A Model of Labor Supply, Fixed Costs and Work Schedules☆

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Abstract

We develop a three-dimensional labor supply framework, distinguishing between hours worked per day, days worked per week and workweeks. Individuals make labor supply choices given heterogeneous schedule-dependent fixed costs of work. We show that the three margins are not perfect substitutes. Leisure on days not worked in a workweek has the largest weight in preferences, leisure on weeks off has the smallest weight. We use the model to analyze heterogeneous response to changes in fixed costs, schedule flexibility, and restrictions on weekly hours. We show that fixed costs of work affect response to each policy and determine associated losses.

Keywords: labor supply, work schedule, work flexibility, fixed costs of work

1. Introduction

Labor supply theory emphasizes the importance of distinction between the extensive margin and the intensive margin. At the intensive margin, individuals respond to wage fluctuations by varying their hours or intensity of work on the job. At the extensive margin, individuals make participation choices subject to individual constraints and comparative advantage considerations. Labor supply elasticity at each margin reflects different aspects of individual behaviour. For an extensive summary of this literature, see for example Hausman (1985), Pencavel (1986), and Blundell and MaCurdy (1999).

We extend the standard labor supply framework to account for detailed work schedules by incorporating three time dimensions: hours per day, days per week and

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weeks per year. The three labor supply decisions are jointly and simultaneously determined. Agents maximize utility by choosing consumption and three types of leisure: leisure time in the workweek on days worked, leisure time in the workweek on days not worked and leisure time in the weeks not worked. The choice of the optimal labor schedule is subject to individual fixed costs of work at each time dimension and given hourly wage which is a function of the total hours worked.[1] To obtain the parameters that govern the substitution between the three margins, we empirically estimate the model using individual level data. We show that hours worked per day and days worked per week are not perfect substitutes.

To estimate the model we use 2003 - 2015 Current Population Surveys, including the Food Security Supplements and American Time Use Surveys and the 1996 Survey of Income and Program Participation, including the Work-Related Expenses and Work Schedule files. We adjust MaCurdy's (1981) and Altonji's (1986) methodologies and estimate two alternative empirical specifications. Both methods use instruments for leisure variables employing the exogenous variation in fixed costs of work and non-labor income. Both methods yield very similar results. We show that hours worked per day, days worked per week and weeks worked per year are not perfect substitutes. Each type of leisure has a different weight in preferences, with leisure on days not worked during a workweek having the largest weight and leisure on weeks off having the smallest weight.

The estimation results are in line with findings in earlier studies. For example, Hanoch (1976), Hanoch (1980), Blank (1988), Triest (1990) and Reilly (1994) show that weekly hours and annual weeks are not perfect substitutes, and therefore should not be aggregated. Hamermesh (1996) empirically analyzes days worked per week and hours worked per day decisions and shows that the two margins should not be treated as a homogeneous unit.

We use the model to evaluate a number of policies. We recover the intertemporal elasticity of substitution of labor supply. We produce a large range of elasticities for the same set of model parameters by varying work schedules and degrees of attachment to the labor force. The individual intertemporal elasticity is around 0.2, within the range of the existing estimates. We show that among seemingly similar workers with the same weekly hours, those who work more compressed weeks have higher elasticity. The less attached or partially employed workers have a higher elasticity of

[1]The fixed cost structure relates to Gronau (1974), Heckman (1974), James (1979) and Cogan (1981) use a two-dimensional labor supply framework and show that the response of labor supply to wage fluctuations varies with the structure of fixed costs and not only with the overall cost of work.

labor supply. These findings are in line with results reported in Rogerson and Rupert (1991) who find that individuals employed 52 weeks per year have significantly lower labor supply elasticity than those not in the corner solution. Additionally, we show that proximity to a corner at any time dimension: hours, days or weeks, reduces the elasticity of labor supply. We also compute the aggregate, or "macro", elasticity of labor supply and find it to be 1.15, which is within the range of the existing estimates.

Previous studies show that the size of the elasticities at the extensive and intensive margins differ significantly by gender, age and other individual characteristics, (see for example Diamond, 1980; Eissa and Liebman, 1996; Meyer and Rosenbaum, 2001; Blau and Kahn, 2007; Bishop, Heim, and Mihaly, 2009; Laroque, 2005; Saez, 2002). In our model, individual heterogeneity is driven by variation in fixed costs of work and individual productivity (and tax rates). Our results are in line with the existing literature.

We calibrate the model to analyze changes in labor supply in response to policies that generate changes in fixed costs of work, affect schedule flexibility, and policies that set restrictions on weekly hours. Policies that address the common fixed costs of work, such as commuting child care costs, are widespread. For example, in many European countries, workers can deduct commuting expenses to reduce the income tax liability; whereas in the US commuting costs are not tax deductible. Child care subsidies are available in many OECD countries, including the US, where these subsidies are limited to low-income families.[2] We show that a 1% or 5% decline (increase) in daily fixed costs of work lead to a reduction (increase) in hours worked per day, no effect on days worked per week and a marginal decline (increase) in weeks worked per year. There are substantial utility gains (losses) associated with such changes in fixed costs. Similar magnitude changes in weekly costs have small effects on time allocation. Most OECD countries also implement policies that may affect the choice of working hours and schedule flexibility. These policies include restrictions on total hours worked per week, hours worked per day, number of rest-days per week, and penalty rate systems for overtime work and for work on prescribed days of rest.[3] We conduct two experiments to analyze the effects schedule flexibility on

[2]See OECD (2013) for a survey of early childhood education and care policies. In the US, some of the programs subsidize work-related child care expenses only, but others have no employment requirement for the parents. See Blau (2003) for an extensive discussion of these policies in the US.

[3]Policy makers justify such regulations using various explanations: to reduce unemployment and yield a better division of labor, to increase the work-life balance and to improve the quality of life. For example, in Belgium overtime rates must be paid for all work in excess of eight hours per day or 39 hours per week, and every worker must be given at least one 24-hour rest period each week.

labor supply and wellbeing. First, we compare outcomes in the benchmark allocation with outcomes in an environment that allows only 5-days-per-week jobs. In the restrictive environment, workers who remain employed work more hours per day on average, earn higher wages and lower utility. The average utility cost due to schedule flexibility loss for constrained workers is equivalent to 22% of annual consumption value. Second, we analyze effects of restrictions on weekly hours worked. Such restrictions affect mostly individuals with higher daily and weekly costs. Workers at the higher end of weekly costs distribution are more likely to leave the labor force. Under such policies, constrained workers reduce their hours worked per day, days worked per week and increase weeks worked per year. The associated utility costs for constrained workers (excluding those who leave the labor force) in terms of consumption are 15% for the 45-hours per week policy and 12% for the 40-hours per week policy. Participation declines by 5% and 7%, respectively. Some of these losses are mitigated by fixing wages of constrained workers to pre-policy levels.

The remainder of the paper is organized as follows: Section 2 builds the theoretical framework and outlines the empirical strategy. Section 3 describes the data. In Section 4 we discuss the estimation methods in detail and provide the results. Section 5 reports individual and aggregate estimates of the intertemporal elasticity of labor supply. In Section 6 we analyze effects of popular public policies on labor supply. Section 7 concludes the paper.

2. Theoretical Model

2.1. Environment

Consider a three-dimensional labor supply framework in which workers derive utility from consumption, c_{it}, and three types of leisure, leisure time on days worked in workweeks, l_{1it}, leisure time on days off in workweeks, l_{2it}, and leisure time on weeks off in year t , l_{3it}, defined as follows

$$l_{1it} = n_{it} d_{it} \left(\overline{h} - h_{it} \right), \tag{1a}$$

$$l_{2it} = n_{it} \overline{h} \left(\overline{d} - d_{it} \right), \tag{1b}$$

$$l_{3it} = \overline{dh} \left(\overline{n} - n_{it} \right), \tag{1c}$$

Work time is normally limited to 11 hours per day and 50 hours per week. The standard French working week is 35 hours, with a statutory requirement for one rest-day per week (Sunday). The 35-hours limit can be extended to 48 hours at a premium wage rate.

where h_{it} are hours worked per day on days worked, d_{it} are days worked per week on weeks worked and n_{it} are weeks worked per year. The values $\overline{h}$, $\overline{d}$ and $\overline{n}$ are maximum values of hours worked per day, days worked per week and annual weeks, respectively.[4]

Agent i maximizes his/her expected lifetime utility given by

$$U_i = E_0 \sum_{t=0}^{T} \beta^t \left[\varphi_{cit} \frac{c_{it}^{1-\gamma_c}}{1-\gamma_c} + \varphi_{lit} \left(\frac{[l_{1it} l_{2it}^{\rho_1} l_{3it}^{\rho_2}]^{1-\gamma_n}}{1-\gamma_n} \right) \right] \qquad (2)$$

where β is a discount factor and T is the end of the planning horizon. Person specific preferences over consumption and leisure in period t are given by φ_{cit} and φ_{lit}, respectively. Parameters ρ_1 and ρ_2 summarize the differences in preferences over the three types of leisure and together with $1-\gamma_n$ determine the substitution between l_{1it}, l_{2it} and l_{3it}. Strict concavity of the utility function requires $\gamma_c, \gamma_n, \rho_1, \rho_2 > 0$, while $\gamma_n > 1$ implies that the three types of leisure are substitutes, (i.e. the marginal utility of week off or day off is lower the shorter the workday). The utility share of leisure on workdays, l_{1it}, is normalized to one. Expectations are conditioned upon the information set of the individual at time 0. The preference structure assumes separability of consumption and leisure, and a constant elasticity of substitution between the three dimensions of labor supply.[5]

Firms may not be indifferent to the number of hours worked when there are fixed costs involved in hiring and retaining workers, as in Lewis (1969) and Barzel (1973) more recently in Keane and Wolpin (2001) and Aaronson and French (2004). We follow Aaronson and French (2004) and assume the following structure for hourly earnings,

$$\ln w_{it}(H_{it}) = \alpha_{it} + \theta \ln H_{it},$$

where $H_{it} = n_{it} d_{it} h_{it}$ is total hours worked in period t and α_{it} it represents an individual's underlying productivity and sums up proportional tax rate, i.e. $\alpha_{it} = \widetilde{\alpha}_{it} + \ln(1 - tax_t)$.[6]

[4]Cho, Merrigan, and Phaneuf (1998) use a similar definition of leisure in a two-dimensional labor supply model.

[5]We are maintaining the common assumption of separability between consumption and leisure. Previous studies, see for example Ham and Reilly (2002), show that the separability assumption may restrict the estimations and bias the results. On the other hand, Altonji (1986) argues that if measurement errors in variables are small, the elasticity can still be estimated implementing the MaCurdy (1981) methodology.

[6]Aaronson and French's (2004) estimate of θ is 0.4. Keane and Wolpin's (2001) estimate is 0.2.

