely within standard hours ("Short"); and schedules of standard length which fall mostly in the afternoon and evening ("Afternoon").

After categorizing mothers' days, I re-configured the data into a week format: each mother had a sequence of seven days where each day was represented by the cluster to which it was assigned in the previous step. I ran a second sequence analysis and clustering exercise, again using the PAM algorithm, across this set of person-week sequences. The end result was to categorize each mother's week into one of seven clusters.[7] The resulting week-level clusters paralleled the day-level clusters presented above. Each week-level cluster was heavily but not exclusively populated by days of the given type (for more detail, see Figure 2 in Methodological Appendix A). For instance, most days in the week-level Early category were of the Early type,

[7] ASW of the seven-cluster solution is .786. This approach to analyzing workweeks is very similar to the process described by Lesnard and Kan (2011). In terms of noteworthy differences, Lesnard and Kan made use of a hierarchical clustering algorithm (beta-flexible), analyzed non-working days separately from working days in the first-stage clustering, and combined similar day-level clusters before carrying out the second-stage clustering.

but there were also Standard and Short type days scattered throughout, as well as Limited Work (especially on the weekends).

TABLE 1 HERE

Table 1 provides a description of the resulting schedule typology. The first two columns provide the modal start and end times for the seven clusters.[8] The next three columns present the average number of weekday standard and nonstandard hours—with standard hours defined here as 8 am to 6 pm—and weekend hours. Here we see, for instance, that those with a Standard schedule typically worked from 8:30 am to 5:00 pm, putting in an average of 7.9 weekday standard hours and almost no weekday nonstandard (0.2) or weekend (0.6) hours per day. Those working one of the nonstandard schedules, by contrast, worked on average only 1.7 weekday standard hours but 4.6 weekday nonstandard and 2.5 weekend hours. The next four columns of Table 1 switch to the week level, displaying the average number of days that individuals in each schedule type (or combination) reported no working hours, fewer than seven hours (recorded as a part-time day), or seven or more hours (recorded as a full-time day), as well as the percentage of individuals who reported doing any work on either Saturday or Sunday (weekend work). Here we see, for instance, the large number of non-working days amongst those in the Limited Work category. Part-time work—analyzed in Methodological Appendix B—was most common for those working a nonstandard or a Short schedule. Weekend work was rare for Standard workers but quite common for mothers in one of the nonstandard schedule types. The final column of Table 1 displays within-week variability: the percentage of individuals within that schedule type

[8] Limited Work entails little or no work; there are no modal start or end times. Night schedules had two elements: 45 minutes of work at the end of the day as shifts begin and seven hours to start the next day for the remainder of the shift.

(or combination) that have more than one working schedule type (i.e., excluding Limited Work) in the observed week. For workers with a Standard schedule this is relatively rare: only 16.3% work more than one type of schedule. This variability is still uncommon for those working a nonstandard schedule, but considerably less so: almost a quarter of these workers had more than one schedule type in the observed week.

Within-week schedule variability is one of a set of characteristics typical of unstable schedules; others include limited advance notice, low worker control over scheduling, and between-week variability in schedules (Lambert et al., 2014). The combination of these various elements is important in assessing the valence and lived significance of each. A schedule that varies from day-to-day is, for example, less pernicious when the worker has six weeks notice rather than only 48 hours. Within-week schedule variability is the only component of unstable scheduling that can be effectively measured across these two surveys. It is important that it not be misinterpreted as a direct proxy for schedule instability. The benefits and drawbacks of the measure are discussed in greater depth in Methodological Appendix B.

Analytic Plan

Once working schedules are defined, analysis proceeds in three steps. First, I compare the distributions of working schedules and two other schedule characteristics—within-week variability and weekend work—in 1990 and 2012. I carry out these comparisons for single and partnered mothers separately. I test for significant differences between years as well as between single and partnered mothers within years.

Second, building on key findings from the first step, I carry out a series of logistic regressions testing for changes in the odds of holding three schedule characteristics. In each case

the given outcome is modeled on the basis of mother's occupation,[9] mother's education (a dummy variable indicating a college diploma or higher), respondent's race (a dummy variable indicating that the survey respondent was non-white), log of family income, and, as appropriate, household type (a dummy variable indicating single mother). I predict holding the given schedule characteristic (e.g., a nonstandard schedule) relative to holding any other schedule type. I run the models across a pooled sample and include interactions between each of the independent variables and the survey year (with the 1990 NCCS serving as the baseline). I focus my attention on the average marginal effects (AMEs) of the independent variables. AMEs provide the average instantaneous rate of change in the *probability* of the given outcome across the observed distribution of a given independent variable while holding all other covariates constant. AMEs offer an intuitive alternative to logistic regression coefficients. They are particularly important when attempting to interpret interaction effects because traditional significance tests are neither necessary nor sufficient for assessing the substantive effect of interaction term coefficients in logistic regression (Berry, DeMeritt, & Esarey, 2010). I look for significantly different AMEs in the independent variables between 1990 and 2012 as indicative of noteworthy changes in the associations between the independent variables and the given schedule characteristic.

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[9] Occupation is a simplified version of the 1990 Census occupation categories. These classifications changed dramatically in the late 1990s. I used the Integrated Public Use Microdata Series' well-validated recoding of current Census categorizations back to the 1990 standard. Anyone who was not working in the previous week was categorized as having no occupation recorded. Mothers were allocated into the six other categories per standard occupation classifications with one exception: those working as cashiers were set as "Service" rather than "Technicians/Support/Sales." Those whose occupation could not be coded were marked as having an "Other" occupation.

Third, on the basis of these logistics regression models I carry out a simple standardization exercise. I apply the coefficients estimated from the 2012 NSECE to the population from the 1990 NCCS sample. This approach, which builds on previous work in the sociology of the family decomposing changes over time in time use (e.g., Sandberg & Hofferth, 2001), addresses the counterfactual posed above: how would rates of nonstandard and variable work have changed if the population's characteristics and occupational distribution had stayed fixed? The differences between the counterfactual rate and the observed rates allow for assessment of the net structural and relational changes over time. Differences between the observed 1990 rate and the counterfactual rate reflect net relational changes: if working conditions had generally improved, we would expect to see fewer such schedules (more if conditions had worsened). Differences between the observed 2012 rate and the counterfactual rate, by contrast, represent the net structural change. If the distribution of jobs and workers saw a net improvement over time, the observed 2012 rate would be lower than the counterfactual rate (higher if there had been a net worsening).[10]

Results

TABLE 2 HERE

Table 2 provides a description of the sample split by survey year (1990 and 2012) and household type (single mothers and those with a partner in the household). All results are weighted with the provided sample weights so as to be nationally representative of households with children under age 13. In terms of the number of children and age of the youngest child, there were few notable

[10] A test of the relative significance of net relational and structural changes can also be attained via Blinder-Oaxaca decomposition. Results from such models are presented in Methodological Appendix C.

differences between 1990 and 2012. Both single and partnered mothers were, on average, approximately three years older in 2012 than in 1990. Mothers living with a partner reported significantly higher household income than their single-mother peers, but they experienced no change in total household income (standardized to 2012 dollars) between 1990 and 2012. Single mothers, however, reported a significant increase (p=.002) in household income between 1990 and 2012. There were fewer white and black survey respondents in 2012 than in 1990 and more that reported being Hispanic or of another race.[11] As expected, mothers in 2012 were considerably more educated than their counterparts in 1990. Modal education for both single and partnered mothers shifted from a High School diploma to a college diploma. Single mothers were almost twice as likely to be working retail or service jobs in 2012 as in 1990 (p<.001). By contrast, the percentage of partnered women working such jobs barely changed.

TABLE 3 HERE

Table 3 presents the distributions of mothers' schedule characteristics by household type, year, and work status. The rates of evening and night work reported here are, for a number of reasons, lower than often seen in the literature (e.g., Presser & Ward, 2011; Presser, 2003). Results in the top panel of Table 3 are over the denominator of *all* mothers (including non-workers), whereas nearly all literature in this vein pertains just to *working* mothers. Results in the bottom panel (over the denominator of working mothers) are also lower than comparable estimates. This may result from both lower selection into such schedules by mothers and the nature of this typology. The table provides results from weighted t-tests for significant

[11] In both surveys, race was collected only for the respondent. I report here and throughout on just respondent's race (disregarding sex of respondent in two-partner households). All observed changes in race were statistically significant with the exception of the small decline in the reported number of black respondents in two-partner households.

differences between years (within household type) and, in the final two columns, between single and partnered mothers within years. Here we can see, for instance, that the percentage of all mothers in the Limited Work category increased while the percentage working a Standard schedule fell between 1990 and 2012 (changes were significant amongst mothers living with a partner, but not amongst the smaller sample of single mothers). Off-standard schedules were, collectively, more common than standard schedules: slightly more than half of working mothers in both years held such a schedule.

