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EXERCISE, PHYSICAL ACTIVITY, AND EXERTION OVER THE BUSINESS CYCLE

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ABSTRACT

As economic recessions reduce employment and wages, associated shifts in time and income constraints would be expected to also impact individuals' health behaviors. Prior work has focused exclusively on recreational exercise, which typically represents only about 4% of total daily physical exertion. The general presumption in these studies is that, because exercise improves health, if unemployment increases exercise it must also improve health. Yet a person may be laid off from a physically demanding job, exercise more, and still be less physically active than when employed. Thus the relevant question is whether unemployment leads persons to become more physically active. We study this question with the American Time Use Survey (2003-2010), exploring the impact of the business cycle (and specifically the Great Recession) on individuals' exercise, other uses of time, and physical activity during the day. We also utilize more precise measures of exercise (and all other physical activities), which reflect information on the duration as well as intensity of each component activity, than has been employed in past studies. Using within-state variation in employment and unemployment, we find that recreational exercise tends to increase as employment decreases. In addition, we also find that individuals substitute into television watching, sleeping, childcare, and housework. However, this increase in exercise as well as other activities does not compensate for the decrease in work-related exertion due to job-loss. Thus total physical exertion, which prior studies have not analyzed, declines. These behavioral effects are strongest among low-educated males, which is validating given that the Great Recession led to some of the largest layoffs within the manufacturing, mining, and construction sectors. Due to the concentration of low-educated workers in boom-and-bust industries, the drop in total physical activity during recessions is especially problematic for vulnerable populations and may play a role in exacerbating the SES-health gradient during recessions. We also find some evidence of intra-household spillover effects, wherein individuals respond to shifts in spousal employment conditional on their own labor supply.

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1. Introduction

The Great Recession, which officially ended in June 2009, has witnessed the unemployment rate almost double from 5% to 9.5% and has caused widespread economic distress. Associated shifts in time and income constraints would also be expected to impact individuals' health behaviors and outcomes. While it may be intuitive to suppose that population health would improve with the macroeconomy, the evidence is surprisingly mixed. A number of recent studies suggest that individuals behave more healthily when the economy worsens; for instance, they exercise more, lose weight, drink and smoke less, and obtain more preventive medical care (Xu and Kaestner 2010; Ruhm 2000,2005). Other studies have uncovered no relation between economic fluctuations and health behaviors (Charles and DeCicca 2008). Still others find that recessions adversely impact healthy behaviors; individuals tend to consume a less healthy diet (Dave and Kelly 2011), exercise less, not more, and suffer from more physical impediments to mobility (Nicholson and Simon 2010).

The discordant results regarding exercise merit further study for several reasons. First, exercise itself is a significant direct input into health (Saffer et al. 2011; Danaei 2009; USDHHS 1996), as well as an indirect input through its effects on obesity (Shaw et al. 2006), which has become the second leading cause of preventable mortality (Danaei 2009). Second, most of the prior work has relied on surveys such as the Behavioral Risk Factor Surveillance System (BRFSS) and the National Health Interview Surveys (NHIS), wherein measures of exercise are limited to self-reported participation in "moderate" or "vigorous" exercise in the past week or past month. In addition to potential recall bias due to the retrospective nature of the questions, these measures also do not specifically reflect the duration and intensity of the exercise. Most importantly, exercise constitutes only about 4% of total physical activity.[1] Prior work has indicated significant substitution across exercise, work-related physical activity, and other modes of activity (Saffer et al. 2011). Thus, currently available estimates of the impact of the

[1] Authors' calculations based on the 2003-2010 American Time Use Surveys (see Table 1).

business cycle on exercise yields an incomplete picture since shifts in exercise may be counteracted with or reinforced by shifts in other activities.

We address these gaps and reexamine the results for exercise using the American Time Use Survey (ATUS), a detailed study of time use in the U.S. conducted from 2003 to 2010. We make four contributions in the process. First, because the ATUS measures the time spent exercising much more precisely than other surveys, we can estimate the effect of unemployment on exercise with much less measurement error, while also accounting for the intensity of all activities through the use of the Metabolic Equivalent of Task (MET). Second, since the ATUS tracks all activities during the day, we can estimate the effect of unemployment on physical exertion in activities other than exercise. This is important since prior studies have assumed that, because exercise improves health, if unemployment increases exercise it must also improve health. Yet it is not exercise per se but rather physical activity that improves health (Warburton 2006; Albanes et al. 1989). A person may be laid off from a physically active job, exercise more, and still be less physically active than when employed. Thus the pertinent question is whether unemployment induces persons to become more physically active. We study this question using the time use reported in the ATUS for all activities along with estimates of the physical exertion required by different activities. Third, we recognize that due to joint household production and potential intra-household reallocation of time subsequent to job-loss, it is potentially the household rather than the individual that may be the appropriate decision-making unit for married or cohabiting couples. Thus one question of interest is whether local area employment affects time use only through the respondent's employment or also through the employment of the spouse. Supplementary analyses allow for this possibility and test whether there are spillover effects of the business cycle on an individual's exercise and other activities that operate beyond the respondent's own employment. Finally, we utilize all available waves of the ATUS spanning up to 2010, allowing us to present updated estimates that exploit some of the largest increases in unemployment in the U.S. in the post-World War II period.

