



Improving health and economic security by reducing work schedule uncertainty

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Work schedules in the service sector are routinely unstable and unpredictable, and this unpredictability may have harmful effects on health and economic insecurity. However, because schedule unpredictability often coincides with low wages and other dimensions of poor job quality, the causal effects of unpredictable work schedules are uncertain. Seattle’s Secure Scheduling ordinance, enacted in 2017, mandated greater schedule predictability, providing an opportunity to examine the causal relationship between work scheduling and worker health and economic security. We draw on pre- and postintervention survey data from workers in Seattle and comparison cities to estimate the impacts of this law using a difference-in-differences approach. We find that the law had positive impacts on workers’ schedule predictability and stability and led to increases in workers’ subjective well-being, sleep quality, and economic security. Using the Seattle law as an instrumental variable, we also estimate causal effects of schedule predictability on well-being outcomes. We show that uncertainty about work time has a substantial effect on workers’ well-being, particularly their sleep quality and economic security.

labor | uncertainty | health | job quality

Work is an important social determinant of health (1–4) but working conditions have become significantly more precarious for US workers over the past several decades (5), particularly in the service sector (6). Absent significant new federal legislation, cities and states have passed laws to regulate job quality, most notably by mandating minimum wages in excess of the federal minimum wage (7). However, wages are only one element of job quality. Alongside wages, the temporal dimension of work—namely, the stability and predictability of work schedules—represents a fundamental dimension of job quality that has only recently begun to receive recognition as such (8–10). The city of Seattle and six other cities or states have recently regulated work schedules by passing “fair workweek” laws, which aim to improve working conditions, and potentially workers’ quality of life, by mandating more schedule predictability (11). The Seattle law provides a unique opportunity to learn about the effects of legislating predictability and the causal effects of work schedules on well-being outcomes.

The fair workweek movement has largely targeted the service sector, which employs nearly one in five US workers (12) and where work schedule unpredictability is endemic (6). In the contemporary service sector, workers commonly receive their weekly work schedules only a few days in advance, and their scheduled work hours and workdays often change substantially from week to week (13–17). Precarious scheduling practices have been facilitated by workforce management algorithms that gauge customer flow and sales and allow employers to align staffing levels to closely match consumer demand (18–20). Rather than commit to a set of stable employee schedules, employers seek to maintain as lean staffing as possible by scheduling workers for minimal regular hours, adding shifts at the last minute, asking workers to leave shifts early, and requiring “on-call” shifts (21). Consequently, employees encounter

substantial uncertainty about when and how much they will work.

Such scheduling practices have come to the fore as a public and policy concern in part because research suggests that unstable and unpredictable work scheduling practices are negatively associated with workers’ health and well-being (22). Such scheduling practices appear to interfere with daily routines and cause chronic stress and uncertainty (23, 24) and have negative associations with worker sleep and mental health (16, 17, 25, 26). Prior research also suggests that schedule unpredictability leads to economic insecurity (27–30) and income volatility (31, 32). However, because these precarious scheduling practices go hand-in-hand with low hourly wages, high turnover, and limited economic mobility (6), disentangling the causal effects of precarious work schedules on worker well-being has been a challenge.

Seattle’s Secure Scheduling ordinance, implemented in 2017, provides the opportunity to generate causal estimates of the relationship between schedule predictability and worker well-being. The ordinance generated a localized exogenous shock to schedule unpredictability, which affected workers employed in the service sector within Seattle city limits but left other workers unaffected. This ordinance aims to increase schedule predictability by requiring 2 wk of advance notice and requiring employers to pay predictability pay for schedule changes. The law also requires extra pay for closely spaced shifts that do not allow at least 10 h of rest in between. The law covers hourly workers

Significance

Alongside wages, work schedules are a fundamental component of job quality, yet work schedules are largely unregulated in the US labor market. In 2017, Seattle became the second large US city to pass fair workweek legislation. Seattle’s Secure Scheduling ordinance aims to increase schedule predictability by requiring employers to provide 2 wk notice of work schedules, among other provisions. Our paper shows that Seattle’s law not only increased schedule predictability but also improved subjective well-being, sleep quality, and economic security. The law had no effect on reports of psychological distress. Using the natural experiment afforded by Seattle’s fair workweek law, we provide causal evidence that uncertainty about work time has harmful effects on worker happiness, sleep quality, and material hardship.

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employed by large retail and food service industries, defined as employers with at least 500 employees worldwide (33).