Three patterns from Table 3 are noteworthy in the context of this paper. First, changes between 1990 and 2012 in the prevalence of evening and night work schedules were negligible, with one important exception: the percentage of single mothers working evening shifts nearly doubled (from 2.4% to 4.3% among all single mothers and from 5.1% to 9.2% among working single mothers; changes significant at the $p<.05$ level in both cases). In 2012, single mothers were more likely than their partnered peers to be working an evening schedule (significant at the $p<.01$ level). Second, the prevalence of within-week variability increased significantly for both single and partnered mothers. Amongst working mothers (bottom panel) the increase between 1990 and 2012 was from 14.2% to 21.3% of single mothers and from 11.5% to 20.2% of partnered mothers. Third, weekend work grew more common between 1990 and 2012. Single mothers worked weekends at higher rates in both years, but the proportional increase in prevalence of weekend work was larger among partnered women. These three changes—to the prevalence of evening work among single mothers and of variable and weekend work among all mothers—serve as the objects of the subsequent two analytic steps.

FIGURE 2 HERE

Figure 2 presents average marginal effects estimates from a set of logistic regressions predicting these three key outcomes on the basis of year, maternal occupation, maternal education, survey respondent race, the natural log of household income, and, as appropriate, household type.[12] AMEs for categorical and binary independent variables measure how the probability of holding the given schedule characteristic changes, on average, as the variable departs from the reference category. For the continuous measure of the natural log of family income, the AME is the average instantaneous rate of change in the predicted probability. The top-most entry (year) can be read as the average change in probability for all cases in 2012 relative to 1990. This AME was positive in all three panels, and significantly different than zero in the latter two.

AMEs of service sector work were consistent: employment in this sector—relative to employment in an administrative occupation—was associated with higher probabilities of evening work (among single mothers), within-week variability, and weekend work. There was some variation between years, but nothing that suggests a significant change in the effect of service sector employment over time. Education yielded a different story: in 1990, having a college education or more had limited effect on probabilities (AMEs statistically indistinguishable from zero in all three cases). In 2012, however, higher education was associated with lower probabilities of all three outcomes. The pattern on respondent race was mixed. For evening work among single mothers, the AMEs were indistinguishable from zero in both years. Households in which the survey respondent was nonwhite had lower probabilities of maternal within-week schedule variability in both 1990 and 2012. In 1990 this was true of

[12] Full results from these regression models are presented as Table A4 in Methodological Appendix C.

weekend work as well, but the 2012 AME suggested no association between respondent race and the probability of weekend work. AMEs of family income indicated limited effects in the left and middle panels. The probability of weekend work, however, declined as family income increased, and more dramatically in 1990 than 2012. This pattern is better-demonstrated in Figure 3, which plots, by year and household type, the predicted probabilities of weekend work across the observed distribution of family income. The probability of weekend work was higher at lower incomes in 1990 than in 2012, but declined more rapidly as income increased. At highest incomes, the probability of weekend work was lower in 1990 than in 2012, especially among partnered women. Finally, returning to Figure 2, we see that single motherhood was associated with higher probabilities of within-week variability and weekend work in 1990, but that these AMEs were indistinguishable from zero in 2012.

FIGURE 3 HERE

In the final analytic step I took the 1990 NCCS sample and predicted mothers' probabilities of these three schedule characteristics as though they were members of the 2012 NSECE (that is, applying the coefficients that result from the logistic regressions in the previous step). Figure 4 presents the weighted distributions and confidence intervals for the observed distributions of evening work (among single mothers), within-week variability, and weekend work, as well as the distributions that result from this counterfactual exercise. The vertical distance between the observed 1990 rate and the counterfactual rate represents the net *relational* change: if the population had stayed exactly the same, how much would work schedules have changed just as a function of working conditions getting better or worse? The vertical distance between the observed 2012 rate and the counterfactual rate represents the net *structural* change:

holding working conditions constant, how much difference did demographic shifts and changes to the distribution of jobs make?

FIGURE 4 HERE

In the left panel of Figure 4 we see that the counterfactual condition split the difference between the observed 1990 and 2012 rates. Had the working conditions of 2012 held amongst the single mothers of 1990, marginally more of them would been working an evening schedule. Comparing the observed 2012 rate to the counterfactual condition, we see that structural changes to the population of single mothers put them at a net disadvantage: single mothers in 2012 were more likely than their peers in 1990 to work an evening schedule even when holding constant the associations between demographic and economic factors and the odds of holding such a schedule. The result is striking given the significant gains in income and education amongst this population. The near-doubling in service sector employment (from 11.5% to 21.5% among single mothers) is a plausible explanation.

The middle and right panels of Figure 4—pertaining to the prevalence across all mothers' schedules of within-week variability and weekend work, respectively—demonstrate a different pattern. In each case the counterfactual condition yielded a rate slightly *above* the observed 2012 rate. This suggests that nearly all of the observed differences over time were driven by net relational changes. If the population of mothers from 1990 were exposed to the working conditions of 2012, they would have experienced much higher rates of within-week variability and weekend work—rates functionally equivalent to the observed 2012 rates. The small differences between observed 2012 rates and the counterfactual conditions can be ascribed to net structural changes.

Discussion and Conclusion

Nonstandard and unstable maternal working schedules can have serious implications for family well-being and children's development. This paper explored how the prevalence of such schedules has changed over the last quarter century and, in so doing, achieved three ends. First, it provided and described a new typology of maternal working schedules. I used sequence analysis and clustering methods to inductively derive a scheduling typology from two sets of uniquely detailed data. This typology improved upon traditional schedule definitions and allowed for assessment of within-week schedule variability. Second, it described the distribution of these schedules, in both single-mother and heterosexual two-partner households, in 1990 and 2012. I analyzed the schedules of nearly all mothers—working and not, single mothers and those living with a partner of the opposite sex—rather than focusing just on *working* mothers. This approach serves to account for selection into employment and for the possibility that nonstandard or variable schedules affect mothers' decisions about seeking work. I found that single mothers were significantly more likely to be working evening schedules in 2012 than in 1990, and that all mothers were exposed to significantly more schedule variability and weekend work. Third, it analyzed changes in the prevalence of three key schedule characteristics on the basis of a set of maternal demographic and economic characteristics that have been documented to be associated with nonstandard and unstable schedules. Regression results suggested a strong and stable link between service sector employment and nonstandard and variable work, as well as a growing protective effect of education. The counterfactual standardization exercise highlighted the importance of net relational changes rather than structural shifts in explaining the observed differences, particularly in weekend work and within-week schedule variability.

Between 1990 and 2012, the share of single mothers working evening shifts increased significantly. This trend stood out because the evidence presented here suggested that maternal

evening and night shift work did not, by and large, grow more common over this period. 3.5% of all mothers were working an evening or night nonstandard shift in 1990; exactly the same percentage was doing so in 2012. This finding should not be misread to suggest that nonstandard work was stable across the full population; it may be that mothers actively chose other schedules or selected out of the labor force. That explanation would fit with the finding of differences in exposure to nonstandard work by household type. In 2012, single mothers—who plausibly have less leeway to select out of such schedules by leaving the labor market—were significantly more likely than their partnered peers to work a nonstandard shift.

By contrast, there was strong evidence in Table 3 that schedules grew more variable over this period and were more likely to involve weekend work. The percentage of mothers with variability in their working schedules over the course of the week increased by two-thirds between 1990 and 2012. This measure of within-week schedule variability is, as discussed above, only one indicator of overall schedule instability, but the sizable increase observed here is nonetheless noteworthy. The rate of weekend work across all mothers grew from 11.7% in 1990 to 14.4% in 2012, a change that was primarily driven by significant increases in such work for partnered women.

Results from the regression models led to four conclusions. First, the probability of nonstandard and variable work rose *regardless of worker characteristics* between 1990 and 2012. Changes to mothers' occupational distribution, educational attainment, racial composition, incomes, and household structure cannot fully account for the observed increases in evening schedules among single mothers and within-week variability and weekend work among all mothers. Second, service sector employment was, as expected, associated with nonstandard and variable work schedules. This association, however, did not change between periods.