In every period t, the budget constraint is given by

$$w_{it}(H_{it})H_{it} - F(d_{it}, n_{it}) - c_{it} + (1+r)A_{it} - A_{it+1} = 0, \tag{3}$$

where A_{it} is wealth in t and r is the real interest rate. Individual work related fixed costs in time t are summarized by $F\left(d_{it}, n_{it}\right)$. For simplicity of presentation We assume that fixed costs of work are constant within period t, (i.e. in a given year, daily fixed costs of work are the same each day worked). Therefore, in optimum, individuals choose to work same number of hours each day worked and same number of days each week worked. Fixed costs of work are defined as follows:

$$F(n_{it}, d_{it}) = n_{it}\left[f_{dit}d_{it} + f_{nit}\right] + f_{pit}I(n > 0),$$

where f_{dit} is a daily fixed cost of work, f_{nit} is a weekly fixed cost of work and f_{pit} is a participation cost. The worker pays f_{dit} on each day worked, regardless of how many hours are worked that day; an example of such costs are commuting costs or costs of making oneself presentable for work. Similar assumptions apply to f_{nit} and f_{pit}.[7]

2.2. First-Order Conditions

For simplicity of notation, the individual subscripts i are omitted.

Each individual chooses consumption and leisure to maximize the expected lifetime utility in equation (2) subject to the budget constraint (3). First-order conditions are given by

$$\beta^t \varphi_{ct} c_t^{-\gamma_c} = \lambda_t, \tag{4a}$$

$$\beta^t \varphi_{lt} \rho_2 l_{3t}^{\rho_2(1-\gamma_n)-1} l_{2t}^{\rho_1(1-\gamma_n)} {l_{1t}}^{1-\gamma_n} = \lambda_t \left\{ w_t(H_t)(1+\theta) - \frac{f_{dt}}{\overline{h}} - \frac{f_{nt}}{\overline{dh}} \right\}, \tag{4b}$$

$$\beta^t \varphi_{lt} \rho_1 l_{3t}^{\rho_2(1-\gamma_n)} l_{2t}^{\rho_1(1-\gamma_n)-1} {l_{1t}}^{1-\gamma_n} = \lambda_t \left\{ w_t(H_t)(1+\theta) - \frac{f_{dt}}{\overline{h}} \right\}, \tag{4c}$$

$$\beta^t \varphi_{lt} l_{3t}^{\rho_2(1-\gamma_n)} l_{2t}^{\rho_1(1-\gamma_n)} {l_{1t}}^{-\gamma_n} = \lambda_t w_t(H_t)(1+\theta), \tag{4d}$$

$$\lambda_t = (1+r)E_t\lambda_{t+1}, \tag{4e}$$

where λ_t is the marginal utility of wealth, a function of wealth, current and future preferences and current and future wages. Equation (4e) determines the allocation

[7] The effect of hourly fixed costs is to shift down the slope of the wage rate, which does not change the nature of the labor supply decision. Therefore, hourly costs are not considered.

of wealth across periods. We use the first-order conditions to estimate ρ_1, ρ_2, γ_n and γ_c.

The first-order conditions deliver demand functions for each type of leisure:

$$\ln l_{1t} = \kappa_1 \ln w_t(H_t) + \kappa_2 \ln \left[w_t(H_t)\,(1+\theta) - \tfrac{f_{dt}}{\bar{h}} \right] + \kappa_3 \ln \left[w_t(H_t)\,(1+\theta) - \tfrac{f_{dt}}{\bar{h}} - \tfrac{f_{nt}}{dh} \right] + \ln \Gamma_t \tag{5a}$$

$$\ln l_{2t} = (\kappa_1+1) \ln w_t(H_t) + (\kappa_2 - 1) \ln \left[w_t(H_t)\,(1+\theta) - \tfrac{f_{dt}}{\bar{h}} \right] + \kappa_3 \ln \left[w_t(H_t)\,(1+\theta) - \tfrac{f_{dt}}{\bar{h}} - \tfrac{f_{nt}}{dh} \right] + \ln \Gamma_t + \ln\left[\rho_1\,(1+\theta)\right] \tag{5b}$$

$$\ln l_{3t} = (\kappa_1+1) \ln w_t(H_t) + \kappa_2 \ln \left[w_t(H_t)\,(1+\theta) - \tfrac{f_{dt}}{\bar{h}} \right] + (\kappa_3 - 1) \ln \left[w_t(H_t)\,(1+\theta) - \tfrac{f_{dt}}{\bar{h}} - \tfrac{f_{nt}}{dh} \right] + \ln \Gamma_t + \ln\left[\rho_2\,(1+\theta)\right] \tag{5c}$$

Where $\kappa_1 = \frac{1-(\rho_1+\rho_2)(1-\gamma_n)}{(\rho_1+\rho_2)(1-\gamma_n)-\gamma_n}$, $\kappa_2 = \frac{\rho_1(1-\gamma_n)}{(\rho_1+\rho_2)(1-\gamma_n)-\gamma_n}$ and $\kappa_3 = \frac{\rho_2(1-\gamma_n)}{(\rho_1+\rho_2)(1-\gamma_n)-\gamma_n}$ and $\Gamma_t = \frac{\beta^t \varphi_{lt}}{\lambda_t}\,(1+\theta)^{(\rho_1+\rho_2)(1-\gamma_n)-1}\,\rho_1^{\rho_1(1-\gamma_n)}\,\rho_2^{\rho_2(1-\gamma_n)}$.

2.3. Empirical specification

Rearranging equation (4d) and taking the first differences yields:

$$\Delta \ln w_t(H_t) = -\gamma_n \Delta \ln l_{1t} + \rho_1\,(1-\gamma_n)\,\Delta \ln l_{2t} + \rho_2\,(1-\gamma_n)\,\Delta \ln l_{3t} - \ln\beta + \Delta \ln \varphi_{lt} + \Delta \ln \lambda_t, \tag{6}$$

Given uncertainty in wages, λ_t is a random variable which is not realized until the start of period $t+1$. $\Delta \ln \lambda_t$ is computed as follows. Backdating of (4e) delivers $\lambda_{t-1} = (1+r)E_{t-1}\lambda_t$, and therefore, assuming rational expectations, $\lambda_t = 1/(1+r)\,(\lambda_{t-1} + e_{\lambda t})$, where $e_{\lambda t}$ is a mean-zero expectation error. Taking logs of both sides and using first order linear approximation of $1/(1+r)\,(\lambda_{t-1}+e_{\lambda t})$ around $e_{\lambda t} = 0$, and ignoring higher order terms leads to $\ln \lambda_t = -\ln(1+r) + \ln \lambda_{t-1} + \xi_t$, or $\Delta \ln \lambda_t = -\ln(1+r) + \xi_t$, where $\xi_t = (1/\lambda_t)\,e_{\lambda t}$ is an approximation error.

Combining and rearranging equations (5a) and (5d) yields:

$$\ln c_t = \frac{\gamma_n}{\gamma_c} \ln l_{1t} - \frac{\rho_1\,(1-\gamma_n)}{\gamma_c} \ln l_{2t} - \frac{\rho_2\,(1-\gamma_n)}{\gamma_c} \ln l_{3t} + \frac{1}{\gamma_c} \ln w_t(H_t) + \frac{1}{\gamma_c} \ln \left(\frac{\varphi_{ct}}{\varphi_{lt}} (1+\theta) \right) \tag{7}$$

To construct $\ln l_{1t}$, $\ln l_{2t}$ and $\ln l_{3t}$, we set $\overline{h} = 16$.

Equation (6) uses lagged labor supply to proxy for wealth and equation (7) uses consumption to proxy for the lifetime wealth.[8] We estimate these equations empirically, addressing endogeneity and potential measurement errors in variables issues. We derive ρ_1, ρ_2, γ_n and γ_c from from the estimated coefficients of the leisure variables. Section 4 describes empirical estimations in detail. Using these estimated parameters we calculate the intertemporal elasticity of labor supply at each time dimension and perform a range of experiments. Sections 5 and 6 report these results.

3. Data

1996 SIPP First-differences equation (6) is estimated using the 1996 Survey of Income and Program Participation (SIPP). The SIPP features a panel structure and has detailed monthly demographic and employment data for all persons in the household. The panel has 12 waves, collecting data for a continuous 48-month period. Detailed questions about work schedules were asked of a subsample of individuals during the 4th and 10th waves (Work Schedule supplements). Commuting data, weekly miles driven to work, are reported in the 3rd, 6th, 9th and 12th waves (Work-Related Expenses supplements). The wage rate variable, denoted $\ln w_t^*$, is a log of weekly earnings divided by usual weekly hours worked.

The sample is restricted to working individuals between 21 and 60 years old who are married, not disabled, not attending school, not in military and not retired. We use only married individuals because spousal information is used in the estimation procedure. The initial men sample contains 11,189 and 9,409 observations in waves 4 and 10, respectively. Corresponding women samples have 10,184 and 8,584 observations. We use information on individuals who were interviewed in both waves, which leaves 8,654 observations for men and 7,451 observations for women. Samples are merged with work expenses data available in waves 3, 6, 9 and 12. We exclude individuals who report more than 80 hours of work per week and those who report changes in hours worked or in commuting miles greater than 300% or below -75%. The final sample contains 3,898 observations for men and 3,446 for women.

[8] The assumption of separability in consumption and leisure is maintained throughout the paper. Altonji (1986) shows that if measurement errors are small, the parameters of the model can still be estimated from the first-difference specification in equation (6). The log-level specification in equation (7) may, however, result in biased estimates. We estimate the model using both specifications; the differences between the estimates are not large and can be partially attributed to the bias associated with the separability assumption.

2003 - 2015 ATUS-CPS To estimate equation (7) we draw data from 2003-2015 waves of American Time Use Survey (ATUS) merged with CPS Food Security Supplements. The data contain detailed labor supply and food consumption information. Within each household that participates in ATUS, one randomly selected member (age 15 and up) was asked to provide information about his/her daily activities over a randomly assigned 24 hour period. Each day of the week is equally represented in the survey.

We construct two wage rates, w_t^*, is derived from weekly earnings divided by usual weekly hours and w_t^{**}, wage rate available for a subset of persons who were recorded as paid on an hourly basis. Hours worked per day are obtained from the time-use diary. Days worked per week are calculated by dividing usual hours worked per week by hours worked per day.[9] To minimize the potential correlation between measurement errors in leisure variables and wage rate we draw information on usual weekly hours from different supplements, days worked per week are calculated using hours from ATUS and w_t^* is calculated using hours in Food Security Supplements. Consumption, c_t^*, is from the Food Security Supplements and calculated as food expenditure per equivalent person.[10] We assume that measurement errors in consumption and other variables are not correlated since they come from independent questions or questionnaires. All nominal measures are adjusted using the CPI. Weeks worked per year are obtained from the March CPS Supplements (also known as Annual Social and Economic Supplements), available for a fraction of individuals in the ATUS-CPS sample.

We merge the ATUS, March Supplements and Food Security Supplements, including only individuals with valid food expenditure entries. The merged sample is limited to individuals between 21 and 60 years old, not disabled, not attending school, not in the military and not retired. We exclude individuals who were interviewed on a holiday. Within these specifications, ATUS-CPS sample contains 22,380 observations for men and 28,195 for women. We exclude individuals who do not work, and those who work less than 1 hour per week or more than 16 hours per day, those with missing data on key variables, have more than one employer, travel more than 6 hours per day or report extreme hourly wages. We further drop individuals who report weekly household food consumption which exceeds \$1,000 and individual food consumption below \$5. After these exclusions, the sample contains 6,667 ob-

[9] If the obtained variable is not an integer it is rounded to the closest whole number. If the number of days worked exceeds 7, the observation is considered invalid.