Although Seattle and several other localities have passed fair workweek laws between 2015 and 2019, the research to date on these laws is quite limited. In 2018, Oregon became the first US state to implement a secure scheduling law. In an in-depth interview study of 75 hourly workers in Oregon conducted after the law went into effect, workers reported that employers were offering more advanced notice of schedules and allowing more time to rest between consecutive closing and opening shifts but that schedules still changed on short notice without compensation (34). In Seattle, a short-term impact study and a manager study found that the law had some of its intended effects on scheduling, but the study did not provide information about downstream effects on worker well-being (35).

In the absence of evidence on the effects of fair workweek legislation, an employer-based intervention provides the best evidence to date that intervening to stabilize work schedules improves worker well-being. In a study of The Gap, an apparel retailer, researchers randomly assigned some stores to an intervention that increased schedule predictability and stability. The Gap study found that employees experienced greater consistency, predictability, and control of their schedules as well as improved sleep quality (26). These results align with findings from observational studies showing that retail and food service workers exposed to unstable and unpredictable schedules, including short advance notice and on-call shifts, reported lower overall sleep quality (16, 25).

Overall, the evidence base is quite limited on how legislative interventions affect the predictability of work schedules and whether interventions improve the lives of workers. This question is of great policy importance, as a growing number of states and localities consider fair workweek legislation, often in the face of resistance from the business community (6), and as the Federal Schedules that Work Act proposes a similar set of scheduling regulations nationally (36). Our research fills this gap in data and estimation by providing evaluation results from one of the first governmental efforts to regulate these unstable and unpredictable scheduling practices. We estimate the effects of Seattle's Secure Scheduling ordinance on scheduling outcomes, and use the local fair workweek policy change to estimate causal effects of schedules on health and well-being outcomes.

Work scheduling conditions are not measured in standard social science data sets such as the Current Population Survey or in administrative data. To fill this gap, we use a survey approach that allows us to target workers at the large retail firms covered by the ordinance in Seattle and at the same firms in comparison cities around the country, collected before and after the implementation of the ordinance. We use a difference-in-differences research design to estimate the effects of the law on work schedules and well-being outcomes. We find that the law led to significant improvements not only in stabilizing work schedules but also on multiple dimensions of workers' well-being. We also leverage the law as an instrumental variable to estimate causal effects of schedule predictability on health and economic security outcomes. Here, we find that schedule predictability improves workers' subjective well-being, sleep quality, and economic security.

Data and Methods

The Seattle ordinance covers hourly workers at large firms in the retail and food service subsectors employed within Seattle city limits. To evaluate the effects of the Secure Scheduling ordinance on workers' schedules, our research team compiled a list of employers that would be covered by the ordinance, then

harnessed the advertising infrastructure of Facebook and Instagram to deliver targeted advertisements to workers employed by the particular retail, food service, or casual dining establishments covered by the ordinance. These advertisements invited workers to our online survey, which was designed to capture key scheduling outcomes. Details on the Facebook-targeted advertising platform and data collection process are explained in the *SI Appendix*, and further details on data collection and validation are published separately (37). The research was approved by UC Berkeley's (IRB#2015-10-8014) and Harvard's (IRB#20-0877) Institutional Review Boards, and digital informed consent was obtained from all survey respondents. An anonymized data file and the analysis code to replicate our results are available from Harvard's Dataverse repository.

We focus our data collection and limit our sample to workers paid by the hour and to workers employed by a large retail or food service establishment that falls under the coverage of the Secure Scheduling ordinance. Our survey instrument asked workers to self-report whether their workplace was within Seattle city limits. We determine whether an employer is covered by the ordinance by cross-referencing the named employer against a list of covered employers assembled from City Business Records, Hoovers data, and data from the Reference USA Database.

Treatment Group. Those who reported working in Seattle and whose employers were of the size and type that would be covered by the Secure Scheduling ordinance constitute the "Seattle treatment group." Our sample includes 754 covered workers in Seattle at baseline, 747 Seattle workers surveyed in the first year of implementation, and 441 Seattle workers surveyed in the second year after the law took effect. Because turnover in the service sector is very high (6), we sought to reinterview baseline respondents but also replenished the sample at each subsequent wave. The workers in the first- and second-year surveys included a new cross section of workers employed by covered retail and food service employers and some workers who responded to a previous survey. All of our analyses adjust SEs to account for the nonindependence of observations for those surveyed more than once.

Comparison Group. The comparison group consists of workers employed by the exact same set of companies, all large multi-state employers, that were covered by the Seattle law but were employed in other large US cities. We restricted comparison cities to those that have a minimum wage that is higher than the federal minimum wage to align with Seattle's progressive labor policy environment. We only include metropolitan areas with at least 1 million people so as to compare Seattle workers to those in other large urban areas. The comparison group consists of a pooled sample of workers in the 24 metropolitan areas that met those criteria: Baltimore, Boston, Buffalo, Chicago, Cleveland, Columbus, Denver, Detroit, Hartford, Jacksonville, Las Vegas, Los Angeles, Miami, Minneapolis-St. Paul, Orlando, Phoenix, Providence, Riverside, Rochester, Sacramento, San Diego, St. Louis, Tampa, and Washington, DC. The comparison sample includes 5,394 workers at baseline, 7,734 workers in the first year of follow-up, and 2,619 workers in the second year of follow-up.