Surprisingly, despite the advent of technologies that facilitate just-in-time scheduling strategies—and despite dire warnings in the popular and academic literature on work scheduling—service sector work does not appear to be *increasingly* associated with schedule variability. Third, education had a more pronounced protective effect in 2012 than in 1990: those with a college education or more were at decreasing risk of working a nonstandard or variable schedule. This finding is consistent with literature highlighting the continued high returns to education (e.g., Hout, 2012) and provides further evidence of a growing bifurcation of the labor market around the central cleavage of higher education. Mothers without a college degree find themselves in an increasingly precarious position. Fourth, penalties associated with single motherhood were less severe in 2012 than in 1990. The alternative interpretation is that the working experiences of partnered mothers came to more closely resemble those of single women. Results related to race and income were mixed.

Results from the counterfactual standardization exercise presented above indicate that most or all of the observed changes in within-week variability and evening work were a function of net *relational* changes rather than net *structural* shifts. When the relationships between occupation, education, race, income, household type and the various schedule characteristics that were estimated for 2012 were applied to the population of mothers in 1990, rates of schedule variability and weekend work rose dramatically. This indicates that the characteristics of *work*—rather than the characteristics of *workers*—are driving the observed changes in the prevalence of nonstandard and variable scheduling. By contrast, for single mothers the increase over time in evening work was a function of both relational and structural factors.

Future Directions and Limitations

The working schedules upon which these analyses rest deserve greater analysis. The typology of working schedules presented in Table 1 provides a set of schedules that diverges in important ways from the typical day, evening, and night shifts. Those three traditional shifts are still present, but I highlight three off-standard work schedules: an early day that runs, on average, from 7 am to 4 pm, a short day running from 8:15 am to 2:30 pm, and an afternoon schedule running from 11:15 am to 6:45 pm. Following any traditional definition, these would be subsumed under the "day" or "standard" shift. But for a mother attempting to arrange care for her child, arriving to work at 7 am—when certain forms of childcare are rarely available (NSECE, 2015)—is qualitatively different than arriving at 8:30 am. Leaving the office in the mid-afternoon may allow a mother to care for kids getting home from school, but it may also foreclose opportunities for career advancement or extra-curricular socialization. A first question for future investigation is what accounts for the significant changes in the distribution of these off-standard schedules between 1990 and 2012? Why did early schedules decline in prevalence and short schedules increase? A second set of questions relates to who works and who determines these shifts. Are mothers accepting jobs that demand these hours or are they the ones setting these schedules? How does the age and childcare/schooling of their children affect these schedules (and vice versa)? It would be interesting to analyze the difference between mothers working standard, early, and afternoon shifts. All three yield nearly same average number of weekly working hours, but do they correspond to different career trajectories?

Another direction for further investigation lies in exploring work schedules within the household context. My focus has been on maternal schedules, but it bears acknowledging that these schedules are never set or carried out in a vacuum. All of these women have children and have to manage and contend with their schedules. The women in two-partner households have

boyfriends or husbands with their own schedules; many of the single mothers have additional adults living in their homes whose schedules may affect theirs. The interactions of these schedules—their synchronization, their co-dependencies—deserve greater attention. Some analysis has been carried out at the level of the partner dyad (Lesnard, 2008; Nock & Kingston, 1984; Presser, 1987), but it bears considering how these inter-dependencies operate in less-traditional or more-complex household structures.

This study has a number of limitations. First, the data allow only indirect analysis of schedule instability. As discussed above—and in greater depth in Methodological Appendix B—the measure of within-week variability only assesses observed day-to-day variation in schedule worked. Second, the schedules described here are a function of the data; they derive from the schedules reported in the NCCS and NSECE and are thus unique to these data. Additional data from similar sources would likely yield similar clusters, but the analysis does not, nor should it be interpreted as, producing a new set of shift definitions that are meant to be applied elsewhere. Third, as discussed above, data are collected from different surveys using different collection methods. While care was taken to ensure the comparability of these data, it is ultimately impossible to discount the possibility that some of the between-year variation documented here is a function of the data production mechanisms.

Fourth, these data allow for comparison of maternal schedules in 1990 to those in 2012, but do not allow for identification of a strong trend line. It is possible, for instance, that maternal nonstandard work increased significantly over the 1990s and early 2000s but decreased following the Great Recession. Given a range of economic and policy changes, it would be a mistake to draw simple trend lines between data points in these two surveys. Having one additional data point following passage of PRWORA and preceding the 2007 financial crisis

would allow for analyses of that possibility and others. I am aware of no data that meets the necessary criteria for comparability, unfortunately.

Nonetheless, two data points—and these two data points in particular—do make for an important comparison. A broad and growing body of literature in Sociology suggests that working conditions have declined over the last quarter century, including with regard to working schedules (Gerstel & Clawson, 2014; Kalleberg, 2011; Lambert, 2008). The analyses carried out here provide mixed support for this contention for one important subpopulation: mothers. The 2012 data, moreover, allow us a glimpse into the state of employment at the outset of what may well be a new economic period: a relatively weak economic recovery with limited policies or programs aimed at protecting workers' rights. In short, while this analysis does not allow for investigation of trends between 1990 and 2012, the comparison nonetheless offers a snapshot of the changed employment landscape for American mothers and the inclusion of post-2008 data is a boon for analysis of family functioning in the present day.

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Figures

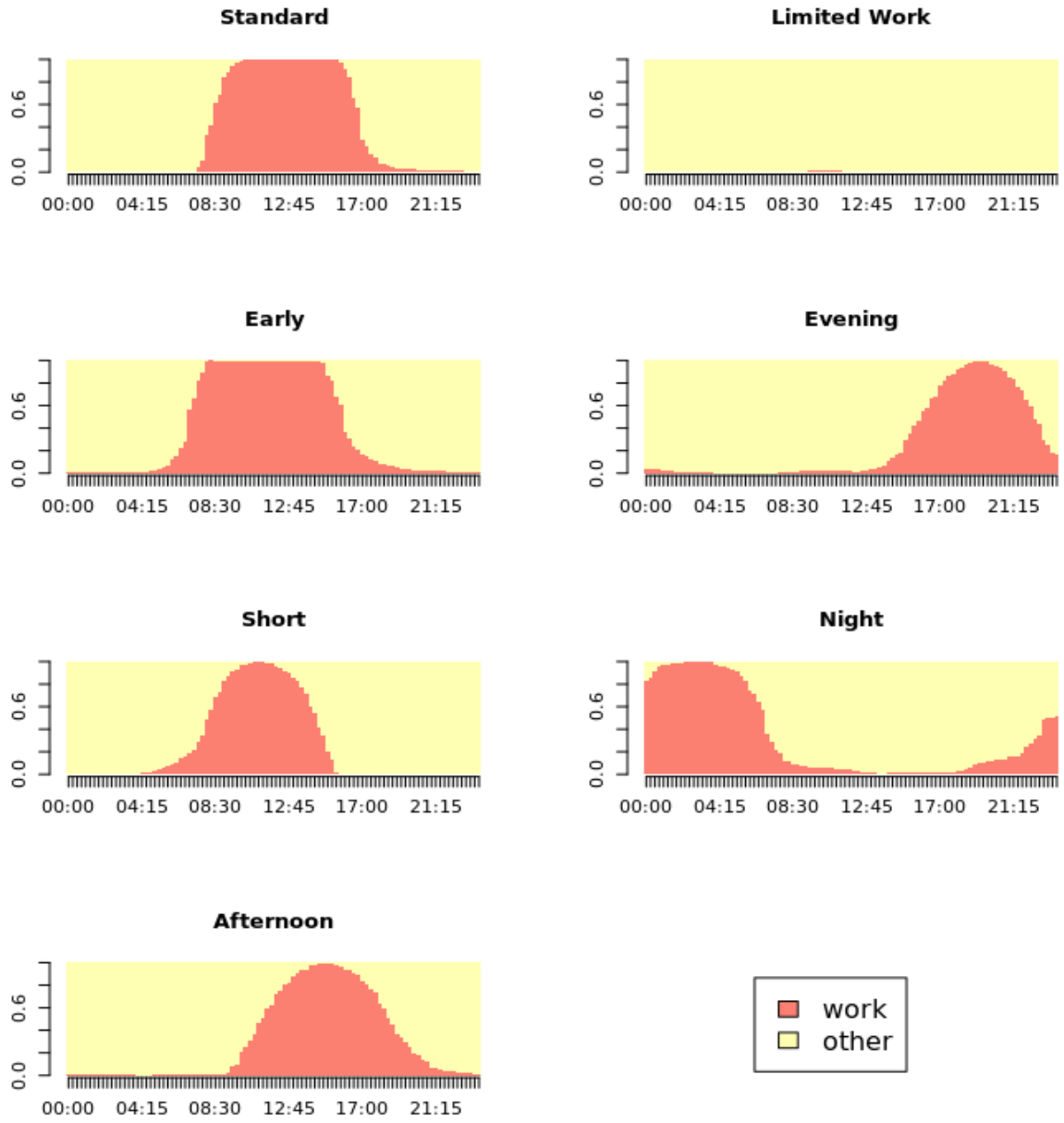

Figure 1. State distribution plots of person-day work schedules.