We find that unemployment is associated with an increase in the time spent exercising, but that total physical activity declines because of the reduced exertion at work and as significant increase in sedentary activities, such as television watching, eating, socializing, and sleeping. We find some evidence of intra-household spillover effects, consistent with spousal employment being an important determinant of own time use. Thus, for married or cohabiting couples the effect of the business cycle on exercise and other activities captures both an own-effect as well as a spousal effect of employment status. Estimates further indicate differential responses across socio-economic factors, consistent with intra-household spillover effects and consistent with a dose-response effect reflecting population subgroups whose employment was most adversely affected during the Great Recession.

2. Prior Studies

Several studies over the past decade have examined the relationship between exercise and unemployment. We focus on Ruhm (2005), Charles and DeCicca (2008), Xu and Kaestner (2010), and Nicholson and Simon (2010), as these are the four most relevant to our topic. The first two studies estimate the following specification:

$$Y_{ijmt} = X_{ijmt}\beta + E_{jmt}\gamma + \alpha_j + \lambda_t + \theta_m + \varepsilon_{ijt} \qquad (1)$$

where Y_{ijmt} denotes the health outcome for person *i* residing in area *j,* interviewed in month (or quarter) *m* and time period *t*. The vector X_{ijmt} includes personal characteristics, E_{jmt} is a measure of local area economic conditions, α_j are fixed area effects, λ_t are fixed time effects, θ_m are fixed month or quarter effects, and ε_{ijmt} is the error term.

Ruhm (2005) uses the BRFSS spanning 1987 through 2000. The primary exercise-related dependent variable is a dichotomous indicator for whether the respondent exercises regularly, defined as exercising outside of work for at least 20 minutes three or more times per week. The primary independent variable is the employment rate, defined as the ratio of employment to the civilian non-institutional population over the age of 16, averaged over the survey month and the two prior months. Controlling for age, gender, education, race and ethnicity, and marital status, the author finds an increase in the employment rate is associated with a decrease in exercise. This result is statistically significant under the assumption that errors may be correlated within state and month, but is not significant allowing for correlation within a state across months. Since the latter is as reasonable an assumption as the former, we cannot conclude from this study that unemployment significantly increases exercise.

Charles and DeCicca (2008) utilize the NHIS from 1997 to 2001. Their primary dependent variables consist of indicators that reflect frequency (any, 3+ and 5+ times per week) of “moderate” and “vigorous” exercise and any participation in strength training. The main independent variable is the unemployment rate in the MSA of residence. Using data from 1997, the authors first predict unemployment for each respondent based on demographic characteristics. They then estimate separate regressions for each decile of predicted unemployment. Clustering standard errors on MSA, the authors find no significant relationship between the MSA-level unemployment rate and the probability of exercise among respondents who are predicted to have the highest levels of unemployment. Nor are the signs consistent. Of the six exercise-related dependent variables, the signs are positive on three, negative on three, and significant on none.

Xu & Kaestner (2010) use data from the BRFSS and the NHIS to estimate the effect on exercise of changes in hours worked and in wages. Since both data sets have information on exercise but neither has data on hours worked or wages, the authors first predict hours and wages using the Current Population Survey (CPS) using demographic and other variables that are also present in the BRFSS and NHIS. They then predict hours of work and wages in the NHIS and BRFSS using the equation estimated with the CPS, and regress a dichotomous indicator for any physical exercise in the past 30 days on these predicted variables. Their estimated specification thus takes the following form:

$$Y_{ijt} = X_{ijt}\beta + \widehat{HRS}_{ijt}\gamma_1 + \widehat{WAGE}_{ijt}\gamma_2 + \alpha_j + \lambda_t + \varepsilon_{ijt} \quad (2)$$

where $\widehat{HRS}$ and$\widehat{WAGE}$ are predicted hours and wages. The sample is restricted to males between the ages of 25 and 55 with less than a college degree, to minimize sample selection bias. Clustering on state and year, the authors find that an increase in predicted hours worked reduces exercise; wages have no effect, controlling for hours. They do not report standard errors clustered on area, and thus inferential statistics cannot be directly compared with Ruhm (2005). They note that since most workers cannot choose their hours, only whether they will work, the results imply that unemployment raises exercise, consistent with Ruhm (2005).