[10] Equivalence scale provided in US Department of Commerce (1991), p. 132. The scale: 1 person = 1 unit, 2 = 1.28, 3 = 1.57, 4 = 2.01, 5 = 2.37, 6 = 2.68, 7 = 3.04, 8 = 3.40.

servations for men, and 6,804 for women. Weeks worked are not reported for every individual in this sample (only for those found in March Supplements). Limiting the data to only those workers with valid weeks who work at least 10 weeks per year and who have at least 10 hours of each type of leisure, reduces the sample to 3,024 observations for men and 3,151 for women. Finally, we do not include individuals with top-coded earnings, and our final samples include 2,856 observations for men and 3,075 observations for women. We also construct a subsample of women whose earnings are similar or higher than their spouses earnings. This subsample is limited to women who have spousal information and it contains 749 observations.

The key variables of the SIPP and ATUS-CPS are summarized in the Online Appendix. Employed men supply 8.3 - 8.9 hours per day, 4.9 - 5.1 days per week and work 49 - 51 weeks per year. For women these statistics are 7.7 - 8.7 hours per day, 4.7 - 4.8 days per week and 50 weeks per year. Fixed costs of work are measured by the presence of children and commuting time or distance. In ATUS-CPS, the average time spent on commuting is 0.82 and 0.62 hours per day for men and women, respectively. Time spent on child care is 0.44 hours for men and 0.74 hours for women. In the SIPP, the average distance traveled to work per week is 109.8 and 80.9 miles for men and women, respectively.

4. Estimation

Using the model we derive two empirical specifications. Equation (6) that uses lagged labor supply to proxy for wealth and consistent with the MaCurdy (1981) methodology, and equation (7) that uses consumption to proxy for the lifetime wealth and builds on Altonji (1986) approach. To address potential measurement errors in variables and endogeneity issues we use instrumental variables. Measurement errors are particularly important in the first-differences specification since leisure variables do not move much over the two years but there can be a measurement error in every period, which can lead to a substantial attenuation bias in the estimated coefficients. The consumption estimation method in equation (7) is more prone to endogeneity issues than the first-differences specification. Preference for consumption, summarized by φ_{ct}, may affect both the consumption and leisure and is not fully observable in the data. On the other hand, it is plausible to assume that the change in φ_{lt} over a two years period is small and therefore should not lead to important endogeneity issues in the estimation of equation (7). We use the demand functions in equations (5a)-(5c) to specify the set of instrumental variables for each specification.

4.1. Using Past Labor Supply Variables to Proxy for λ

To estimate the first-differences specification in equation (6) we use data from the 4th and 10th waves of the 1996 SIPP. Wave 10 survey was administered about two years after wave 4. The available log leisure measures and log real wage rate, $\ln l_{1t}^*$, $\ln l_{2t}^*$, $\ln l_{3t}^*$ and $\ln w_t^*$, are assumed to equal $\ln l_{1t}$, $\ln l_{2t}$, $\ln l_{3t}$, $\ln w_t$, plus classical measurement errors ϵ_{1t}, ϵ_{2t}, ϵ_{3t}, ϵ_{wt}, respectively. The variables are obtained using responses to independent corresponding questions, therefore, $\Delta\epsilon_{1t}$, $\Delta\epsilon_{2t}$ and $\Delta\epsilon_{3t}$ should not be correlated with $\Delta\epsilon_{wt}$. Taking into account the measurement errors, equation (6) is rewritten as:

$$\begin{aligned}\Delta \ln w_t^* = \quad & -\gamma_n \Delta \ln l_{1t}^* + \rho_1 (1-\gamma_n) \Delta \ln l_{2t}^* + \rho_2 (1-\gamma_n) \Delta \ln l_{3t}^* - \\ & \ln \beta(1+r) + \Delta \ln \varphi_{lt} + \upsilon_t, \end{aligned} \tag{8}$$

where $\upsilon_t = \xi_t - \gamma_n \Delta\epsilon_{1t} + \rho_1 (1-\gamma_n) \Delta\epsilon_{2t} + \rho_2 (1-\gamma_n) \Delta\epsilon_{3t} + \Delta\epsilon_{wt}$.

Measurement errors present an important estimation issue in the first-differences specification. To address the measurement errors, we utilize the leisure demand functions in equations (5a)-(5c) and instrument $\ln l_{1t}^*$, $\ln l_{2t}^*$ and $\ln l_{3t}^*$ using proxies for fixed costs and marginal utility of wealth, λ. The instruments include change in commuting distance, an indicator for childbirth between the two waves, change in non-labor income and changes in spousal hours worked. We note that first-differences in equation (8) are computed over a two years period and it is plausible to assume that there was no change in the preference parameter, $\ln \varphi_{lt}$, over this relatively short period. Additionally, because $\Delta \ln \varphi_{lt}$ might be related to age, while wage profile is also age dependent, all estimations include age as a control variable. Other included controls are education, race and changes in job characteristics. We assume that instruments are not correlated with the measurement errors, $\Delta\epsilon_{1t}$, $\Delta\epsilon_{2t}$, $\Delta\epsilon_{3t}$ and $\Delta\epsilon_{wt}$ and exclusion restriction holds. SIPP weights are used to attain representativeness of the sample.[11]

First-stage estimation results of equation (8) are reported in Table 1, columns (1) - (3). Around 85% of workers report working 52 weeks in both waves of the 1996 SIPP, which leads to low variation in $\Delta \ln l_{3t}^*$ and high standard errors in the first and

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[11]MaCurdy (1981) and Altonji (1986) estimate the Frisch intertemporal labor supply elasticity by regressing the difference of log-wages on the difference in log-hours worked, $\Delta \ln HOURS_t = constant + \gamma \Delta \ln WAGE_t + \epsilon_t$. To control for measurement errors, MaCurdy used year dummies and individual specific information such as age and education as instruments for hourly wage. Altonji used two different wage series for each household.

second estimation stages. We propose to estimate equation (8) using an alternative model specification which abstracts from choice of weeks worked. In the simplified model, leisure variables are defined as $\widehat{l}_{1it} = d_{it}\left(\overline{h} - h_{it}\right)$ and $\widehat{l}_{2it} = \overline{h}\left(\overline{d} - d_{it}\right)$. First-stage results of this simplified model using the entire sample and a subsample of job-to-job movers are reported in columns (4)-(7) of Table 1. Table 2 reports first-stage results of the simplified model for men and women.

First-stage estimates are consistent across specifications with some differences between men and women. Change in commuting distance, a proxy for the change in daily fixed costs of work, is negatively correlated with $\Delta \ln l^*_{1t}$ and $\Delta \ln l^*_{2t}$ and positively with $\Delta \ln l^*_{3t}$. Childbirth between the two waves proxies for changing daily and weekly fixed costs of work, has a positive effect on $\ln l^*_{1t}$ and negative effect on $\ln l^*_{2t}$, for men and women. There is no correlation between childbirth and $\Delta \ln l^*_{3t}$. Non-labor income and spousal hours worked per week proxy for the wealth status. Higher spousal hours worked may reflect both higher and lower wealth whereas higher non-labor income may reflect both wealth and substitution effects, therefore the coefficients of these instruments capture a mixture of effects. An increase in the non-labor income positively affects $\ln l^*_{1t}$ and negatively $\ln l^*_{2t}$. An increase in spousal hours negatively affects $\ln l^*_{1t}$ and positively $\ln l^*_{2t}$. The estimates are not statistically significant for $\Delta \ln l^*_{3t}$.[12]

Second-stage estimates are reported in Table 3. Full model results are in column (1), the remaining columns present results for the simplified model. The estimates of γ_n are in the range of 1.9 - 3.5, the estimates of ρ_1 is in the range of 1.1 - 1.4. Using the full model, we estimate the share of l_{3t}, ρ_2, to be around 0.6. Thus, l_{2t} has the largest share in the utility function whereas l_{3t} has the smallest share (the share of l_{1t} is normalized to 1).

4.2. Using Consumption to Proxy for λ

Equation (7) is estimated using the ATUS-CPS data. We assume that the available measures of leisure, consumption and real wage, $\ln l^*_{1t}$, $\ln l^*_{2t}$, $\ln l^*_{3t}$, $\ln c^*_t$, $\ln w^*_t$, equal $\ln l_{1t}$, $\ln l_{2t}$, $\ln l_{3t}$, $\ln c_t$, $\ln w_t$ plus additive measurement errors ϵ_{1t}, ϵ_{2t}, ϵ_{3t}, ϵ_{ct}, $\epsilon_{\omega t}$, respectively. Considering the measurement errors, equation (7) is rewritten as follows

[12] The F-statistics of the excluded instruments in the full specification, Table 3 columns (1) - (3), are between 5.4 and 7.4. Stock and Yogo (2003) critical values for the acceptable 5%-10% range of maximum IV bias are between 6.61 and 9.53. For robustness and sensitivity analysis, the next subsection reports results using the alternative estimation methodology, which yields very similar parameter values.

$$\ln c_t^* = \frac{\gamma_n}{\gamma_c}\ln l_{1t}^* - \frac{\rho_1\left(1-\gamma_n\right)}{\gamma_c}\ln l_{2t}^* - \frac{\rho_2\left(1-\gamma_n\right)}{\gamma_c}\ln l_{3t}^* + \frac{1}{\gamma_c}\ln w_t^* + \frac{1}{\gamma_c}\ln\frac{\varphi_{ct}(1+\theta)}{\varphi_{lt}} + \varepsilon_t \tag{9}$$

where $\varepsilon_t = \frac{\gamma_n}{\gamma_c}\epsilon_{nt} + \frac{\rho_1(1-\gamma_n)}{\gamma_c}\epsilon_{dt} + \frac{\rho_2(1-\gamma_n)}{\gamma_c}\epsilon_{dt} - \epsilon_{ct} + \frac{1}{\gamma_c}\omega$.

Labor supply variables are measured with errors and might also be correlated with preferences $\ln\varphi_{ct}$. To estimate equation (9) we instrument for $\ln l_{1t}^*$, $\ln l_{2t}^*$ and $\ln l_{3t}^*$ use proxies for fixed costs of work and lifetime wealth. The instruments include time spent on commuting, number of children, time spent on child care, calendar month of the ATUS interview and an indicator for a weekend ATUS interview. In some specifications, for individuals who have spousal data, we also include spousal earnings. To address the measurement error in wage rate, we construct a predicted hourly rate based on how $\ln w_t^{**}$ projects on $\ln w_t^*$.

All estimations include age, education, race, marital status, and state variables to control for consumption preferences, labor supply preferences and price differences across regions. As a robustness check, we use four IV specifications to estimate the coefficients for men and three specifications for women, each specification uses a different subset of instruments or a subsample of individuals with spousal information. In IV1 the included instruments are number of children, time spent on child care, calendar month of the interview and an indicator for a weekend interview; in IV2 we add time spent on commuting; estimation of IV3 is limited to workers with spouses; IV4 uses the subsample of workers with spouses and includes spousal earnings as an instrument and spousal hours as a control variable. ATUS person weights are used to attain representativeness of the sample.