Table 1 shows that the Seattle and comparison workers are similar in their work schedule attributes at baseline. Seattle workers and those in comparison cities averaged around 2.8 out of 6 possible types of schedule unpredictability. Workers in comparison cities were more likely than Seattle workers to report working back-to-back closing then opening (clopening) shifts. Seattle workers and those in comparison cities were well matched at baseline on well-being indicators. Our difference-in-differences research design addresses baseline differences

Table 1. Baseline work schedule and well-being outcomes for workers in Seattle and comparison cities

	Seattle (%) or mean	Comparison cities (%) or mean
Work schedules		
Unpred. scale (0 to 6)	2.79	2.85
Less than 2 wks' notice	57	55
Last-minute change	76	74
Change without pay	70	68
Clopening	37	44**
On-call	26	27
Cancel without pay	14	16
Well-being indicators		
Happiness	76	75
Psychological distress	30	31
Good sleep	30	32
Any material hardship	60	58
N	754	5,394

Mean values and percentages are regression-adjusted to control for demographics (age, race/ethnicity, sex, educational attainment, school enrollment, marital status, and parental status) and work characteristics (managerial status, job tenure, and industry subsector).

Statistically significant differences between groups are indicated by ** $P < 0.01$.

between Seattle and comparison group workers by design, given that we are comparing changes over time for Seattle workers to changes over time for workers in comparison cities.

The Seattle and comparison samples are also closely aligned on their demographic characteristics at baseline (*SI Appendix, Table S2*). All of our model estimates control for individual-level demographic, socioeconomic, and job characteristics. As a robustness check, we also estimate a separate set of difference-in-difference models using samples of Seattle workers and workers in comparison cities who are matched on educational attainment, school enrollment, job tenure, industry subsector, age, race, gender, parenthood, and marital status using propensity score matching (for further details, see the *SI Appendix*).

The data for this study are from a nonprobability sample and as such may differ from the broader population of workers in Seattle and comparison cities. When we compare our sample characteristics to workers in the American Community Survey, we see that our sample resembles the broader population of service sector workers in terms of age and educational attainment but that our sample is disproportionately female and White, non-Hispanic. To align our sample with the broader population of workers, we construct and apply survey weights, drawing on data from the American Community Survey. We describe the construction of these weights in the *SI Appendix* along with our multiple imputation approach for addressing missing values due to item nonresponse.

Schedule Unpredictability Measures. The Seattle law contained a complex set of scheduling provisions designed to regulate aspects of job quality that are not reported on by workers in any existing large-scale data set (such as the Current Population Survey or American Community Survey) or in administrative data. A key innovation of our approach is to field a survey questionnaire that was tailored to align with the provisions of the Secure Scheduling ordinance. We focus here on six work schedule measures that were regulated by the Secure Scheduling ordinance, given our aim of estimating causal effects of schedule predictability on well-being outcomes. The six schedule measures are 1) short notice of work schedules (less than 2

wk), 2) last-minute schedule changes, 3) last-minute scheduling changes without pay, 4) working back-to-back closing then opening shifts, 5) being asked to be on-call for work, and 6) shift cancellations without pay. We sum these six measures of schedule unpredictability into a scale ranging from 0 to 6 types of schedule unpredictability. Our analysis first estimates the impacts of Seattle's fair workweek legislation on these measures of schedule unpredictability. Then, we estimate the effect of this unpredictability on well-being outcomes by using the Securing Scheduling Ordinance as an instrumental variable that parcels out endogeneity in a two-stage least squares analysis.

Well-Being Measures. We also examine four self-reported measures of worker well-being: happiness (very or pretty happy), sleep quality (good or very good), psychological distress (frequently feeling sad, restless, nervous, hopeless, that everything was an effort, and worthless), and experience of one or more material hardships from among six types of hardship related to hunger or food insecurity, housing instability, difficulty paying bills, and deferring needed medical care.