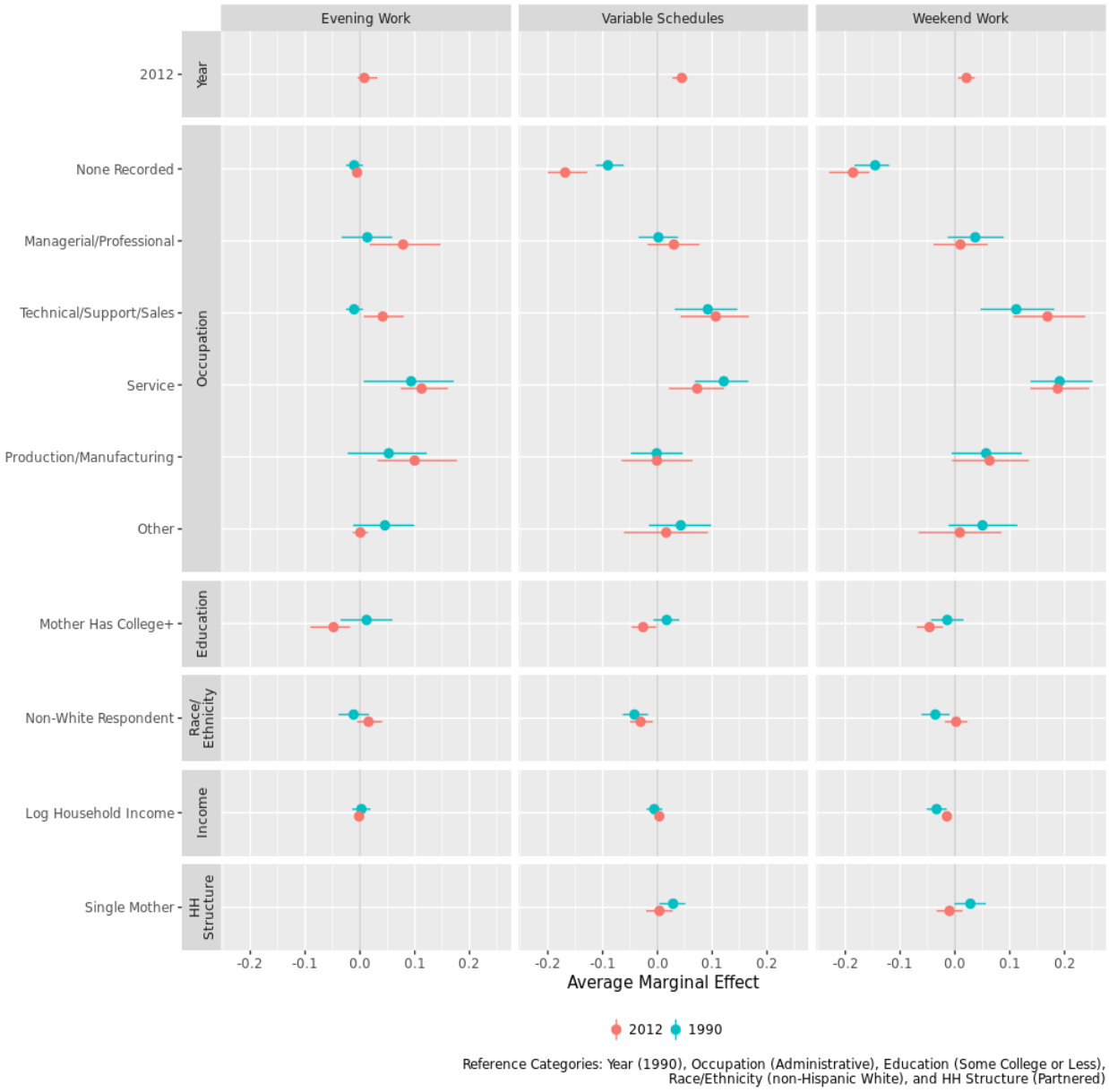

Figure 2. Average marginal effects calculated from logistic regressions predicting evening work (for single mothers), within-week schedule variability (for all mothers), and weekend work (for all mothers).

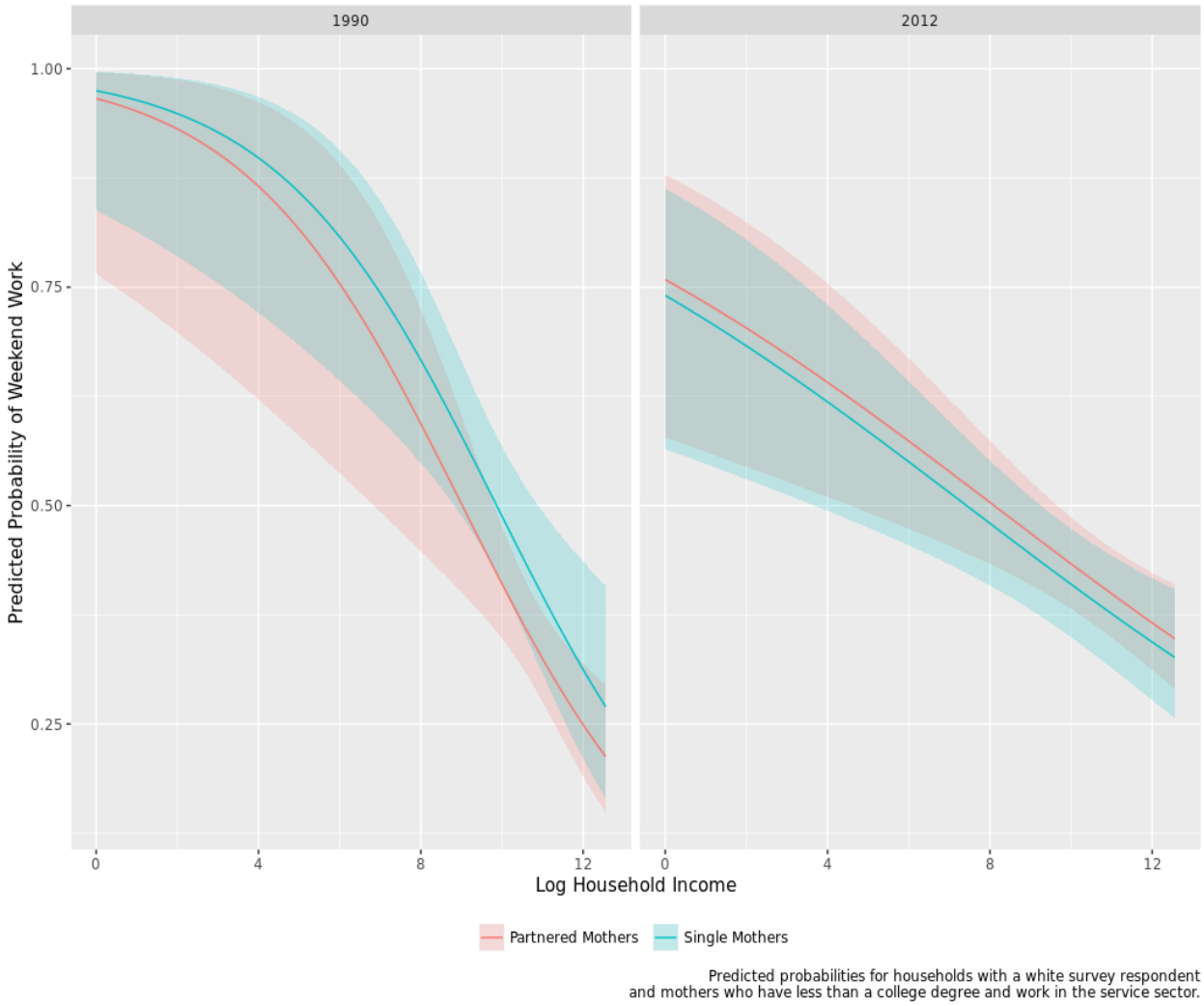

Figure 3. Predicted probabilities of weekend work across the family income distribution, by year and household type.