Using the entire sample of women, we obtain estimates which are very different from the first-differences or men estimates, and most of them are of a wrong sign. This result suggests that working women's consumption is not a good proxy for their lifetime wealth.[13] To estimate the utility parameters for women, we use a subsample of women whose earnings are similar or higher than earnings of their spouses, or women in the top 15% of the earnings distribution. For these women we expect consumption to be a better proxy for lifetime wealth. This estimation is limited to women who have spousal information and earn relatively high wages, therefore, the number of observations is relatively low, 947 observations.

[13]These results are not reported but available from the authors upon request.

Table 4 summarizes selected first-stage results for men and women. Number of children, time spent on work travel and on child care reflect differences in fixed costs of work and in time constraints and produce mixed results. Higher childcare costs increase hours worked per day and reduce days worked per week. Spousal earnings, controlling for working hours, measure permanent differences in spousal productivity and proxy for wealth effects. Workers with higher earnings spouses work less weeks per year.

F-statistics of the excluded instruments in estimations that use the full sample of men, IV1 and IV2 specifications, are between 5.8 and 10.9. For women, in IV1 specification, the F-statistics are 9.50 and 7.00 for $\ln l_{1t}^{*}$ and $\ln l_{2t}^{*}$, respectively, and 2.44 for $\ln_{3t}^{*}$. F-statistics in estimations for men indicate that the maximum IV estimator bias is within the acceptable 5%-10% range in most cases.[14]

Table 5 reports second-stage estimates for men and women. Columns (1) and (2) present the results for all men, IV1 and IV2 specifications, respectively Columns (3) and (4) present results for men who have eligible spouse information, specifications IV3 and IV4, respectively. The estimates in Table 5 are similar to those obtained using the first-differences estimation approach (Table 3). The estimate of γ_n is between 3 and 5, the share of l_{2t} in the utility function, ρ_1, is between 1.9 and 2.1 and the share of l_{3t}, ρ_2 is around 0.7. The estimates of γ_c are in the range of 2.6-3.5. Most of the coefficients for men are statistically significant at the 1%-5% level. Columns (5) and (6) in Table 5 report the results for women. Due to the low number of observations some estimates in these specifications are not significant. This is mostly driven by the low variation in weeks worked; in this subsample 819 out of 947women report working 52 weeks. The significant coefficients are very similar to those in estimations for men.

We estimate the model using two alternative methods and two datasets. Both methods use instruments for leisure variables employing the exogenous variation in fixed costs of work and non-labor income. Both methods yield very similar results, ρ_1 is larger than 1 and ρ_2 is smaller than 1. These results suggest that leisure on days not worked during a workweek has the largest weight in utility and leisure on weeks off has the smallest weight (leisure on hours off on days worked is normalized to 1). In the next two Sections we use the estimated model parameters to examine a range of policy experiments.

[14] To analyze the F-statistics, we use Stock and Yogo (2003) critical values tables for TSLS with multiple endogenous variables. These critical values, for specification in column (1), Table 5, are between 9.53 and 6.61.

5. Elasticity of Labor Supply

In this Section we recover the intertemporal elasticity of substitution of labor supply and show how it varies with costs of work and with work schedule. Our goal is to evaluate differences in labor supply elasticity between workers who work different schedules.

Using leisure demand functions in (5a)-(5c) we derive the following intertemporal elasticities of each type of leisure with respect to $w_t(H_t)$,

$$\eta_1 = \kappa_1 + \kappa_2 \frac{\widetilde{w_t(H_t)}(1+\theta)}{\widetilde{w_t(H_t)}(1+\theta) - \widetilde{\frac{f_{dt}}{h}}} + \kappa_3 \frac{\widetilde{w_t(H_t)}(1+\theta)}{\widetilde{w_t(H_t)}(1+\theta) - \widetilde{\frac{f_{dt}}{h}} - \widetilde{\frac{f_{nt}}{dh}}}, \tag{10a}$$

$$\eta_2 = (\kappa_1 + 1) + (\kappa_2 - 1) \frac{\widetilde{w_t(H_t)}(1+\theta)}{\widetilde{w_t(H_t)}(1+\theta) - \widetilde{\frac{f_{dt}}{h}}} + \kappa_3 \frac{\widetilde{w_t(H_t)}(1+\theta)}{\widetilde{w_t(H_t)}(1+\theta) - \widetilde{\frac{f_{dt}}{h}} - \widetilde{\frac{f_{nt}}{dh}}}, \tag{10b}$$

$$\eta_3 = (\kappa_1 + 1) + \kappa_2 \frac{\widetilde{w_t(H_t)}(1+\theta)}{\widetilde{w_t(H_t)}(1+\theta) - \widetilde{\frac{f_{dt}}{h}}} + (\kappa_3 - 1) \frac{\widetilde{w_t(H_t)}(1+\theta)}{\widetilde{w_t(H_t)}(1+\theta) - \widetilde{\frac{f_{dt}}{h}} - \widetilde{\frac{f_{nt}}{dh}}}, \tag{10c}$$

where $\kappa_1 = \frac{1-(\rho_1+\rho_2)(1-\gamma_n)}{(\rho_1+\rho_2)(1-\gamma_n)-\gamma_n}$, $\kappa_2 = \frac{\rho_1(1-\gamma_n)}{(\rho_1+\rho_2)(1-\gamma_n)-\gamma_n}$ and $\kappa_3 = \frac{\rho_2(1-\gamma_n)}{(\rho_1+\rho_2)(1-\gamma_n)-\gamma_n}$, and "tildes" indicate averages of corresponding variables.[15]

The intertemporal elasticity for each labor supply margin is derived by taking total derivatives of leisure functions (1a)-(1c). The elasticities are given by

$$\eta_n = -\eta_3 \frac{\overline{n}-\widetilde{n}}{\widetilde{n}}, \tag{11a}$$

$$\eta_d = (\eta_n - \eta_2) \frac{\overline{d}-\widetilde{d}}{\widetilde{d}}, \tag{11b}$$

$$\eta_h = (\eta_d + \eta_n - \eta_1) \frac{\overline{h}-\widetilde{h}}{\widetilde{h}}, \tag{11c}$$

and the intertemporal elasticity of the total labor supply is $\eta_H = \eta_h + \eta_d + \eta_n$. Throughout this study we use $\overline{h} = 16$. Choosing a higher value for $\overline{h}$, i.e. $\overline{h} = 24$, delivers significantly higher estimates of labor supply elasticity.

It follows from equations (11a)-(11c) that individuals who work shorter hours, days or weeks have a higher elasticity of labor supply. The stronger the tie between

[15] We assume $\frac{\partial \ln \lambda_t}{\partial \ln w_t(H_t)} = 0$ and compute the λ-constant elasticities of intertemporal substitution. This assumption follows McLaughlin (1995), who argues that the short-run uncompensated labor elasticity is likely to embed small wealth effects in an environment where the shocks are assumed to be temporary, the horizon is infinite and the discounting is small. Thus, if wage change captures unexpected temporary changes the income effect is negligible.

hours worked and wages, i.e. the higher the θ, the higher the elasticity of the labor supply. In computations we use Aaronson and French (2004) estimate, $\theta = 0.4$.

Table 6 reports the elasticity estimates. To obtain an estimate for the average fixed costs of work we draw from a number of sources. The 1996 SIPP Work-Related Expenses supplements provide data on daily work-related spending (commuting, parking, etc.), which is calculated to be around \$1 for men and \$0.9 for women, on average. ATUS provides daily time costs of work, commuting and other work-related activities; these are measured to be around 0.85 hours for men and 0.7 hours for women. Average child care costs are estimated by Kimmel (1998) at \$10.5 per day. These calculations suggest that the average daily fixed costs are around one hourly wage. We assume that the weekly costs of work are the same as the daily costs of work.[16] For the elasticity computations we use $\widetilde{f_{dt}}, \widetilde{f_{nt}} \in \{\widetilde{w}, 3\widetilde{w}\}$.

Table 6 shows calculations using ATUS-CPS and SIPP estimates. In all specification the margin of hours worked per day has the highest elasticity whereas the margin of weeks worked is the least elastic. At the benchmark case, i.e. for $\widetilde{f_{dt}}, \widetilde{f_{nt}} = \widetilde{w}$, the elasticity of annual hours worked is in the range of 0.18-0.24. The aggregate elasticity is decreasing with the fixed costs of work.[17] Our computed elasticity is within the standard range of the estimates that use individual level data. Chetty (2012) summarizes the relevant literature and shows that the estimated micro elasticity of the intensive margin of labor supply is in the 0-0.25 range. For example, the estimates are 0.15 in MaCurdy (1981), 0.09 in Browning et al. (1985), 0.14 in Blundell et al. (1998) and 0.15 in Ziliak and Kniesner (1999).[18]

In Table 7 we report simulated elasticities for workers on different schedules. Column (1) reports the benchmark result (similar to column (1) in Table 6). In column (2) we show that the elasticity is substantially higher, 0.50 compared to 0.18, for workers who work half of the year (26 weeks). This result somewhat reconciles the gap between "macro" and "micro" elasticities; where "macro" elasticity refers

[16] Assuming the weekly costs of work to be above or below the daily costs does not change the main conclusions.

[17] Previous studies show that not accounting for human capital accumulation effects on labor supply leads to negatively biased elasticity estimates. In our model we can account for human capital accumulation by incorporating an additional benefit for working more hours, days or weeks by adjusting the fixed costs be negative. Such modification increases the elasticity of labor supply.

[18] None of these studies uses the ATUS or CPS (or a combination of the two). To facilitate comparison with a standard model, we use the ATUS-CPS data to estimate Altonji (1986) cross-sectional specification. We obtain elasticity of 0.11-0.22 (using OLS and IV specifications), whereas Altonji (1986) reports 0.17. Estimation results of the standard model are not reported but available from the authors upon request.

to the intertemporal elasticity of aggregate hours and "micro" elasticity refers to the intensive margin elasticity of hours conditional on employment. The majority of currently employed reports working the maximum 52 weeks per year, which leads to very little flexibility in terms of weeks worked. Our simulation result demonstrates that incorporating workers who have a marginal attachment to the labor force leads to a substantial increase in the elastifcity of labor supply.

5.1. Aggregate elasticity of labor supply

In columns (3) and (4) of Table 7 we show simulation results for part-time workers who supply 24 weekly hours for 49 weeks per year, distinguishing between those who work three days and two days per week. The elasticity of part-time workers is 0.46 and 0.49, substantially higher than the 0.18 benchmark estimate. The higher estimate of 0.49 is obtained for workers with the more compressed work schedule.

Columns (5)-(8) report results for full-time workers with 40 weekly hours and 49 weeks per year, who work different days per week, from three to six. The overall elasticity of annual hours is declining with the number of days. For more compressed schedules the elasticity of the days margin is higher, whereas the elasticity of hours margin is lower. This is an important example of how seemingly similar workers who work 40 hours per weeks respond differently to wage fluctuations.