Difference-in-Differences Analytic Approach. The survey data, collected from workers before and after the ordinance took effect in Seattle and in comparison cities, allow us to estimate the ordinance's effects using a difference-in-differences approach. We compare changes over time for workers at the large companies covered by law in Seattle with the changes for workers at the same companies that are not affected because they work in other cities without fair workweek laws in place. In particular, we estimate the change in outcomes between baseline and follow-up for Seattle workers (the first difference) after parceling out any change in outcomes over the same period for workers in comparison cities (the second difference). The estimation approach is displayed in Eq. 1.

$$Y_{it} = \alpha + \beta X_{it} + \gamma Seattle_{it} + \delta YearOne + \mu Seattle_{it} YearOne + \pi YearTwo + \rho Seattle_{it} YearTwo + \varepsilon_{it} \quad [1]$$

where Y is an outcome of interest for individual i at time t (where time t is either baseline, year 1, or year 2); X represents a vector of individual-level control variables; $Seattle$ is a dummy variable that is 1 for "Seattle treatment group" and 0 for "Comparison group" workers; $YearOne$ is 1 for the year one follow-up period and 0 otherwise; $YearTwo$ is 1 for the year two follow-up period and 0 otherwise; $Seattle_{it} YearOne$ and $Seattle_{it} YearTwo$ are interaction terms that are 1 for treatment group members when the ordinance was in effect in year 1 and year 2, respectively, and 0 otherwise. The terms of interest are the μ and ρ coefficients, which represent the effect of the fair workweek law on outcome Y after 1 and 2 y following implementation.

The difference-in-differences models assume the trends in outcomes are parallel in the treatment and comparison groups prior to the intervention and would continue on a parallel trend were it not for the intervention. Because schedule unpredictability data are not available in historic survey or administrative data, we do not have pretrend data available. However, the large national sample from the Shift Project demonstrates that, in the absence of a legislative change regulating work schedules, workers in the retail and food service sectors reported a high and steady level of schedule unpredictability from Spring 2017 through Spring 2019. Examining survey reports from service sector workers in localities without scheduling legislation, we find that levels of schedule unpredictability remain uniform over time in the absence of a legislative intervention. In particular, *SI Appendix, Fig. S2* shows that on the summative scale of schedule unpredictability ranging from 0 to 6, the average worker reports about 2.8 types of schedule unpredictability and that level remains stable across three points in time: spring of

2017, 2018, and 2019. In all, a key strength of our approach is that we ensure significant homogeneity in the comparison and treatment samples by design (38). By focusing on large multi-state employers who have substantial homogeneity in their scheduling practices across geography absent regulation, we impose substantial constraints on the possibility of unobserved heterogeneity. In contrast, prior literature on minimum wage effects (39, 40) or on paid sick leave (41) lack firm-identified information and so must pool across many very different employers by geography. Notably, our design is most similar to the canonical minimum wage study by Card and Krueger (42) that similarly constrained the comparison and treatment samples to the same employers.

Using the difference-in-differences approach, we assess whether the “treated” group—workers in Seattle covered by the Secure Scheduling legislation—experienced significantly greater changes in outcomes between baseline and follow-up compared with comparison nontreated groups. We estimate these difference-in-differences models using linear probability models for dichotomous outcomes. Linear probability models were chosen for their ease of interpretation and have been found to generate results that closely align with marginal effects from probit and tobit models (43).

We control for a set of demographic characteristics including age, race/ethnicity, sex, educational attainment, school enrollment, marital status, and presence of children in the household. We also control for job tenure, managerial status, and industry subsector (retail apparel, cafe, casual dining, department or big box store, fast food, grocery, hardware, health and beauty, and miscellaneous retail). We adjust SEs to account for repeat observations of respondents.

Instrumental Variables Analytic Approach. The Seattle policy change represented an exogenous shock to work schedules that we exploit to examine the causal effects of schedules on well-being outcomes in an instrumental variables framework. We combine the bundle of scheduling conditions that were affected by the Secure Scheduling ordinance into a “schedule unpredictability scale” that ranges from 0 to 6 types of unpredictability. In the first stage, we treat working in Seattle after the fair workweek law went into effect as the exogenous treatment, which we use to predict the endogenous schedule unpredictability scale (Eq. 2). In the second stage, we use the predicted value for the schedule unpredictability scale, now purged of endogeneity, to predict well-being outcomes (Eq. 3).

$$\begin{aligned} Sched_{it} = & \alpha + \beta X_{it} + \gamma Seattle_{it} + \delta YearOne + \mu Seattle_{it} YearOne \\ & + \pi YearTwo + \rho Seattle_{it} YearTwo + \varepsilon_{it} \end{aligned} \quad [2]$$

$$Y_{it} = \alpha + \beta X_{it} + \gamma Seattle_{it} + \delta YearOne + \pi YearTwo + \rho \hat{Sched}_{it} \quad [3]$$

The first stage estimation uses ordinary least squares (OLS) regression, and the second stage estimates a probit model for each of a set of dichotomous dependent variables. We estimate these models in Stata 16 using the `ivprobit` command. We then use the model estimates from Eq. 3 to predict well-being outcomes under two scenarios: with the unpredictable schedule scale set to its average value of 3 of 6 types of unpredictability and with the scale set to 0 of 6 types of unpredictability. These estimates are generated using Stata’s margins postestimation command to simulate the difference between observed average baseline unpredictability and hypothetical elimination of unpredictability.