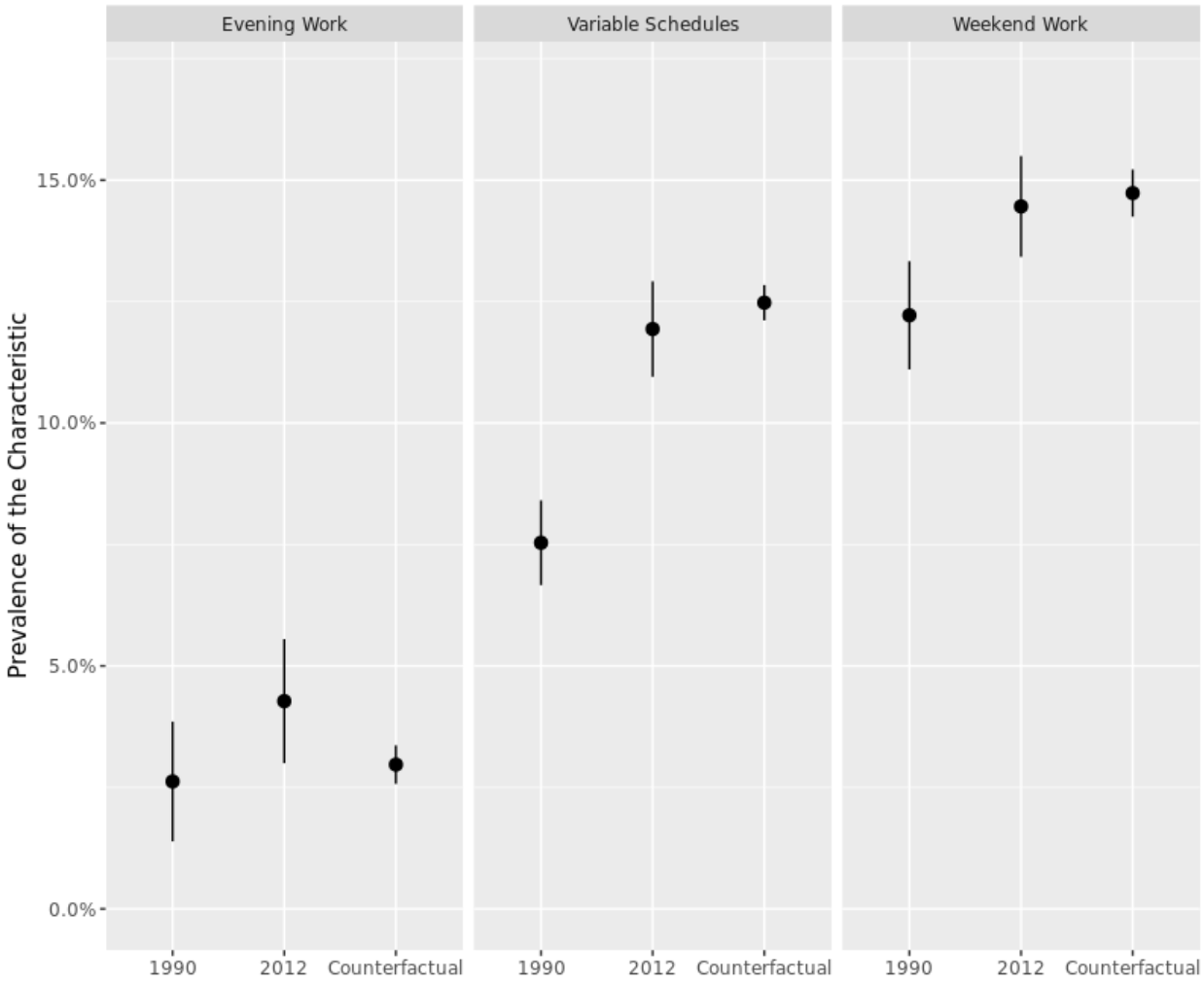

Figure 4. Prevalence of evening work, within-week schedule variability, and weekend work: 1990 and 2012 observed and counterfactual rate applying 2012 associations to the 1990 population.

Methodological Appendix to "Work Scheduling for American Mothers, 1990 and 2012"

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Appendix A: Schedule Data and Analysis

This appendix provides a detailed account of (1) how schedule data were collected in the NCCS and NSECE and (2) how these data were used to develop the maternal schedule typology described in the main text of the paper. The level of detail provided is likely too great for the general reader but should prove helpful for those interested in replicating or extending this study. Most analysis is carried out in R. Sequence analysis is conducted using the TraMineR (Gabadinho, Muller, Ritschard, & Studer, 2015), TraMineRextras (Ritschard, Studer, Gabadinho, Muller, & Rousset, 2015), and WeightedCluster (Studer, 2014) packages; weighted logistic regression is carried out via the survey package (Lumley, 2016); and weighted, non-linear Blinder-Oaxaca decompositions are carried out via the Oaxaca package in Stata.

In the NCCS, the respondent was asked how many jobs they currently work. For each job, starting with the one in which they reported working the most hours in the previous week (Monday through Sunday), they were asked which days they worked in that previous week. The interviewer then asked what time they began and ended working on each of those days. The respondent was allowed to report two shifts per day per job, and reported on up to three jobs. Multiple shifts are rare. For instance, roughly 52.5% of respondents report the start time for a first shift on Monday, but only 0.31% report the start time of a second shift. Likewise, few respondents have multiple jobs. Of the 59.4% of respondents who report paid employment, 92.5% have only a single job. Respondents are then asked an identical set of questions about their spouse or partner, if present in the household.

The NSECE schedule data collection was somewhat more complicated. The respondent was asked if, in the last week, they did any work for pay; attended classes in a high school, college, or university; or attended any courses or training programs intended to help find a job, learn a skill, or learn a job. For each day of the previous week they were then asked if they participated in each of the

reported activities (if any); there was no limit on the number of work, school, or training shifts reported in each day. The respondent was allowed to report that a given day of the week was identical to a previous day–thus reducing respondent burden–but if they did so they were asked a follow-up question confirming that the chosen day was indeed identical to the previously-described day. This set of questions was then repeated for the respondent's partner (if present in the household), any other parent of a child under age 13 in the household, and any other household members who provided more than five hours of childcare in the previous week. Respondent fatigue is a concern because this section comes after a similar, potentially more complex, childcare calendar section of the survey. The survey instrument was programmed to check parental work schedules for duplicated periods and to check against previously-collected childcare schedules for any periods of one hour or more in which children were not reported to be in care and parents were at work, school, or training. In such instances the respondent was prompted for more detail. It does not appear that the NCCS instrument included such checks.

The first difference between these two approaches is in the content of schedules. The NCCS functionally divides time into two categories: work and non-work. The NSECE allows for more states: work, school, training, and unclaimed time. For the sake of comparability, I was forced to collapse the school, training, and unclaimed categories in the NSECE into non-work (henceforth labeled "other").

The second difference is in the number of individuals whose schedules are recorded. In the NCCS, schedules are gathered only for the respondent and the spouse/partner; schedules for additional household members may be collected in the NSECE (if there are additional parents in the household or if other household members provided care in the previous week). Because my focus here is just on maternal schedules, I eliminate all schedules not associated with the focal mother.

Third, as discussed in the main text of the article, respondents to the NSECE were instructed to include time spent commuting to and from the given activity (work, school, or training) as part of the activity itself. There is no way to easily disentangle commuting time from working time, nor any way to confirm whether or not respondents to the surveys systematically followed the prompt to include commuting time. NCCS respondents were not instructed to include commute time in their responses nor does that survey collect data that would allow the analyst to add commuting time on to existing work reports.

Because the introduction of commuting time in the NSECE leads to a basic problem of commensurability with the NCCS, I trimmed working schedules in the former by taking into account three related variables: how far the individual's place of employment is from home (where individual is either the respondent or, as appropriate, the respondent's partner); the urbanicity of the area where the household is located; and whether the household has a car. Working off of American Community Survey numbers, I developed a simple rule to determine how much time to trim from the start and end of working periods. Table

A1 provides the numbers for households with a car; for those without a car I doubled all times. The resulting mean estimated commute among workers is 22.5 minutes, which is close to the 2009 national mean of 25.1 minutes traveled to work (McKenzie & Rapino, 2011).