Our framework provides a clear and simple relationship between the "micro" or individual labor supply elasticity and the "macro" or aggregate elasticity. We derive the aggregate labor supply elasticity by including marginally attached workers in weighted calculations, $\eta_{AH} = \sum \mu_i \eta_{Hi}$, where μ_i is a weight of individual i and η_{Hi} is individual labor supply elasticity. The data are from the 2003-2015 CPS, which provides the number of weeks worked last year for those currently employed and those who are not employed but willing to work if they receive a job offer (these individuals can be unemployed or out of the labor force at the time of the interview). Using this definition of marginally attached, we obtain that fraction of workers who work 0 weeks is 6.79%. As demonstrated in Table 6, elasticity varies with work schedules and it is higher for partially employed workers. Marginally attached workers have the highest elasticity of labor supply. Using equations (11a)-(11c), we compute that a worker who works one week per year, five days per week and eight hours per day, has an elasticity of almost 20 (men) and 19 (women), (using parameters as in Table 5, column 1). Using these elasticities for the marginally attached workers, we estimate the aggregate elasticity of labor supply to be 1.15, which is within the range of "macro" elasticities accepted in the literature. In their seminal paper, Lucas and Rapping (1969) estimate this elasticity to be 1.4. More recently, Chang and Kim (2006), assuming an individual elasticity of 0.4, find an aggregate elasticity of about 1.

Rogerson and Wallenius (2009) assume an individual elasticity ranging from 0.05 to 1.25 and find that the corresponding macro elasticity is in the 2.25 - 3 range. Gourio and Noual (2009) estimate the macro elasticity to be 1.3 and Fiorito and Zanella (2012) estimates range between 1.1 to 1.7. The concept utilized in these studies is similar to the outcomes of our model: labor is more elastic at the aggregate than at the individual level because marginal workers move in and out of employment in response to wage fluctuations.

6. Policy experiments

We produce a large range of elasticities for the same set of model parameters by varying the work schedules. We proceed with calibrating the model to analyze changes in labor supply in response to public policies that affect fixed costs of work, schedule flexibility, and policies that set restrictions on weekly hours.

6.1. Calibration and policy experiments

We set a time period equal to one year. We take some of the parameters of our model directly from our empirical estimates. We calibrate the remaining parameters to match some moments of the data. The value of θ is fixed at 0.4, as in Aaronson and French (2004).

The parameters γ_c, γ_n, ρ_1 and ρ_2 are from our estimations. The value of γ_c is set at 2.6, γ_n is 3.3, ρ_1 is 1.8 and ρ_2 is 0.7 (from Table 5, column (2)). To obtain α_{it} in wage equation, $w_{it}(H_{it}) = \alpha_{it} + \theta \ln H_{it}$, we calculate the portion of the wage not explained by annual hours worked using the ATUS-CPC data. For these calculations we use a residual wage, netting out effects of education, experience, race, year and state effects. The residual average hourly wage is \$8.26. We find α_{it} to be distributed over the range of $[-2, -0.5]$. In the model, agents draw a productivity parameter from a uniform distribution over the specified range.

The model is calibrated in a static environment abstracting from assets distribution. We match distributions of hours worked per day, days worked per week and weeks worked per year. Agents choose their work schedules from a menu of bundles of hours per day $[0, 16]$, days per week $[0, 7]$, weeks per year $[0, 52]$ and wages. In Columns (1) and (2) of Table 8 we report the value of the statistics that we target in the data and their values in the calibrated model implied by the chosen parameters. The parameters of the model we calibrate are daily and weekly fixed costs and preference parameter φ_c, assuming that $\varphi_l = 1 - \varphi_c$.

The calibrated φ_c is 0.0031. Daily fixed costs are calculated using equations (5a) and (5b), according to which $\rho_1 = \frac{1}{w(H)(1+\theta)} \frac{l_2}{l_1} \left(w(H)(1+\theta) - \frac{f_d}{\bar{h}} \right)$. We use ATUS-CPS data to obtain the daily fixed costs. We project the calculated fixed cost on

$x_i \in [-1, 1]$, and obtain the following polynomial form: $f_{di} = a_d + b_d x_i + c_d x_i^2 + d_d x_i^3$. We use b_d, c_d and d_d we obtain from the data and calibrate a_d such that the model produces levels of hours and days we observe in the data. We use a similar polynomial form to construct the weekly costs of work: $f_{ni} = a_n + b_n f_{di} + c_n f_{di}^2 + d_n f_{di}^3$. We calibrate a_n, b_n, c_n and d_n. Calibration results for fixed costs are as follows:

$$f_{di} = 11.6 + 39.02 x_i + -35.32 x_i^2 + 200.96 x_i^3,$$

$$f_{ni} = -5.13 + 0.00003 f_{di} + 0.11 f_{di}^2 + 0.00003 f_{di}^3.$$

Columns (1) and (2) in Table 8 show that the model performs well in capturing means and standard deviations of the three dimensions of labor supply. However, weeks worked in the model are lower than in the data, we consider this outcome not to be a concern because the weeks measure in the data appears to overstate the actual number of weeks worked. Taking into account that both datasets utilized in our empirical analysis report weeks with a job (including vacations and sick days), our measures of mean and standard deviations for weeks worked should not be too far from the true moments in the data.

For 25% of individuals our calibration delivers negative daily fixed costs. This outcome is consistent with a theory that argues that workers work longer workweeks (or annual hours) not only to gain higher incomes but also to acquire human capital or promotion opportunities. When analyzing effects of changing fixed costs on labor supply allocations we identify $f_{di} = \hat{f_{di}} + \phi_i$, where $\hat{f_{di}}$ is the actual cost which is always positive, and ϕ_i, zero or negative, and sums up the incentives to work more days per week.

In the model, 61% of workers work more than 40 hours per week, compared to 42% in the data; 34% of workers work more than 45 hours per week, compared to 29% in the data. In terms of days, our calibration matches well the mean of days worked but generates variance below the data estimate. In the model, 82% of workers work 5 days per week, 9% of workers work 4 days, 8% work 6 days, and less than 1% work 7 days; corresponding statistics in the data are 52%, 24%, 19% and 5%. Our calibration does not target labor force participation rate; however, our model performs well in matching this moment, around 81% in the data and 83% in the model.

The following table displays correlations between productivity, fixed costs and labor supply allocations.

In the benchmark economy, higher productivity workers work less hours per day, less days per week and less weeks per year. Higher weekly fixed costs lead to working longer hours per day, more days per week, and less weeks per year. Higher daily fixed

Correlations between worker's type and labor supply allocations

	α_i	f_{di}	f_{ni}
h_i	-0.3468	0.0867	0.4230
d_i	-0.3141	-0.4586	0.6536
n_i	-0.4554	0.2338	-0.1318

costs lead to working longer hours per day, less days per week, and more weeks per year.

The Online Appendix presents distributions of hours worked per day, days worked per week and weeks worked per year for the benchmark allocation and selected experiments.

6.1.1. Benefits from hours flexibility

Using the model we examine the importance of schedule choice flexibility on time allocations and the value of flexible choice of schedules. We compare a restricted 5-days workweek allocation to the benchmark scenario and also calculate the cost of such restriction in terms of consumption. This exercise is of particular interest because regulations that aim to restrict the number of working days per week (or weekend length) are constantly debated by policymakers.

In an economy where workers can freely choose work schedules, a restriction of maximum of 5-days per week leads to an overall utility loss. Given that there is a large mass of workers that voluntarily choose a 5-day schedule, the impact of the policy is moderated. In the benchmark allocation 82% work 5 days per week. Workers who work less than 5 days per week constitute 9% of the economy, these workers have relatively low weekly fixed costs and relatively high daily costs of work. Forcing these workers to increase their days worked reduces their hours per day from 8.8 to 7.1, and weeks worked from 43.1 to 42.5. Workers with more than 5 days work increase hours worked per day from 10.7 hours to 13.3 after the policy is implemented and increase weeks worked from 43.0 to 45.2. Restricting to a maximum 5 days per week does not change the labor force participation rate. Column (3) in Table 9 presents labor supply allocations for this experiment. The average utility loss suffered by constrained workers is equivalent to 22% of annual consumption. We discuss effects of such schedule flexibility loss in conjunction with other policies in the following paragraphs.

6.1.2. Restricting hours worked per week

We analyze the effects of weekly hours restrictions on the labor market. Our experiment uses the general lines of the French policy that implements a rigid 35-hour working week, which was gradually implemented between 1982-2012. The French policy implements a list of regulations regarding weekly hours, overtime restrictions, subsidies to firms and changes in tax schemes. France is not the only economy that has legal restrictions on weekly hours; other countries, some only for selected industries, implement similar regulations with various degrees of enforcement.[19]

Our experiment is simple; we restrict individuals not to work more that 45 or 40-hours per week and analyze changes in labor supply and labor market allocations in terms of work schedule.

In the benchmark allocation, 34% work more than 45-hours per week. We show that constrained individuals reduce average daily hours from 10.9 to 9.7 and average days worked per week from 5.5 to 4.7; they increase weeks worked per year from 43.6 to 44.8. The 45-hours per week restriction also leads to a 5% reduction in labor force participation. The dropouts are workers with high weekly fixed costs who were working particularly long hours before the policy. Column (3) in Table 9 presents aggregate labor supply allocations for this experiment. The average utility loss suffered by constrained workers (not including those who left the labor force) is equivalent to 15% of annual consumption.

Setting the maximum hours worked per week at 40 affects 61% of workers. Forcing these workers to reduce weekly hours to 40, leads to a reduction in their hours worked per day from 9.58 to 8.8, and a reduction in days worked per week from 5.2 to 4.7, on average; they increase their weeks worked per year from 43.2 to 43.8. Labor force participation drops by 7%. Column (5) in Table 8 presents labor supply allocations for this experiment for the aggregate economy. The average utility loss suffered by constrained workers is equivalent to 12% of annual consumption (it is lower than in the 45-hours per week policy case because more workers drop out of the labor force).

Weekly hours restrictions also imply reductions in wage rates for constrained workers. With the 45-hours per week restriction, average wage rates of constrained workers drop from 6.3 to 5.4, and with the 40-hours per week policy wages drop from 6.2 to 5.7 (workers who work more hours in the benchmark allocation are, on average, less productive). We evaluate allocations and utility losses for policies that restrict weekly hours but keep wages of constrained workers at pre-policy levels (for those workers who choose the maximum weekly hours allowed after the policy is implemented). Aggregate allocations are reported in columns (4) and (6) of Table 9. Implementing the 45-hours policy with a constant wage leads to a utility loss of 12% in terms of annual consumption in the benchmark economy, for constrained workers.

[19]Examples are Algeria, Bahamas, Belgium, Bulgaria, Chad, Chile, Czech Republic, Egypt, Italy, Mongolia, Morocco, Netherlands, Republic of Korea, Portugal, Rwanda and Slovenia.

The 40-hours per week policy with a constant wage leads to a 11% utility loss for constrained workers.

The experiments show that hours restrictions lead to declines in labor force participation and in utility of the remaining workers, even when keeping wage rates constant. The most affected workers are those with high fixed costs, who need to work long hours to sustain consumption. Our results also show that restrictions on weekly hours reduce both hours per day and days per week, which may require significant adjustments on the firm side to transition to shorted workweeks.