The instrumental variables approach relies on two key assumptions (44). First, the treatment—exposure to the Seattle Secure Scheduling ordinance—must be strongly predictive of the endogenous predictor: schedule unpredictability. Indeed,

the F-statistic measuring the strength of the relationship between treatment and the endogenous scheduling scale is 17.1, above the conventional, acceptable threshold (45). Second, the exclusion restriction requires that the Seattle law treatment influence well-being outcomes only via the endogenous schedule unpredictability scale and not through other channels. By bundling all six scheduling features together rather than examining each measure individually, we avoid the risk of violating the exclusion restriction because the omitted scheduling features would represent an alternative avenue through which the fair workweek law treatment could have influenced outcomes. The law may have influenced outcomes not only by mandating schedule predictability but also by changing the composition of the workforce in Seattle relative to comparison cities, perhaps by retaining workers or attracting new workers. We find that the law did not change the sex, race/ethnic composition, or educational attainment of workers. The law did lead to a slightly younger workforce with slightly less job tenure compared with workers in comparison cities. Because younger workers with short job tenure have lower well-being than their counterparts, these small compositional changes will bias our causal estimates downward.

Effects of a Fair Workweek Ordinance on Work Schedules and Well-Being. In Seattle, service sector workers experienced a similar level of schedule unpredictability in the spring of 2017 as workers elsewhere before the Secure Scheduling ordinance took effect. Before the legislation went into effect, workers in Seattle and other cities reported an average of nearly 3 out of a possible 6 types of schedule unpredictability. After the legislation went into effect, workers in other cities continued to experience the same levels of schedule unpredictability, but Seattle workers experienced a 0.50-point reduction in unpredictability (an 18% reduction). These results are shown in Fig. 1A.

Fig. 1B displays the impacts that the Secure Scheduling ordinance had on the six specific types of schedule unpredictability that are summed into the unpredictability scale. The Secure Scheduling ordinance stipulated that workers should receive at least 2 wk notice of their schedule. The ordinance increased the share of workers who received at least 2 wk notice of their work schedules by 11 percentage points. Before the law went into effect, 57% of Seattle workers received less than 2 wk schedule notice (Table 1) and that share had declined by 11 percentage points by Year 2 (Fig. 1B). Meanwhile, in comparison cities, the share who received less than 2 wk notice was 55% at baseline (Table 1) and remained the same in Year 2 (Fig. 1B). The difference between the change for Seattle workers (11 percentage points) and the change for workers in other cities (0 percentage points) is the 11 percentage-point impact estimate.

The ordinance generated a large impact on last-minute shift changes without pay. This practice decreased by 19 percentage points for Seattle workers in 2019 compared with the period in 2017 before the law went into effect. Over that same time period, this practice decreased by 6 percentage points for workers in other cities. Thus, we estimate that the net impact of the law was 13 percentage points (19 percentage points minus 6 percentage points).

The Secure Scheduling ordinance was associated with modest declines in on-call shifts (7 p.p., $P \leq 0.07$), back-to-back closing then opening (clopening) shifts (6 p.p., $P = 0.09$), and in cancelled shifts without pay (3 p.p., $P = 0.23$). Seattle workers experienced slight reductions in each of these work conditions, whereas workers in comparison cities reported a slight increase in these conditions.

Our estimates treat the passage and implementation of the Secure Scheduling ordinance as exogenous. However, the factors that shape city selection into legislative action could confound the effects we estimate. We propose a strategy to test this potential source of bias. We re-estimate our models,