TABLE A1 HERE

Finally, fourth, data from these two studies are also stored differently. In the NCCS files these data are stored as collected: as start and end times by shift and job. In these NSECE they are stored as 15-minute blocks: each household member for whom a schedule was collected has a vector of 15-minute blocks starting from 12:00-12:14 am Monday and ending with 11:45-11:59 pm Sunday (15-minute blocks over a 7-day week results in 672 entries). Each block can take on one of four values: "work," "school," "training," or "no work/school/training" (essentially an open block). The blocks can also take on a "don't know/refused" status, but this is exceedingly rare, occurring in only 0.04% of all blocks across all schedules collected. I recoded these as open blocks. This states-sequence format is ideal for sequence analysis; I reformatted the NCCS to match. Because shifts in the NCCS were not constrained to 15 minute intervals, I was forced to round starting and ending times to the nearest quarter hour.

As discussed in the main text, I placed four restrictions on the data. First, I limited single-parent households to those headed by a woman. Second, I included only partnered mothers from heterosexual two-partner households. The exclusion was driven by the extremely small number of same-sex couple households available for analysis. Third, I removed male sex-sex two-partner households because they include no mothers. Fourth, for data quality reasons, I removed cases where the mother was listed as having worked the entirety of at least one 24-hour day. Each individual's schedule is stored as a 672-block vector running from 12 am Monday until 11:59 pm Sunday (four 15-minute blocks per hour * 24 hours per day * 7 days per week = 672). I modified both data sets such that each individual had seven day-level (96-block) sequences rather than one week-level (672-block) sequence. Once harmonized, I merged the two datasets. As noted above–and given these restrictions–schedule data were collected from 916 single-mother respondents and from 3,532 mothers in two-partner households in the NCCS. In the NSECE, schedule data were collected from 2,780 single-mother respondents and from 7,590 mothers in two-partner households.

Figure 1 is a sequence index plot that presents, as a set of horizontal bars, a simple visualization of the vectors of work and non-work for six selected person-days. In this case, each of the selected days is a Tuesday; time runs left-to-right from 12 am through 11:59 pm (23:59 military time). The bottom-most individual (individual 1) did no work on this particular Tuesday and thus all 96 of their 15-minute blocks are set to "other." Individual 2, by contrast, worked from 7:45 am to 4 pm (a standard work day, albeit one that both started and ended slightly early). Individual 3 worked an extended standard day, arriving to work at 6 am and staying through to 5 pm. Individual 4 also worked during standard hours, but only three and a half hours total. Individual 5 worked slightly less (two and

a half hours) and in the evening (6-8:30 pm). Finally, the top-most individual shows the classic signs of working the evening/night shift: he or she reports having started work at 12 am (the shift in fact started on Monday evening) and their shift ends at 6 am. They then report work starting back up at 6 pm and running through the end of the day (the shift continues in the Wednesday report).

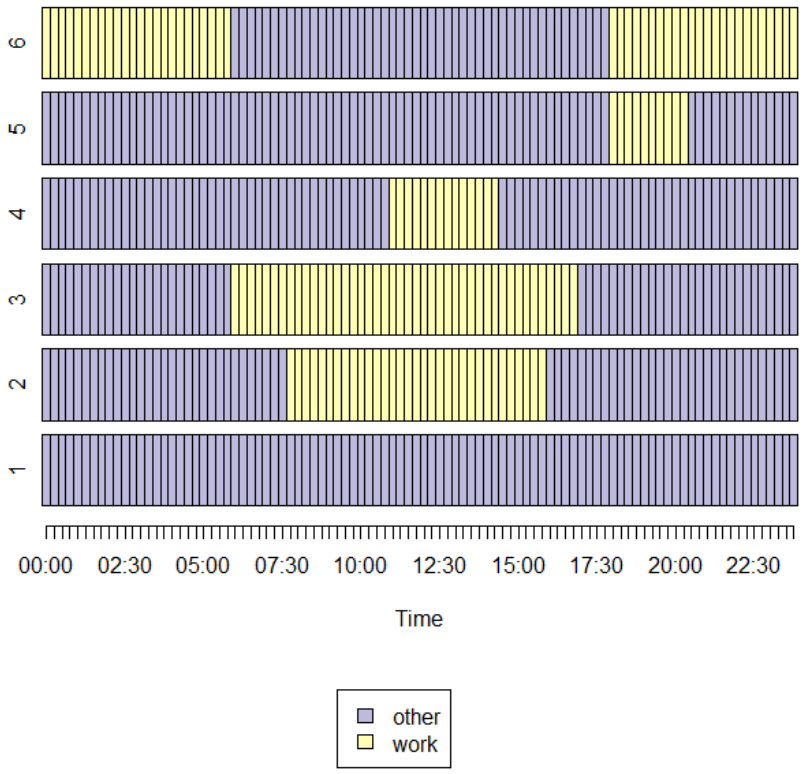

Figure 1: Sequence index plot of six selected Tuesdays.

To analyze these data I made use of a set of sequence and cluster analysis tools. I began by running a variant of Optimal Matching (OM) over all person-day reports from single mothers. OM yields a measure of how dissimilar each sequence is from every other sequence; given n sequences it produces an n x n symmetrical matrix (called a dissimilarity matrix) wherein each (i,j) off-diagonal entry is the dissimilarity between sequence i and j. Functionally, it provides the "cost" of transforming–through insertions, deletions, and substitutions–any one observed

sequence into another observed sequence. More similar sequences cost less to transform into one another whereas such transformation is more "expensive" between dissimilar sequences. The costs associated with each substitution are presented as a substitution-cost matrix which is generated using either theory, intuition, the observed transition rates between the various states, or some combination of those methods (Abbott, 1995; Abbott & Tsay, 2000; Aisenbrey & Fasang, 2010; Elzinga & Studer, 2015). Following Lesnard (2008, 2010; Lesnard & Kan, 2011), I employed Dynamic Hamming Distance (DHD) matching, a variant of OM in which the cost of transitioning between states varies with time. Rather than rely on a single substitution-cost matrix (as in standard OM), there is one for each contiguous pair of blocks. Functionally this means that the cost of substituting "non-work" for "work" at 9 am (when such a transition is relatively common and thus "cheap") will be different than doing so at 9 pm (when the transition is rare and thus "expensive"). DHD matching is well-suited to a time-varying process like employment. It is also worth noting that DHD matching relies solely on substitutions and does not allow insertions or deletions. Given that all sequences in these data are of equal length, this poses no serious problem. In addition to the papers cited above, those interested in the particulars of DHD matching and its use should refer to Lesnard & de Saint Pol (2009); Raab, Fasang, Karhula, & Erola (2014); and Fasang & Raab (2014). To establish the multi-dimensional substitution matrix I relied solely on the transition rates between states at each point in time.

Because of the number of comparisons involved, OM can be a computationally intensive process. To streamline it, I aggregated such that each unique person-day appears only once in the data and weighted these cases according to their frequency. The 103,684 total person-days from single mothers were reduced to 2,369 unique lines; each line represented, on average, 43.8 person-days (minimum of 1, maximum of 67,300). I carried out DHD matching on these unique lines. Because the process took into account the frequency weights associated with each unique sequence, the multi-dimensional substitution cost matrix that resulted was identical regardless of whether it was produced with the full or the aggregated data set.

I used the resulting dissimilarity matrix and employed the non-hierarchical Partitioning Around Medoids (PAM) algorithm to derive clusters from the data. Studer (2013) makes a strong case for PAM, which seeks to maximize a global rather than local criterion, as an alternative to hierarchical clustering. I did, however, test alternative clustering options: Ward's Minimum Variance Method and the Weighted Pair Group Method with Arithmetic Mean (WPGMA, which is advocated by Lesnard (2008)). The former derived very similar clusters with slightly lower average silhouette widths; I used the Ward clusters as the initial medoids in the PAM algorithm. WPGMA, by contrast, yielded lower-quality and often quite sparse clusters.

This process resulted in each person-day being allocated to a cluster; the reader should refer to Figure 1 and associated text in the main text for description of

these day-level clusters. The final selection of clusters involved weighing both fit statistics and the descriptive potential of each additional group. This was, admittedly, a somewhat subjective process, but a necessary one. Adjudicating number of clusters by fit statistics alone would have led to a clearly-inadequate two-cluster solution: workers and non-workers. I attempted to select more clusters where (a) the additional cluster offered a qualitatively new pattern relative to those already selected and (b) the additional cluster did not result in significantly worse average silhouette width across all clusters

I then re-configured the data into a week format; each mother had a sequence of seven days where each day is represented by the cluster to which it was assigned in the previous step. I run a second sequence analysis and clustering exercise, again using the PAM algorithm, across this set of person-week sequences. The end result is to categorize each individual's week. Figure 2 provides state distribution plots that correspond to the seven week-level clusters. As is evident, each week-level cluster is primarily but not exclusively made up of days of the associated type; weekends are particularly likely to be non-working regardless of cluster.