Nicholson and Simon (2010) use the Gallup Healthways Wellbeing Survey from 2008 to 2010 and look at the effects of the current recession on health and health behaviors, including insurance coverage, doctor visits, smoking, eating healthily, exercise, and body mass index (BMI). Exercise is measured as the number of days in the past week that the respondent exercised for 30 minutes or more. The main independent variable is the local area unemployment rate, where "local" refers to county or state. Standard errors are clustered on the local area. The authors find that an increase in unemployment is significantly associated with a decrease in the number of days that the respondent exercised, and with a decrease in BMI.

The evidence from these studies is rather mixed. Ruhm (2005) and Xu and Kaestner (2010) suggest that unemployment raises exercise, though estimates in the former are not statistically significant if errors are assumed to be correlated within a given state and the latter study does not report standard errors under this assumption. Charles and DeCicca find no significant or consistent link between unemployment and exercise, while Nicholson and Simon (2010) suggest that the most recent recession is associated with a decrease in the frequency of exercise. While exercise is an important component of physical activity and an important input into health, it only comprises about 4% of total daily activities for the average individual. And it is total physical activity, not exercise per se, that is health-promoting. Thus, it cannot be presumed that if unemployment raises exercise, it must also improve health. Saffer et al. (2011) find that work-related physical activity and leisure-time physical activity, including exercise, tend to be substitutes. Thus, even if job-loss leads to more exercise, an individual who was physically active in their job may be still be less physically active after becoming unemployed. An exclusive focus on exercise thus yields an incomplete picture of the link between the business cycle and physical activity.

In addition, prior work has either completely bypassed or not explicitly estimated the effects of the business cycle that operate outside of own-employment effects. For instance, when Ruhm (2005) regresses exercise on the area employment rate, the parameter γ (equation 1) conflates both the own-effect and any spillover effects of spousal employment for married individuals (in addition to any other ecological effects). In contrast, the parameters γ_1 and γ_2 (equation 2) in Xu and Kaestner only reflect channels operating through shifts in own-work status. However, it is entirely plausible that a husband's job loss may alter the spouse's time allocation decisions across both market and non-market activities. We address these gaps in the literature by utilizing up-to-date and more measures of exercise as well as information on all other activities undertaken during the course of the day -- measures that reflect both the duration and intensity of each activity -- to investigate whether individuals exercise more and become more physically active during a recession. We also attempt to shed some light on intra-household spillovers by estimating effects consistent with own-employment effects and those that may operate external to shifts in own-employment.

3. Framework

3.1 Analytical Framework

The objective of this study is to assess the extent to which employment affects an individual's exercise and activity decisions. This question can be framed within a modified static version of the human capital model for the demand for health (Grossman 2000). Grossman combines the household production model of consumer behavior with the theory of human capital investment to analyze an individual's demand for health capital. In this paradigm, individuals demand health for its consumptive and investment aspects. That is, health capital directly increases utility and also reduces work loss due to illness, consequently increasing healthy time and raising earnings.[2] The individual maximizes a utility function that contains own health (H_i), exercise (EX_i), other activities (TZ_i), and household goods (Z) as arguments.[3]

$$U_i = U(H_i, EX_i, TZ_i, Z) \quad (3)$$

Utility is increasing at a diminishing rate with respect to all arguments except exercise. We assume that exercise is utility-reducing, but that other activities (such as child-care, television watching, etc.) are utility-enhancing. This dichotomy between EX and TZ is simply meant to denote that individuals may find some activities directly enjoyable and some unpleasant, though all physical activities can be health-promoting to different degrees.

Maximization occurs subject to the following production constraints for health and other household commodities, each of which is produced using time inputs and relevant market inputs; S represents an efficiency parameter and is typically proxied by the individual's schooling (S).[4]

$$H_i = H[EX_i, TZ_i, M_i; S] \quad (4)$$

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[2] Investment in health capital may also raise earnings by raising the marginal product of labor and consequently the wage rate.

[3] Expanding the above model to an intertemporal context does not alter the main conclusions or the directions of the comparative statics. See Grossman (2000) for a full exposition of the general intertemporal model. We also abstract from a joint household utility maximization framework (for instance, as employed in Chippori 1997) in order to maintain generality to both married and non-married individuals, and for convenience since the basic conclusions remain unaltered in either case. For married individuals, the spouse's health may enter as an argument into own-utility (3); this would lead to externalities with respect to spousal exercise and activities on own-utility, but the direction of effects again do not change materially.