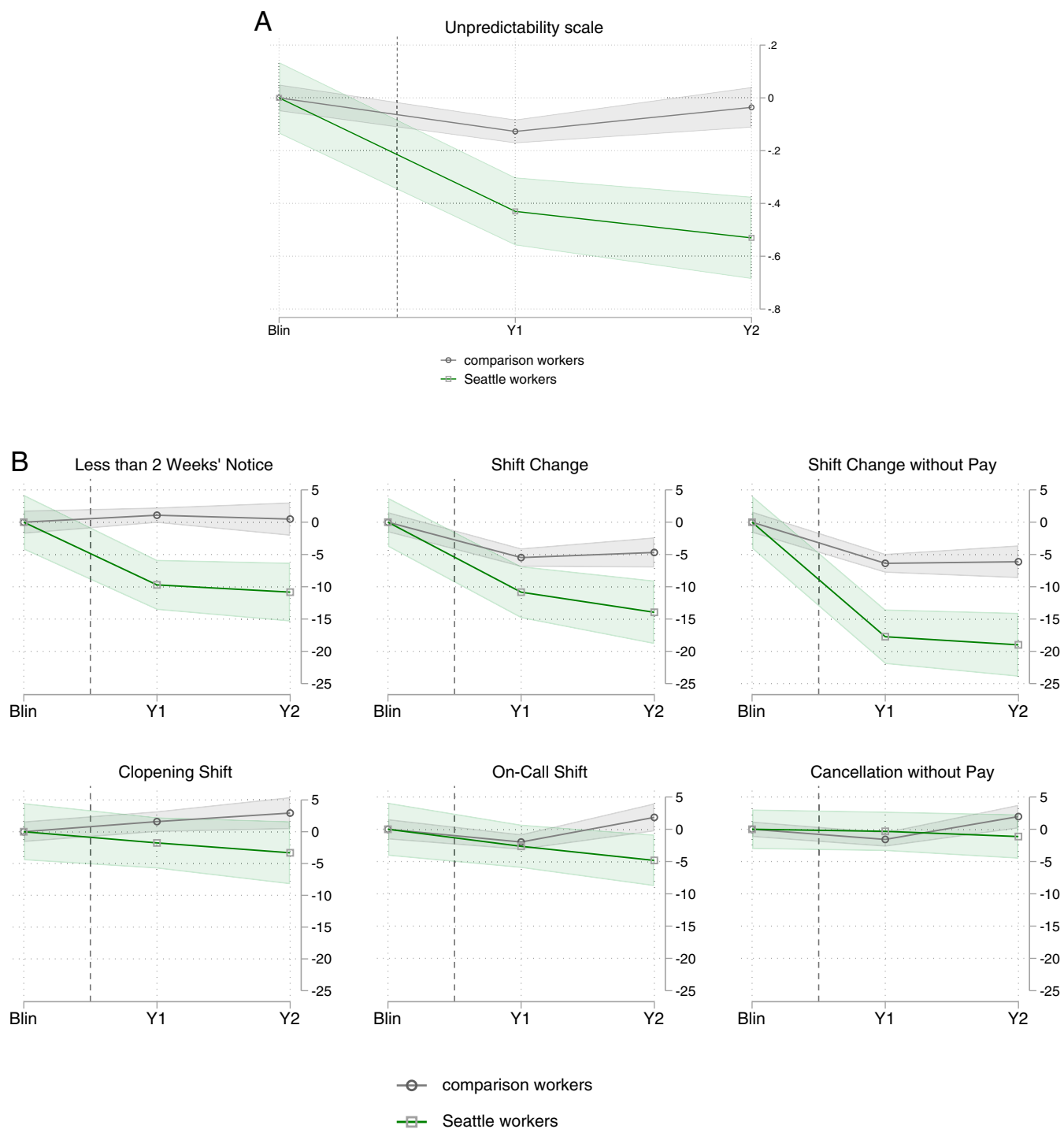


Fig. 1. (A) Impacts of Seattle's Secure Scheduling ordinance on work schedule unpredictability scale (0 to 6). (B) Impacts of Seattle's Secure Scheduling ordinance on work schedules. For Figs. 1 A and B and 2, baseline values are set at zero. Y1 and Y2 values are the difference-in-differences estimates, which represent changes relative to baseline for Seattle and comparison workers. Estimates are regression-adjusted to control for demographics (age, race/ethnicity, sex, educational attainment, school enrollment, marital status, parental status) and work characteristics (managerial status, job tenure and industry subsector). The 95% confidence intervals are indicated by green shading for Seattle workers and gray shading for comparison workers. Dashed vertical line indicates when the Secure Scheduling ordinance went into effect.

comparing Seattle workers to their counterparts in cities or states that had considered scheduling legislation but had not yet enacted it. As shown in the *SI Appendix, Table S3*, we find very similar results with this alternative estimation.

We also compare Seattle workers to their counterparts who worked just outside of Seattle city limits. Here, we find

somewhat smaller impacts on schedule unpredictability. One reason for this attenuation could be that the effects of Seattle's ordinance spilled over to affect workers in the surrounding area.