Finally, implementing weekly hours restrictions together with a 5-days per week policy leads to further reductions in labor force participation. Simulation results are reported in columns (4)-(7) of Table 9. In the case of 45-hours and 5-days per week policy, 25% of workers are OLF, whereas in the case of 40-hours and 5-days per week policy, 26% are out of the labor force; these numbers are compared to 15% and 12% OLF when there is no 5-days restriction. Hours per day decrease and days per week increase when adding the 5-days restriction.

6.1.3. Fixed costs and labor supply

We analyze how changes in daily and weekly costs affect labor supply allocations. These experiments aim to assess effects of policies that impact commuting costs or child care costs.

Table 10 summarizes outcomes of the simulations. Columns (2) and (3) show results for 1% and 5% declines in daily fixed costs. A 1% (5%) decline in daily fixed cost reduces the number of hours worked per day from 8.84 to 8.74 (8.35); no change in days worked and a marginal decline in weeks worked per year. Reducing daily fixed costs leads to an increase in labor force participation by 0.5% (1.3%). The average utility gain is equivalent to 5% (23%) of annual consumption.

Columns (4) and (5) show results for 1% and 5% increases in daily fixed costs. An increase in the daily fixed cost by 1% (5%) leads to an increase in hours worked per day from 8.84 to 8.92 (9.31). There is no change in days worked and marginal increase in weeks worked per year. The cost of this policy, in terms of annual average consumption in the benchmark allocation, is 6% (39%). Labor force participation declines by 0.4% (1.1%).

The remaining columns (6)-(9) show simulation results for changes in weekly costs of work. The 1% and 5% changes in weekly fixed costs of work do not generate big movements in work schedules. A 1% (5%) decline in weekly fixed cost leads to a utility gain equivalent to 1% (5%) of annual consumption in the benchmark environment. The loss from an increase in weekly costs by 1% (5%) is 2% (6%). A drop in weekly fixed costs leads to an increase in labor force participation, whereas an increase in costs reduces participation.

7. Conclusion

The standard implicit assumption in the labor supply framework is that hours worked per day and days worked per week are perfect substitutes and therefore can be aggregated into weekly hours. This study extends the standard framework and proposes a model of a three-dimensional labor supply. In the extended model individuals make choices over hours per day, days per week and weeks per year, incorporating daily and weekly fixed costs of work and allowing wage rates to be tied to total hours worked.

We show that hours worked per day and days worked per week are not perfect substitutes. Each type of leisure, during workweek on days worked, during workweek on days not worked and on the weeks not worked, has a distinct share in preferences. The leisure on days not worked during a workweek has the largest share and leisure on weeks off has the smallest share.

We use the model to evaluate a number of policies. In our framework, the intertemporal elasticity of labor supply is around 0.2, within the standard range of micro elasticities. Hours worked per day is the most elastic margin of labor supply whereas weeks worked is the least elastic. We produce a large range of elasticities for the same set of model parameters by varying work schedules and degrees of attachment to the labor force. The less attached workers have a significantly higher elasticity of labor supply which can explain the differences between "macro" and "micro" elasticities. Seemingly similar workers with the same weekly hours have different elasticities of labor supply if they allocate their time differently. Those who work fewer days have higher elasticity.

We calibrate the model to analyze changes in labor supply in response to changes in daily and weekly fixed costs of work, restrictions on schedule choice flexibility and restrictions on weekly hours. We show that when there is a relatively small decline in daily fixed costs of work (costs that account for commuting, child care, etc.), there will be a reduction in hours worked per day, no change in days worked per week and a marginal decline in weeks worked per year. There are substantial utility gains and losses associated with small changes in daily fixed costs. Similar magnitude changes in weekly costs have small effects on time allocation. Costs of losing schedule flexibility is analyzed in an environment that restricts days worked to 5 days per week. This policy is associated with a significant utility cost, equivalent to 22% of annual consumption value for constrained workers. We also evaluate policies that restrict weekly hours worked, such as the French 35-hours-per-week policy. We analyze changes in time allocations, labor force participation and utility losses associated with a 40- an 45-hours restrictions. Such policies lead to large utility losses and declines in labor force participation.

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Table 1: First stage, first-difference method, 1996 SIPP

	men				women			
	all		job movers		all		job movers	
	$\Delta \ln l1$	$\Delta \ln l2$	$\Delta \ln l1$	$\Delta \ln l2$	$\Delta \ln l1$	$\Delta \ln l2$	$\Delta \ln l1$	$\Delta \ln l2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ ln sp. hours	-0.0256	0.0303	-0.0860	0.1194	0.0191	0.0185	0.0266	0.0000
	(0.0180)	(0.0221)	(0.0374)	(0.0441)	(0.0223)	(0.0267)	(0.0394)	(0.0515)
Δ ln non-labor inc.	0.0019	-0.0033	0.0096	-0.0144	0.0030	-0.0078	0.0071	-0.0089
	(0.0023)	(0.0030)	(0.0045)	(0.0058)	(0.0037)	(0.0039)	(0.0074)	(0.0067)
Δ work travel	-0.0053	-0.0023	-0.0009	-0.0176	-0.0104	0.0042	-0.0167	-0.0013
	(0.0050)	(0.0071)	(0.0100)	(0.0134)	(0.0081)	(0.0084)	(0.0142)	(0.0154)
childbirth {0,1}	0.0064	-0.0047	-0.0034	-0.0121	0.0562	-0.0609	0.0296	-0.0805
	(0.0133)	(0.0188)	(0.0303)	(0.0397)	(0.0222)	(0.0205)	(0.0405)	(0.0382)
educ	0.0004	-0.0004	0.0029	-0.0025	-0.0015	0.0033	0.0014	-0.0010
	(0.0013)	(0.0021)	(0.0031)	(0.0045)	(0.0023)	(0.0025)	(0.0046)	(0.0052)
age	-0.0001	0.0001	0.0005	-0.0011	0.0009	-0.0010	0.0009	-0.0027
	(0.0005)	(0.0007)	(0.0010)	(0.0013)	(0.0007)	(0.0007)	(0.0013)	(0.0015)
black	0.0124	-0.0132	0.0043	-0.0261	0.0120	-0.0029	0.0082	0.0270
	(0.0156)	(0.0250)	(0.0356)	(0.0532)	(0.0167)	(0.0198)	(0.0377)	(0.0336)
job change	-0.0118	0.0120			-0.0033	-0.0026		
	(0.0100)	(0.0133)			(0.0129)	(0.0128)		
shift change	-0.0112	-0.0055	-0.0156	-0.0386	-0.0158	0.0246	-0.0500	0.0570
	(0.0127)	(0.0171)	(0.0254)	(0.0325)	(0.0171)	(0.0173)	(0.0308)	(0.0311)
cons	0.0000	-0.0138	-0.0667	0.0885	-0.0273	0.0075	-0.0560	0.1204
	(0.0273)	(0.0411)	(0.0590)	(0.0863)	(0.0445)	(0.0473)	(0.0848)	(0.0939)
N	3898	3898	1082	1082	3446	3446	1060	1060
R2 adj.	0.0004	-0.0009	0.0054	0.0107	0.0018	0.0035	-0.0002	0.0061
F-stat excl. IV	0.97	0.74	2.11	3.51	2.51	3.29	0.78	1.55

Note: All estimations use 1996 SIPP weights. Model 1 refers to the full model, i.e. model with three leisure variables. Model 2 refers to the simplified model which does not consider weeks and uses two leisure variables. Job movers are workers who changed employers between the 4th and 10th waves of the survey. Spouse hours are usual hours worked per week, only married workers in the sample. Work travel is in 100 miles. Coefficients and robust standard errors presented.

Table 2: First-stage, first differences method, men and women, 1996 SIPP

	men				women			
	all		job movers		all		job movers	
	$\Delta \ln l1$	$\Delta \ln l2$	$\Delta \ln l1$	$\Delta \ln l2$	$\Delta \ln l1$	$\Delta \ln l2$	$\Delta \ln l1$	$\Delta \ln l2$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ ln sp. hours	-0.0256	0.0303	-0.0860	0.1194	0.0191	0.0185	0.0266	0.0000
	(0.0180)	(0.0221)	(0.0374)	(0.0441)	(0.0223)	(0.0267)	(0.0394)	(0.0515)
Δ ln non-labor inc.	0.0019	-0.0033	0.0096	-0.0144	0.0030	-0.0078	0.0071	-0.0089
	(0.0023)	(0.0030)	(0.0045)	(0.0058)	(0.0037)	(0.0039)	(0.0074)	(0.0067)
Δ work travel	-0.0053	-0.0023	-0.0009	-0.0176	-0.0104	0.0042	-0.0167	-0.0013
	(0.0050)	(0.0071)	(0.0100)	(0.0134)	(0.0081)	(0.0084)	(0.0142)	(0.0154)
childbirth {0,1}	0.0064	-0.0047	-0.0034	-0.0121	0.0562	-0.0609	0.0296	-0.0805
	(0.0133)	(0.0188)	(0.0303)	(0.0397)	(0.0222)	(0.0205)	(0.0405)	(0.0382)
educ	0.0004	-0.0004	0.0029	-0.0025	-0.0015	0.0033	0.0014	-0.0010
	(0.0013)	(0.0021)	(0.0031)	(0.0045)	(0.0023)	(0.0025)	(0.0046)	(0.0052)
age	-0.0001	0.0001	0.0005	-0.0011	0.0009	-0.0010	0.0009	-0.0027
	(0.0005)	(0.0007)	(0.0010)	(0.0013)	(0.0007)	(0.0007)	(0.0013)	(0.0015)
black	0.0124	-0.0132	0.0043	-0.0261	0.0120	-0.0029	0.0082	0.0270
	(0.0156)	(0.0250)	(0.0356)	(0.0532)	(0.0167)	(0.0198)	(0.0377)	(0.0336)
job change	-0.0118	0.0120			-0.0033	-0.0026		
	(0.0100)	(0.0133)			(0.0129)	(0.0128)		
shift change	-0.0112	-0.0055	-0.0156	-0.0386	-0.0158	0.0246	-0.0500	0.0570
	(0.0127)	(0.0171)	(0.0254)	(0.0325)	(0.0171)	(0.0173)	(0.0308)	(0.0311)
cons	0.0000	-0.0138	-0.0667	0.0885	-0.0273	0.0075	-0.0560	0.1204
	(0.0273)	(0.0411)	(0.0590)	(0.0863)	(0.0445)	(0.0473)	(0.0848)	(0.0939)
N	3898	3898	1082	1082	3446	3446	1060	1060
R2 adj.	0.0004	-0.0009	0.0054	0.0107	0.0018	0.0035	-0.0002	0.0061
F-stat excl. IV	0.97	0.74	2.11	3.51	2.51	3.29	0.78	1.55

Note: All estimations use 1996 SIPP weights. Model 1 refers to the full model with three leisure variables. Model 2 refers to the simplified model that abstracts from weeks choice. "Job change" and "shift change" are $0, 1$ dummy variables to indicate such changes between the waves. Job movers are workers who changed employers between the 4th and 10th waves of the survey. Spouse hours are usual hours worked per week, only married workers in the sample. Commuting distance is in 100 miles. Coefficients and robust standard errors presented.