The week-level specification allowed me to observe the extent of variability in schedule type across days. I recorded the total number of different work-type clusters that a given individual falls into over the course of the observed week (i.e., the count of unique clusters omitting the non-work cluster). I marked mothers as experiencing within-week schedule variability if they experienced more than one working schedule over the course of the seven-day sequence. This measure is discussed in greater detail in Methodological Appendix B.

Within each person-week I also calculated how many standard hours (8 am - 5:59 pm, Monday through Friday), nonstandard weekday hours (12 am - 7:59 am; 6 pm - 11:59 pm, Monday through Friday), and weekend hours (at any hour, Saturday and Sunday) each individual works. I also designated each day as either non-working (if no work was reported), part-time (if less than seven hours of work are reported), or full-time (if seven or more hours of work are reported). These measures are used in Table 3.

Finally, it bears noting that the NCCS and NSECE were collected over slightly different calendar periods. The NCCS was collected between October, 1989 and June, 1990; the NSECE was collected between January and June, 2012. In both cases the majority of cases were collected between January and April. I carried out a series of regressions to check whether month of interview was a predictor of week-level schedule cluster. I found no evidence of seasonality in work schedules; results are available upon request.

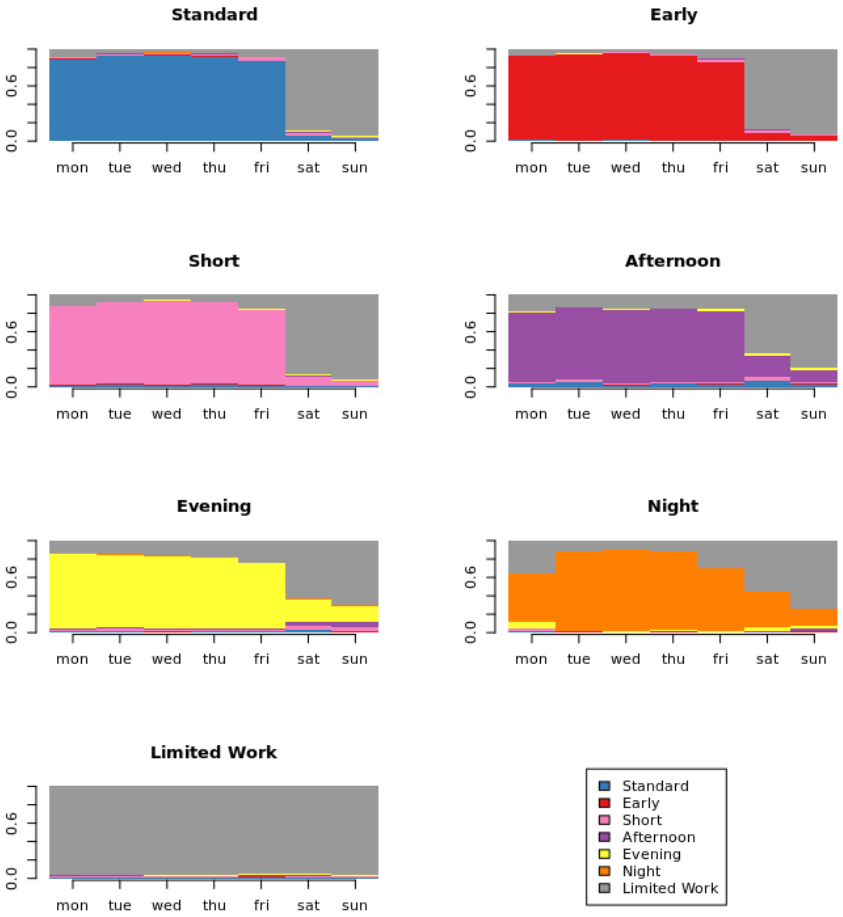

Figure 2: State distribution plot of person-week work schedules.

Appendix B: Schedule Variability

Unstable schedules–those that vary from day-to-day or week-to-week or that may be changed in the course of a shift–have the potential to be more disruptive than nonstandard shifts. A predictable nonstandard shift can be planned for; an unpredictable working schedule may make organizing other arrangements (including childcare) especially problematic (Bohle, Quinlan, Kennedy, & Williamson, 2004; Gerstel & Clawson, 2014; Henly, Shaefer, & Waxman, 2006; Zeytinoglu, Lillevik, Seaton, & Moruz, 2004). In this paper I was unable to offer a measure of schedule instability that captured all four components instability that have been highlighted in the literature: worker control, advance notice, and within- and between-week variability. I was, in fact, able to measure *only* within-week schedule variability: were individuals working the same type of schedules each working day or did their working schedules vary? To do so, I counted the number of unique work-type schedules (omitting non-working days) over the seven observed days. Individuals who took on more than one unique working-type cluster were marked as holding variable schedules. This definition raised two questions. First, how did this measure of within-week schedule variability relate to other components of schedule instability? Second, was this measure driven by part-time employment?

To answer the first question, I explored the relation between within-week schedule variability several questions from the NCCS and NSECE. In both surveys, work schedules were complemented by questions on schedule variability. Unfortunately, these are not the same questions. In the NCCS, respondents were asked (of each job), "Do you usually work the same or fixed hours every week or do your hours vary from week to week, such as rotating from days to evenings or nights?" An equivalent question was asked of their partner's schedule (as appropriate). In the NSECE they were asked, "Did (you/she/he) work (your/his/her) usual schedule last week, is there no usual schedule, or was last week's schedule not the usual one?" These two questions can both be understood as measures of between-week variability. There was an additional question in the NSECE that asks the respondent how far in advance they (or the other individual whose schedule they are describing) usually knew what days and hours they would need to work. Neither survey included any questions on worker control over schedules.

I cross-tabulated within-week schedule variability with mother-specific reports from these three questions. If my measure was indeed capturing something about schedule variability, I expected that those mothers who I categorized as having variable schedules would be more likely to have worked varying schedules (in the NCCS), that they would have had no usual schedule or that last week's would not have been usual (in the NSECE), and that they would have had less advance notice of scheduling (in the NSECE). From the NCCS I developed a variable that indicates whether the respondent reported maternal schedule variability in any job. Results are displayed as column percentages in Table A2.

TABLE A2 HERE

In the NCCS, mothers marked as having within-week schedule variability were far more likely to report between-week variability in hours (40.1% compared to 14.2%). In the NSECE only 24.4% of mothers who I categorized as having within-week stable schedules reported either "No Usual" or an "Unusual" week, whereas 41.1% of those with variable schedules did so. Almost twice as many mothers displaying within-week schedule variability reported having less than a week of advance notice of their schedule (17.2% compared to 9.4%).

These results generally supported the idea that this measure of within-week schedule variability was related, in the expected ways, with other components of schedule instability. Those with within-week variability in their schedules did self-report *more* of the factors that characterize unstable or contingent work than their counterparts with observed stability in schedule. But it was also clear that it would be a mistake to treat within-week variability as a direct proxy for schedule instability. 14.2% of mothers displaying within-week stability in working schedules reported in the NCCS that their working schedules varied from week to week. That sort of between-week variation should be accounted for in measuring instability. At the same time, 59.9% of mothers with within-week variability *did not* report between-week variability. It may not be appropriate to include these significant sub-populations in any analyses of schedule instability.

The second question posed above was whether within-week variability was driven by part-time employment. If this was the case, then the observed increase in within-week schedule variability between 1990 and 2012 may simply have been a function of the across-period growth in part-time employment. To check this possibility, I cross-tabulated weekly working hours (none, less than 35, or 35 hours or more) and within-week variability. The results are in Table A3, split by household type and year, presented as row percentages.

TABLE A3 HERE

Amongst single mothers working some hours in 1990, the difference in within-week variability between part-time and full-time workers was 1.1 percentage points (a non-significant difference according to a weighted chi-square test). By 2012 this gap had grown to 2.8 percentage points and, interestingly, it is full-time workers who demonstrate greater within-week schedule variability.

Partnered mothers working part-time did have significantly higher rates of within-week variability in 1990 relative to their peers working full-time (14.5% compared to 11.0%; p=.036 for a weighted chi-square test). This difference shifted in the 2012 data: here mothers working full-time had significantly higher observed variability (22.4% compared to 18.7%; p=.049). A simple weighted logistic regression model predicting maternal within-week schedule variability in two-partner households on the basis of (1) a dummy variable for survey year (1990 as the reference group), (2) a dummy variable for mother's part-time work (with full-time as the reference group), and (3) the interaction between these two provided some further illumination (results available upon request). Both survey year (being in the 2012 sample) and part-time work status significantly increased

the odds of within-week variability. The interaction, however, is significantly negative, suggesting a weakening of the association between maternal part-time work and schedule variability in such households.