The *SI Appendix, Table S3* contains the difference-in-differences estimates (the coefficients on the interaction of Seattle

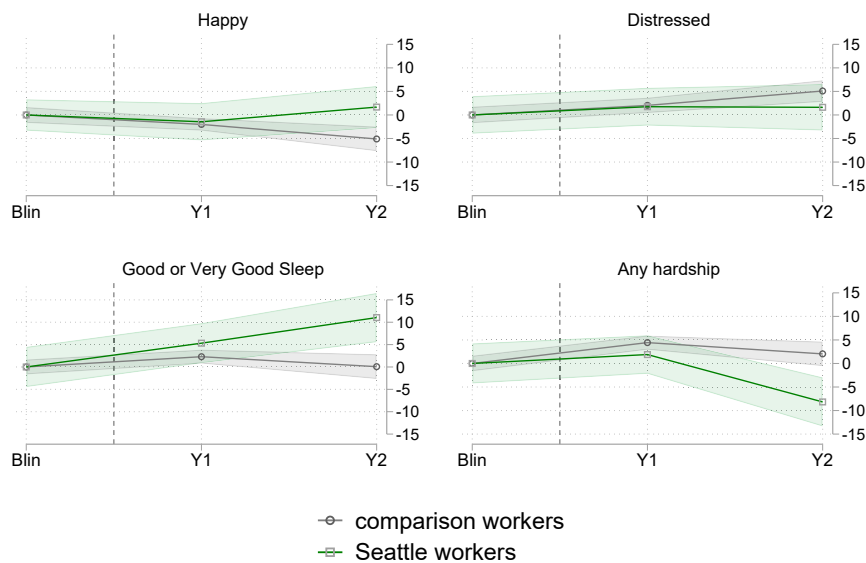


Fig. 2. Impacts of Seattle's Secure Scheduling ordinance on worker well-being. See Fig. 1A for notes.

worker \times postordinance period) for each scheduling dependent variable for each of the four comparison groups. This appendix table also contains results from a fifth comparison group derived using propensity score matching to closely align background characteristics between Seattle and the matched comparison group without applying survey weights. The impact estimates on scheduling outcomes derived from each of the five comparison groups are similar (*SI Appendix, Table S3*).

Although the central aims of the Secure Scheduling ordinance were related to work scheduling practices, by increasing schedule predictability the ordinance also had positive effects on workers' well-being.

Fig. 2 shows the trends in levels of happiness for Seattle workers and workers in comparison cities. Reported happiness was similar for workers in Seattle and in comparison cities before the ordinance went into effect (Table 1). Happiness levels slightly improved for Seattle workers after the law took effect and declined for workers in comparison cities. On net, the law was associated with a 7 percentage point increase in happiness for Seattle workers relative to their counterparts (Fig. 2 and *SI Appendix, Table S4*). The ordinance did not have a statistically significant effect on Seattle workers' reports of psychological distress.

The ordinance also led to improvements in sleep quality for Seattle workers. The impact estimate was an 11 percentage point increase in "good" or "very good" sleep quality as opposed to "fair" or "poor" sleep quality. This positive impact

came about largely because reported sleep quality improved over time for Seattle workers while it stayed the same over time for workers in comparison cities.

The Secure Scheduling ordinance led to a 10 percentage-point decrease in reports of at least one of the material hardships described previously, such as food or housing insecurity. This improvement was driven by a reduction in hardships for Seattle workers and stability in hardships over time for workers in comparison cities.

In the *SI Appendix, Table S4*, we show that these results were consistent across most alternative comparison groups but somewhat weaker for the comparison group comprised of workers employed near Seattle but outside of city limits, which, as discussed previously, could reflect spillover effects of the ordinance.

Causal Estimates of the Effects of Schedule Predictability on Well-Being Outcomes. The legislative change in Seattle provides an opportunity to estimate the causal effects of precarious work schedules on well-being outcomes using an instrumental variables approach. We generate causal estimates of the relationship between schedule unpredictability and well-being outcomes, using the Seattle Secure Scheduling ordinance as an instrumental variable. Table 2 contains probit coefficients from the second stage of the two-stage least squares modeling. The Table 2 estimates imply that increases in the number of types of schedule unpredictability cause statistically significant reductions in sleep

Table 2. Two-stage least squares estimates of causal effects of schedule unpredictability scale on well-being outcomes ($n = 17,689$)

	Happiness	Psychological distress	Good sleep	Any material hardship
Second stage				
Unpred. coef.	-0.33+	0.14	-0.46**	0.44**
Unpred. std. error	(0.19)	(0.22)	(0.15)	(0.14)
First stage				
F-statistic	17.1	17.1	17.1	17.1

Probit coefficients from the second stage of Two-Stage Least Squares Models and (SEs) shown. Models include controls for age, race/ethnicity, sex, education, school enrollment, marital status, parental status, managerial status, job tenure, and industry subsector. Working in Seattle after the Secure Scheduling ordinance took effect is the instrumental variable, and the schedule unpredictability scale is the endogenous predictor.

+ $P < 0.10$; ** $P < 0.01$.