Table 3: Second-stage, first-differences method, 1996 SIPP

	model 1	model 2					
				men		women	
	all	all	job movers	all	job movers	all	job movers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta \ln l1$	-3.5234	-3.0386	-2.9629	-1.3317	-3.4535	-3.2670	-1.9228
	(5.0047)	(1.7108)	(1.8994)	(2.3740)	(2.7291)	(1.6232)	(1.8034)
$\Delta \ln l2$	-2.9464	-2.9343	-2.5658	-2.4127	-2.8614	-2.4569	-1.3349
	(3.6169)	(1.4503)	(1.0711)	(2.1578)	(1.7043)	(1.4703)	(1.2576)
$\Delta \ln l3$	-1.6040						
	(2.4764)						
N	7344	7344	2142	3898	1082	3446	1060
γ_n	3.52	3.04	2.96	1.33	3.45	3.27	1.92
	(5.00)	(1.71)	(1.90)	(2.37)	(2.73)	(1.62)	(1.80)
ρ_1	1.17	1.44	1.31	7.27	1.17	1.08	1.45
	(1.06)	(0.77)	(0.90)	(47.38)	(0.72)	(0.39)	(2.06)
ρ_2	0.64						
	(0.33)						

Note: All estimations use SIPP weights. Model 1 refers to the full model with three leisure variables. Model 2 refers to the simplified model that abstracts from weeks choice. The parameters γ_n, ρ_1 and ρ_2 are computed using the coefficients of $\ln l1$, $\ln l2$ and $\ln l3$, see equation (7). Standard errors of ρ_1 and ρ_2 are calculated using the delta method. Coefficients and robust standard errors presented.

Table 4: First-stage, consumption method, ATUS-CPS 2003-2015

	men						women		
		IV2			IV4			IV1	
	ln l1	*ln l2*	*ln l3*	*ln l1*	*ln l2*	*ln l3*	*ln l1*	*ln l2*	*ln l3*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
work travel	-0.0036	-0.0021	0.0029	-0.0009	-0.0096	0.0081			
	(0.0027)	(0.0021)	(0.0069)	(0.0037)	(0.0028)	(0.0084)			
children	-0.0420	-0.0140	0.0470	-0.0230	-0.0100	0.0080	-0.0620	0.0300	-0.0680
	(0.0130)	(0.0100)	(0.0260)	(0.0140)	(0.0120)	(0.0320)	(0.0240)	(0.0190)	(0.0550)
child care	0.0109	-0.0019	-0.0109	0.0075	-0.0022	-0.0046	0.0198	-0.0106	0.0027
	(0.0017)	(0.0015)	(0.0042)	(0.0022)	(0.0021)	(0.0058)	(0.0029)	(0.0021)	(0.0070)
month4	-0.1090	0.0130	0.2470	-0.1150	0.0150	0.1640	-0.0820	0.1190	0.0750
	(0.0450)	(0.0370)	(0.1020)	(0.0680)	(0.0460)	(0.1150)	(0.1150)	(0.0720)	(0.1460)
month5	-0.0100	-0.1030	0.2930	0.0500	-0.1400	0.3410	-0.0780	-0.0310	0.4450
	(0.0290)	(0.0260)	(0.0640)	(0.0410)	(0.0320)	(0.0750)	(0.0600)	(0.0540)	(0.1040)
month6	-0.0580	-0.1060	0.3510	-0.0670	-0.1400	0.4300	-0.0190	0.0000	0.2810
	(0.0270)	(0.0230)	(0.0650)	(0.0410)	(0.0310)	(0.0770)	(0.0560)	(0.0500)	(0.0830)
weekend	0.0130	-0.0550	0.0070	-0.0770	-0.0140	-0.0300	0.3360	-0.2930	0.0260
	(0.0350)	(0.0320)	(0.0760)	(0.0560)	(0.0450)	(0.0900)	(0.0760)	(0.0540)	(0.1500)
sp. earn				0.0270	0.0390	-0.1370			
				(0.0230)	(0.0220)	(0.0520)			
age	0.0020	-0.0010	-0.0090	0.0030	-0.0050	0.0020	0.0020	-0.0060	-0.0040
	(0.0010)	(0.0010)	(0.0030)	(0.0020)	(0.0020)	(0.0040)	(0.0020)	(0.0020)	(0.0040)
black	-0.0430	0.0300	-0.0730	-0.1090	-0.0040	-0.1290	0.0380	-0.0330	-0.2050
	(0.0530)	(0.0400)	(0.0910)	(0.0840)	(0.0670)	(0.1150)	(0.0520)	(0.0440)	(0.0870)
married	-0.0150	-0.0170	0.0130	-0.0670	-0.0540	0.1130	0.1230	-0.0160	-0.0480
	(0.0270)	(0.0240)	(0.0620)	(0.0480)	(0.0450)	(0.1150)	(0.0690)	(0.0480)	(0.1520)
educ	0.0110	-0.0040	-0.0040	0.0110	-0.0070	0.0150	-0.0130	-0.0060	0.0370
	(0.0040)	(0.0040)	(0.0090)	(0.0060)	(0.0050)	(0.0120)	(0.0070)	(0.0060)	(0.0190)
sp. hours				0.0020	0.0000	-0.0040			
				(0.0020)	(0.0010)	(0.0030)			
state	+	+	+	+	+	+	+	+	+
year	+	+	+	+	+	+	+	+	+
cons	7.1810	7.9090	5.3190	6.9580	8.1360	4.9420	7.3930	8.1890	4.8150
	(0.1710)	(0.1510)	(0.3610)	(0.2770)	(0.2190)	(0.3730)	(0.2310)	(0.2210)	(0.4720)
N	2856	2856	2856	1545	1545	1545	749	749	749
R2 adj.	0.0870	0.0900	0.0640	0.1720	0.1680	0.1100	0.3290	0.2990	0.1210

Note: All estimations use ATUS weights. Work travel and child care are in minutes*10. Excluded month is March. Coefficients and robust standard errors presented.

Table 5: Second-stage, consumption method, ATUS-CPS 2003-2015

	men				women		
	IV1	IV2	IV3	IV4	IV1	IV2	IV4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln l1$	1.0950	1.2360	1.4810	1.4250	1.3250	1.0810	0.9380
	(0.4390)	(0.4380)	(0.4540)	(0.4490)	(0.7370)	(0.6510)	(0.5800)
$\ln l2$	1.3730	1.5570	2.4100	2.3540	1.8570	1.4430	1.2110
	(0.5820)	(0.5790)	(0.7050)	(0.6840)	(1.0500)	(0.9200)	(0.8030)
$\ln l3$	0.4940	0.5860	0.8660	0.8040	0.1460	0.0910	0.1710
	(0.3090)	(0.3100)	(0.3420)	(0.3210)	(0.3260)	(0.2860)	(0.2450)
$\ln wage$	0.3600	0.3840	0.2910	0.2840	0.3570	0.4100	0.4700
	(0.0980)	(0.1020)	(0.1040)	(0.1020)	(0.2100)	(0.1780)	(0.1520)
N	2856	2856	1545	1545	749	749	749
γ_c	2.78	2.60	3.44	3.52	2.80	2.44	2.13
	(0.76)	(0.69)	(1.24)	(1.27)	(1.65)	(1.06)	(0.69)
γ_n	3.04	3.22	5.09	5.02	3.71	2.64	2.00
	(0.81)	(0.78)	(1.83)	(1.78)	(3.56)	(2.26)	(1.57)
ρ_1	1.87	1.83	2.03	2.06	1.92	2.15	2.59
	(0.64)	(0.57)	(0.57)	(0.60)	(0.76)	(1.18)	(2.09)
ρ_2	0.67	0.69	0.73	0.70	0.15	0.14	0.37
	(0.22)	(0.20)	(0.22)	(0.22)	(0.29)	(0.38)	(0.51)
F-test $\ln l1$	10.85	9.06	5.32	4.70	10.05	8.81	7.67
F-test $\ln l2$	6.86	5.81	7.71	6.84	10.08	8.67	8.18
F-test $\ln l3$	8.40	6.99	7.69	6.74	3.77	3.34	3.04

Note: All estimations use ATUS weights. The parameters γ_c, γ_n, ρ_1 and ρ_2 are computed using the coefficients of $\ln l1$, $\ln l2$ and $\ln l3$, see equation (9). Standard errors of ρ_1 and ρ_2 are calculated using the delta method. Other included controls are age, years of schooling, race, marital status, state and year fixed effects. The included instruments in IV1 are number of children, time spent on child care, calendar month of the interview and an indicator for a weekend interview; IV2 adds commuting time; IV3 and IV4 are limited to workers with spouses; IV4 also includes spousal earnings as an instrument and spousal hours as a control. Estimations in columns (5) and(6) use a subsample of women whose earnings are similar or higher than earnings of their spouses. F-tests statistics are from first-stage estimations. Coefficients and robust standard errors presented.

Table 6: Labor supply elasticity

	ATUS-CPS				SIPP
	men, all	men, spouse present	women, spouse present	all	job-to-job movers
	(1)	(2)	(3)	(4)	(5)
Parameter values:					
γ_n	3.04	5.09	3.71	3.52	3.04
ρ_1	1.87	2.03	1.92	1.17	1.44
ρ_2	0.67	0.73	0.15	0.64	0.64
Mean values:					
w	26.3	29.2	26.8	16.1	16.1
n	49.3	49.5	50.3	51.0	51.0
d	5.0	5.0	5.0	4.9	4.9
h	8.9	8.9	8.7	8.3	8.3
Elasticities:					
Fixed costs: $fd = w$, $fn = w$					
η_n	0.01	0.00	0.00	0.00	0.00
η_d	0.06	0.03	0.05	0.06	0.07
η_h	0.13	0.05	0.12	0.15	0.17
η_H	0.19	0.09	0.17	0.22	0.24
Fixed costs: $fd = 3w$, $fn = 3w$					
η_n	0.01	0.01	0.01	0.00	0.00
η_d	0.08	0.04	0.07	0.08	0.09
η_h	0.08	0.00	0.08	0.11	0.12
η_H	0.17	0.05	0.16	0.19	0.22

Note: The elasticities are estimated using equations (11a)-(11c). Parameter values are from Tables 3 and 5. Parameters used in column (1) are from Table 5, column (2). Parameters used in column (3) are from Table 3, column (1). The parameters γ_n and ρ_1 used in columns (3) - (7) are based on estimates of job-to-job movers in Table 3, value of ρ_2 is from Table 3, column (1). Mean values for hourly wage, hours worked per day, days worked per week and weeks worked are reported in the Online Appendix. Fixed costs are as specified; $\theta = 0.4$, from Aaronson and French (2004).