Appendix C: Supplementary Tables and Analyses

Table A4 provides results from the three logistic regression models that underlie Figures 2 and 3 in the main text. The models are presented with the main effects (and significance indicators) in the first two columns; interaction terms (and significance indicators) are in the next two columns. In the main text, average marginal effects based on these models are presented in Figure 2 and predicted probabilities from the third model are presented in Figure 3.

TABLE A4 HERE

The counterfactual standardization exercise that I present in Figure 4 and associated text is, in effect, a simple form of decomposition. I also conducted Blinder-Oaxaca decompositions to assess the relative importance of structural shifts and relational changes in explaining observed differences (Hlavac, 2018; O'Donnell, Doorslaer, Wagstaff, & Lindelow, 2008). In each case the change in the given outcome between 1990 and 2012 was modeled on the basis of the same variables used in logistic regression analysis: mother's occupation; mother's education (a dummy variable indicating a college diploma or higher); respondent's race (a dummy variable indicating that the respondent is non-white); log of family income; and, as appropriate, household type (a dummy variable indicating single mother). Because the dependent variables in these cases were binary (i.e., holding a nonstandard schedule or not), I employed a non-linear extension of Blinder-Oaxaca models using logistic regression and the weighting method outlined by Yun (2004). I calculated two-fold decompositions; the reference coefficients were set, following Jann (2008), using a pooled regression model including group indicator as an additional regressor. Results were substantively equivalent regardless of selected reference category (results available upon request). I computed decompositions based on normalized effects across categorical predictors (Yun, 2005).

Figure 3 presents simplified results from these decompositions. Essentially, these models break the observed differences between 1990 and 2012 rates of the given schedule characteristic into a component attributable to changes in structural characteristics and a component attributable to shifting relationships between characteristics and the given outcome measure. Because of missing values in some of the covariates, the absolute differences in the schedule characteristics modeled in the decompositions does not perfectly match the differences reported in Table 3.

In the top panel, we see that changes between 1990 and 2012 in population characteristics–in the occupational distribution, in educational attainment, in

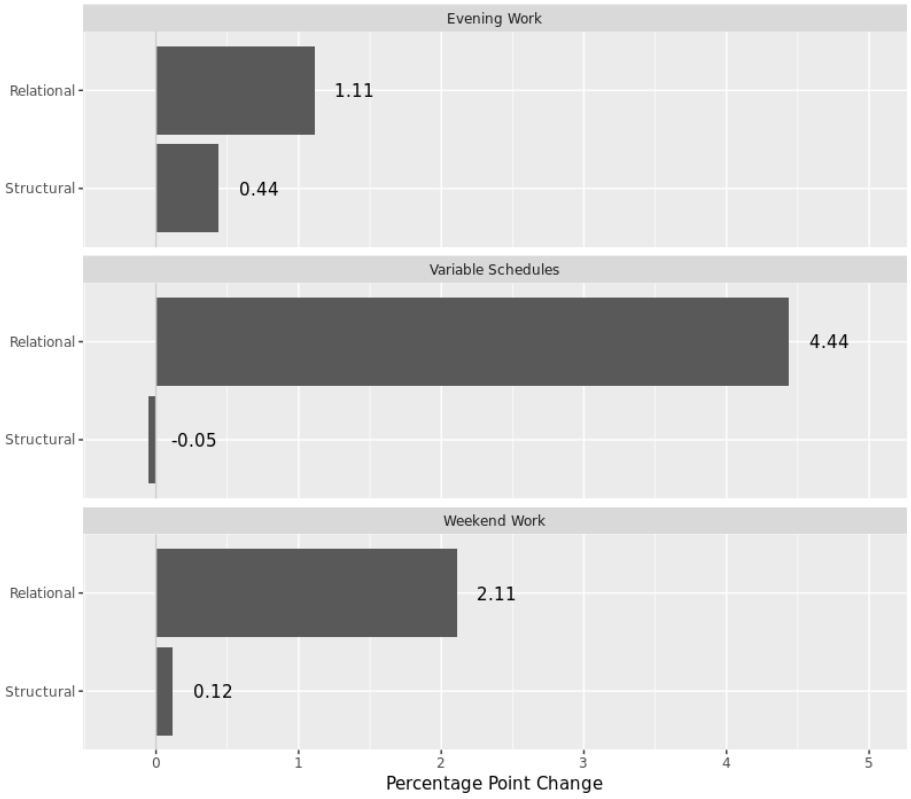

Figure 3: Results from Blinder-Oaxaca Decompositions.

the racial distribution, and in income–would have led, *ceteris paribus*, to a small (0.44 percentage point) increase in single mothers doing evening work. Changes to the relationships between these characteristics and the likelihood of evening work account for the remaining 1.11 percentage points. Put differently, 71.6% of the observed change is accounted for by relational shifts and the remainder by population shifts. The pattern is in the same direction but more stark in the other two panels. The entirety of the increase in within-week variability and 94.6% of the increase in weekend work is due to relational changes. Taken as a whole, these analyses confirm the patterns observed in Figure 4 of the main text.

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Table A1. Summary of Time Trimmed from Working Schedules by Distance to Work and Urbanicity

	High-Density Urban	Moderate-Density Urban	Rural
0 Miles	0 mins	0 mins	0 mins
<3 Miles	15 mins	15 mins	15 mins
3-8 Miles	30 mins	30 mins	30 mins
>8 Miles	45 mins	45 mins	30 mins

Table A2. Observed Work Schedule Variability and NCCS/NSECE Scheduling Questions

	Within-Week Schedule Variability	
	No (%)	Yes (%)
Varying Schedule (NCCS)		
No	85.8	59.9
Yes	14.2	40.1
Usual Schedule (NSECE)		
None	14.8	26.5
Unusual	9.6	14.6
Usual	75.5	58.9
Advance Notice (NSECE)		
<1 Week	9.4	17.2
1-2 Weeks	23.3	27.6
3 Weeks+	67.3	55.3

Table A3. Observed Work Schedule Variability and Hours Worked in the Recorded Week

		Within-Week Schedule Variability	
		No	Yes
Single Mother Households	**Maternal Working Hours (1990)**		
	None (%)	100	0
	<35 (%)	83.7	16.3
	>=35 (%)	84.8	15.2
	Maternal Working Hours (2012)		
	None (%)	100	0
	<35 (%)	80.2	19.8
	>=35 (%)	77.4	22.6
Two-Partner Households	**Maternal Working Hours (1990)**		
	None (%)	100	0
	<35 (%)	85.5	14.5
	>=35 (%)	89	11
	Maternal Working Hours (2012)		
	None (%)	100	0
	<35 (%)	81.3	18.7
	>=35 (%)	77.6	22.4

Table A4. Logistic Regression Models Predicting Work Schedule Characteristics

	Model 1: Evening Schedules (Single Mothers)				Model 2: Variable Schedules (All Mothers)				Model 3: Weekend Work (All Mothers)			
	Main Effect		Interaction w/ Time		Main Effect		Interaction w/ Time		Main Effect		Interaction w/ Time	
	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig	Coef	Sig
2012			0.516				-0.402				-2.028	+
Mother's Occupation												
Administrative (ref)									n/a		n/a	
None recorded	-16.257	***	0.835		-17.489	***	-0.478	*	-18.145	***	-0.068	
Magerial/Professiol	0.839		2.021		0.022		0.179		0.285		-0.219	
Technicians/Support/Sales	-16.468	***	18.696	***	0.819	***	-0.188		0.746	***	0.149	
Service	2.399	**	0.844		1.007	***	-0.555	*	1.147	***	-0.169	
Production/Manufacturing	1.849	*	1.264		-0.017		0.011		0.418	+	-0.039	
Other	1.726	+	-1.6		0.44		-0.329		0.375	+	-0.316	
Mother has College+	0.461		-1.944	+	0.26		-0.533	*	-0.155		-0.294	
Non-White Respondent	-0.433		0.917		-0.647	***	0.326		-0.395	**	0.417	*
Log Income	0.1		-0.147		-0.088		0.125		-0.37	***	0.229	*
Single Mother					0.442	*	-0.402	+	0.313	+	-0.409	*
# Obs	3,570				14,300				14,300			
Weighted	10,600,000				48,400,000				48,400,000			
Pseudo R2	0.226				0.199				0.246			
AIC	830				6,990				8,030			

significance levels: +<.1, *<.05, **<.01, ***<.001