Table 3. Predicted values for well-being outcomes for workers with average unpredictability or simulated elimination of unpredictability ($n = 17,689$)

	Predicted values	
	Actual 3 of 6 types Unpredictability	Simulated 0 of 6 types Unpredictability
Happiness (%)	0.68 (0.05)	0.92 ⁺ (0.07)
Distress (%)	n.s.	n.s.
Good sleep (%)	0.31 (0.01)	0.80** (0.13)
Hardship (%)	0.64 (0.01)	0.19** (0.11)

Predicted values are generated with control variables set to their means. SEs appear in parentheses. The 3 of 6 types of schedule unpredictability is the average observed level of schedule unpredictability. The 0 of 6 types of schedule unpredictability simulates elimination of schedule unpredictability.

n.s., estimated relationship was not statistically significant.

+ $P < 0.10$; ** $P < 0.01$.

quality and increase the share of workers experiencing at least one material hardship. Schedule unpredictability was associated with a reduction in happiness, but this relationship fell short of statistical significance ($P = 0.08$). Schedule unpredictability does not appear to increase psychological distress.

Table 3 draws on the two-stage least squares estimates and generates predicted values for the well-being outcomes for workers with an average level of schedule unpredictability and then simulates the expected level of well-being outcomes if schedule unpredictability were eliminated. The Table 3 estimates suggest that eliminating schedule unpredictability would improve happiness by 24 percentage points (from 68 to 92%), although this result should be interpreted with caution given that the IV estimate fell short of statistical significance ($P = 0.08$). The models also estimate large effects on sleep quality and material hardship. Eliminating all forms of schedule unpredictability would increase the share of workers reporting good or very good sleep quality by 49 percentage points (from 31 to 80%). The models also predict large reductions in the experience of at least one material hardship. Eliminating schedule unpredictability would reduce the share of workers experiencing at least one material hardship by 45 percentage points (from 64 to 19%).

Discussion

In 2017, Seattle became the second large US city to pass legislation aimed at increasing the predictability of work schedules for hourly workers employed in the retail and food service sectors and the first to include a rigorous evaluation of the effects of the legislation on workers' schedule experiences and well-being outcomes. We find that the Seattle ordinance worked as intended to increase work schedule predictability and induced positive downstream improvements in workers' subjective well-being, sleep, and economic security. These findings are significant, given that fair workweek laws have not been rigorously evaluated previously. We provide evidence that these laws can have a positive effect for workers, not only in terms of work schedule conditions but also in their quality of life.

However, while the Secure Scheduling ordinance provided workers with greater schedule stability and predictability, we also find that compliance with the provisions of the ordinance

was far from universal. For instance, while the ordinance caused significant increases in the share of workers getting at least 2 wk notice of their work schedules (an 11-percentage-point increase), that still left over 40% of covered workers reporting less than 2 wk notice 2 y after the law took effect. Seattle's Office of Labor Standards has led the way in developing an innovative model of enforcement (46), but there is still substantial work needed to ensure full compliance with the ordinance.

In addition to providing estimates of the efficacy of a fair work week law, we also make a contribution to the literature on the effects of precarious working conditions generally, and of unstable and unpredictable scheduling conditions more specifically, on workers' health and well-being. While prior research has used observational designs to estimate the association between work scheduling and well-being (16, 17), we provide quasiexperimental estimates of the effects of unstable and unpredictable work schedules on workers' well-being, finding that reducing such practices significantly increases workers' sleep quality and economic security and may also positively affect happiness.

These evaluation results are based on positive changes for Seattle workers that were observed as of the spring of 2019. Since that time, the retail and food service sectors have experienced an enormous shock as the coronavirus outbreak upended life and commerce in Seattle and across the United States. Business and working conditions have changed fundamentally since 2019. Some restaurants and retail businesses closed temporarily or permanently, and many workers have experienced layoffs. For those workers who have managed to remain employed during the pandemic, work schedule stability and predictability take on heightened importance as other aspects of home life have become more complex, for instance, because of closures of many in-person schools and care settings. The stress that comes along with schedule uncertainty may be exacerbated in the context of day-to-day uncertainty and stress related to the pandemic and the economy.

Although the coronavirus outbreak has taken a heavy toll on workers in the retail and food service sector, it has also prompted a growing appreciation that service sector work is essential for meeting our basic needs. As many workplaces were required to close down for safety reasons and only essential businesses could remain open, grocery store workers and those employed in pharmacy and delivery sectors took their place alongside health care workers as part of the essential workforce. With this heightened appreciation may come a reassessment of job conditions in the service sector, for which the evaluation of the Secure Scheduling ordinance in Seattle can be instructive. Fair workweek legislation like the Secure Scheduling ordinance can be effective in increasing schedule predictability and improving worker well-being.

Data Availability. Anonymized data and code have been deposited in Harvard's Dataverse (<https://doi.org/10.7910/DVN/LJMA2N>).

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