Table 7: Labor supply elasticity and work schedule, simulations

	average schedule, part-year 26 weeks (1)	24 weekly hours 2d/12h schedule (2)	24 weekly hours 3d/8h schedule (3)	40 hours per week, 3d/13.3h schedule (4)	40 hours per week, 4d/10h schedule (5)	40 hours per week, 5d/8h schedule (6)	40 hours per week, 6d/6.7h schedule (7)
Parameter values:							
γ_n	3.28	3.28	3.28	3.28	3.28	3.28	3.28
ρ_1	1.81	1.81	1.81	1.81	1.81	1.81	1.81
ρ_2	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Mean values:							
w	26.3	26.3	26.3	26.3	26.3	26.3	26.3
n	26.0	49.3	49.3	49.3	49.3	49.3	49.3
d	5.0	2.0	3.0	3.0	4.0	5.0	6.0
h	8.9	12.0	8.0	13.3	10.0	8.0	6.7
Elasticities							
η_n	0.14	0.01	0.01	0.01	0.01	0.01	0.01
η_d	0.11	0.41	0.22	0.22	0.12	0.07	0.03
η_h	0.28	0.16	0.29	0.06	0.11	0.13	0.13
η_H	0.54	0.58	0.52	0.29	0.25	0.21	0.17

Note: The elasticities are estimated using equations (11a)-(11c). Parameter values are from Table 5, column (1). Mean values for hourly wage, hours worked per day, days worked per week and weeks worked are reported in the Online Appendix. Fixed costs are as specified; $\theta = 0.4$, from Aaronson and French (2004). In these simulations we assume $fd = w$, $fn = w$.

Table 8: Policy experiments, restrictions on weekly hours and days worked

	Data (1)	Benchmark (2)	Days=5 (D5) (3)	D5+weekly hours (WH=45) (4)	D5+WH45 +wage constant (5)	D5+WH40 (6)	D5+WH40 +wage constant (7)
hours	8.88	8.84	8.96	8.21	8.21	7.74	7.74
	(1.74)	(1.39)	(1.88)	(0.77)	(0.77)	(0.41)	(0.41)
days	4.98	5.00	5.00	5.00	5.00	5.00	5.00
	(0.87)	(0.45)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
weeks	49.27	43.10	43.25	43.59	43.22	44.15	43.54
	(7.77)	(0.42)	(0.93)	(1.44)	(1.07)	(1.77)	(1.39)
weekly hours	43.68	44.43	44.78	41.01	41.03	38.71	38.71
	(8.61)	(9.69)	(9.41)	(3.87)	(3.86)	(2.03)	(2.03)
wage	8.26	7.16	7.20	6.99	7.02	6.89	7.00
	(2.50)	(2.84)	(2.89)	(2.74)	(2.74)	(2.76)	(2.72)
fd		-2.18	0.10	1.00	1.22	1.03	1.15
		(34.48)	(32.46)	(23.49)	(23.52)	(22.26)	(22.46)
fn		119.64	105.53	53.16	53.38	47.20	48.19
		(290.79)	(249.20)	(130.89)	(129.97)	(119.02)	(120.29)
Utility loss % of benchmark annual consumption			22%	15%	10%	13%	11%
			(0.84)	(0.62)	(0.22)	(0.24)	(0.18)
% OLF		16.5%	16.5%	24.7%	24.3%	26.2%	25.7%

Note: Data calculations are produced using the ATUS-CPS men sample. Wage for calibration is residual controlling for education, experience, race, state and year effects. D5 refers to days=5 policy experiment and WH40 and WH45 refer to restriction on weekly hours of 40 and 45, respectively. Utility loss is calculated as a consumption equivalent using constrained individuals in the labor force after policy implementation.

Table 9: Policy experiments, restrictions on weekly hours worked

	Data (1)	Benchmark (2)	Hours≤45 (3)	Hours≤45 wage constant (4)	Hours≤40 (5)	Hours≤40, wage constant (6)
hours	8.88	8.84	8.54	8.56	8.35	8.30
	(1.74)	(1.39)	(1.32)	(1.35)	(1.36)	(1.20)
days	4.98	5.00	4.84	4.84	4.69	4.71
	(0.87)	(0.45)	(0.54)	(0.54)	(0.66)	(0.62)
weeks	49.27	43.10	43.54	43.05	43.95	43.42
	(7.77)	(0.42)	(1.17)	(0.73)	(1.41)	(1.23)
weekly hours	43.68	44.43	40.88	40.92	38.43	38.45
	(8.61)	(9.69)	(4.25)	(4.26)	(2.46)	(2.47)
wage	8.26	7.16	6.95	6.93	6.84	6.96
	(2.50)	(2.84)	(2.71)	(2.72)	(2.72)	(2.69)
fd		-2.18	0.22	0.47	-0.03	-0.03
		(34.48)	(26.85)	(26.99)	(25.98)	(25.98)
fn		119.64	70.67	71.54	65.83	65.83
		(290.79)	(170.53)	(170.76)	(162.75)	(162.75)
Utility loss % of benchmark annual consumption			15%	12%	12%	11%
			(0.28)	(0.17)	(0.22)	(0.16)
% OLF		16.5%	21.4%	21.0%	22.8%	22.8%

Note: Data calculations are produced using the ATUS-CPS men and women samples. D5 refers to days=5 policy experiment and WH40 and WH45 refer to restriction on weekly hours of 40 and 45, respectively. Utility loss is calculated as a consumption equivalent using constrained individuals in the labor force after policy implementation.

Table 10: Policy experiments, changes in daily and weekly fixed costs of work

	Benchmark (1)	(-1%) in fd (2)	(-5%) in fd (3)	(+1%) in fd (4)	(+5%) in fd (5)	(-1%) in fn (6)	(-5%) in fn (7)	(+1%) in fn (8)	(+5%) in fn (9)
hours	8.84	8.73	8.35	9.92	9.30	8.83	8.81	8.83	8.84
	(1.39)	(1.39)	(1.42)	(1.36)	(1.38)	(1.38)	(1.39)	(1.38)	(1.37)
days	5.00	5.00	5.00	5.00	4.99	5.00	5.00	5.00	5.00
	(0.45)	(0.45)	(0.45)	(0.45)	(0 .44)	(0.45)	(0.45)	(0.45)	(0.44)
weeks	43.10	43.06	43.09	43.10	43.13	43.10	43.10	43.10	43.10
	(0.42)	(0.41)	(0.42)	(0.42)	(0.44)	(0.41)	(0.43)	(0.41)	(0.41)
hours/week	44.43	43.94	42.05	44.81	46.72	44.35	44.32	44.39	44.41
	(9.69)	(9.71)	(9.93)	(9.47)	(9.42)	(9.58)	(9.61)	(9.59)	(9.52)
wage	7.16	7.13	7.00	7.20	7.32	7.16	7.17	7.16	7.17
	(2.84)	(2.84)	(2.83)	(2.85)	(2.85)	(2.84)	(2.85)	(2.85)	(2.84)
fd	-2.18	-3.87	-10.97	-0.36	6.84	-2.07	-2.61	-1.90	-1.50
	(34.48)	(34.10)	(33.10)	(34.54)	(35.30)	(34.34)	(35.53)	(33.97)	(32.99)
fn	119.64	119.36	118.18	117.64	113.58	117.36	122.74	117.16	114.76
	(290.8)	(289.4)	(292.4)	(287.5)	(280.2)	(285.6)	(296.2)	(283.8)	(273.0)
Utility loss, % of benchmark annual consumption		-5%	-23%	6%	39%	-1%	-5%	2%	6%
		(0.04)	(0.14)	(0.09)	(0.79)	(0.05)	(0.14)	(0.12)	(0.42)
% OLF	16.5%	16.4%	15.6%	16.9%	17.6%	16.5%	15.9%	16.7%	17.3%

Note: Utility loss is calculated as a consumption equivalent using constrained individuals in the labor force after policy implementation.

Table A1: Summary statistics, SIPP, 1996

	All, N=7344		Men, N=3898		Women, N=3446	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
	(1)	(2)	(3)	(4)	(5)	(6)
weeks 4	50.74	4.78	50.98	4.20	50.46	5.35
weeks 10	50.59	5.32	50.92	4.55	50.21	6.06
days per week 4	4.93	0.88	5.10	0.73	4.73	0.98
days per week 10	4.93	0.81	5.09	0.65	4.76	0.93
hours per day 4	8.25	1.93	8.72	1.75	7.72	1.98
hours per day 10	8.27	1.70	8.69	1.55	7.80	1.74
real hourly pay 4	15.21	13.68	17.57	16.39	12.53	9.02
real hourly pay 10	17.02	16.24	19.67	19.70	14.02	10.26
spousal hours 4	28.61	20.15	21.11	19.25	37.13	17.62
spousal hours 10	28.50	19.84	21.42	19.22	36.56	17.31
non-labor inc 4	2369.5	2724.9	1664.1	1920.9	3171.4	3234.9
non-labor inc 10	2676.6	2858.9	1919.9	2095.9	3536.8	3329.0
miles 4	97.0	103.9	111.3	116.5	80.8	84.4
miles 10	95.5	102.8	108.2	114.0	81.1	86.0
childbirth {0,1}	0.12	0.33	0.13	0.34	0.11	0.31
changed shift? {0,1}	0.24	0.42	0.24	0.42	0.24	0.42
changed employer? {0,1}	0.30	0.46	0.28	0.45	0.31	0.46
educ	13.89	2.70	13.83	2.97	13.96	2.36
age	42.50	8.88	43.00	8.89	41.93	8.85
black	0.07	0.26	0.07	0.26	0.07	0.26

Note: First-differences estimation approach uses waves 4 and 10 in the 1996 SIPP, corresponding statistics are denoted as 4 and 10. Distance to work is measured in miles per week and available in waves 3, 6, 9 and 12 of the SIPP, the reported statistics correspond to waves 3 and 12. All measures are weighted using the SIPP weights.

Table A2: Summary statistics, ATUS-CPS, 2003-2015

	Men, N=2856		Women, N=3075		Women, high earners sample, N=749	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
	(1)	(2)	(3)	(4)	(5)	(6)
weeks	49.27	7.77	49.21	8.07	50.26	5.94
days per week	4.98	0.87	4.81	0.95	4.97	0.82
hours per day	8.88	1.74	8.22	1.71	8.65	1.53
real hourly pay	26.34	27.30	22.12	14.30	26.83	13.44
real hourly pay**	18.87	9.36	16.96	8.83	20.30	13.64
food/person	47.91	26.32	48.88	30.50	50.24	29.26
food/ eq unit	89.25	44.72	88.01	49.24	91.42	49.18
total food spending	160.0	83.4	151.9	85.1	154.1	81.3
age	38.51	9.44	39.50	9.67	39.33	9.21
grade	14.13	2.74	14.59	2.67	15.07	2.34
black	0.07	0.25	0.10	0.29	0.09	0.28
married	0.71	0.46	0.70	0.46	0.95	0.22
spousal hours	34.79	12.22	40.96	12.87	38.92	11.85
spousal earnings	728.6	479.2	1070.5	634.6	719.8	403.8
work travel (hours)	0.82	0.66	0.62	0.54	0.61	0.45
child care (hours)	0.44	0.94	0.74	1.14	0.75	1.04
children	1.15	1.14	1.02	1.07	0.95	0.96

Note: All measures are weighted using the ATUS weights. The variable real hourly pay** is recorded only for individuals who reported hourly wages, 1374 observations for men and 1572 observations for women Spousal hours and earnings available for a subsample; for 1545 men and 1766 women.