[4] See Grossman and Kaestner (1997).

$$Z = Z[TZ_i, TZ_j, X; S] \tag{5}$$

Equation (4) denotes that own-health (H_i) is produced with exercise (EX_i), other non-sedentary activities (TZ_i), and market inputs such as medical care (M_i). The marginal product of exercise (H_{EX}) can be assumed to be higher than that of other activities (H_{TZ}).[5] Equation (4) denotes an analogous production function for household commodities (Z) such as child-care and housework. The joint nature of household production implies that Z can be produced with both own-time (TZ_i) as well as the spouse's time (TZ_j) for married individuals , in addition to purchased market inputs (X). All inputs have positive and diminishing marginal products.

In addition to production constraints, the individual also faces income and time constraints.

$$P^M M + P^X X = W^*TW_i + W^*TW_j \tag{6}$$

$$T_i = TW_i + EX_i + TZ_i + TL_i \tag{7}$$

Equation 6 notes that total income (product of wage W and work time TW for both spouses) is exhausted on all market expenditures where P^k (k=M, J) represents the price of the market input.[6] Equation (7) notes that total own-time (T_i) is exhausted between work (TW_i), exercise (EX_i), time inputs on the other activities and household production (TZ_i), and time lost due to illness (TL_i). Note that investments in health reduce time lost to illness and therefore raise total available time for other pursuits including work ($\partial TL/\partial H$ ⍰ $TL_H < 0$); this is the investment return to health.

Maximizing utility subject to the production and full income constraints results in the following conditional input demand functions for exercise (EX) and other activities (TZ):

$$EX_i = EX(TW_i, TW_j, H_i, Z, W, P^M, P^X; S_i) \tag{8}$$

$$TZ_i = TZ(TW_i, TW_j, H_i, Z, W, P^M, P^X; S_i) \tag{9}$$

Substituting the determinants of health (H) and other commodities (Z) into the above equations yields the reduced-form input demand functions for each type of activity:

[5] Without this assumption, the optimal demand for exercise would be zero.

[6] For convenience of exposition, we assume that the wage rate (W) is similar across family members.

$EX_i = EX(W, TW_i, TW_j, P^M, P^X; S_i)$ (10)

$TZ_i = TZ(W, TW_i, TW_j, P^M, P^X; S_i)$ (11)

The above input demand functions highlight two key points. First, job-loss can affect exercise and other activities by 1) easing time endowment constraints (TW ↓ and therefore T-TW ↑), and 2) by reducing the opportunity cost of time (W ↓).[7] Since exercise is a relatively time-intensive activity, we expect job-loss to raise exercise by lowering the opportunity cost of time and relaxing time constraints.[8] The extra time freed up from non-work is also likely to flow into other time-intensive activities such as housework, childcare, and watching television.[9] Job-loss may also lead to a substitution of time inputs for market inputs (for instance, cooking at home relative to eating out; spending own-time on childcare and housework relative to hiring a nanny or a maid). Thus, the effects of job-loss on total physical activity is indeterminate, depending on whether the potential increase in exercise and other household activities compensate for the decrease in work-related physical activity -- a point often overlooked by the literature's focus on exercise and the implicit presumption that effects on total physical activity mirror those found for exercise.

Second, for married or cohabiting couples, spouse's job-loss can affect own time use. This spillover effect is driven by joint household production, that is, the potential substitution or complementarity between the spouses' time use in market and non-market activities (equation 5). For instance, a husband's job-loss can prompt the wife to increase her labor supply, leading to a reallocation of household production from the wife to the husband. Even conditional on own-employment, a spouse's job-loss can still lead to reallocation of activities within the household due to the joint nature of

[7] It should be noted that these effects are not cleanly separated income/endowment and substitution effects. For non-working individuals, the value of time depends on the shadow-price of consumption, which depends both on time endowment, money income, and wages (.

[8] The positive income effect with respect to the demand for health points to an increase in exercise. However, this effect is likely to be negligible for temporary or transitional income shocks such as those experienced due to the business cycle. Dave and Kelly (2010) also do not find that evidence that shifts in the underlying demand for health are driving observed changes in diet over the business cycle.

[9] Aguiar et al. (2011) also find that sleep and television watching has increased in the current recession.

household production (equation 5). This effect partly depends on whether spousal time and own time are complementary or substitutable inputs into household production. For commodities (for instance, housework or childcare) which either the husband and/or the wife can produce using their time (substitutable inputs), we would expect spousal employment to raise own-time spent on these activities. The opposite is true for commodities (for instance, vacations) where the husband's and wife's time are complementary inputs.[10]

Other specific mechanisms may further explain how individuals' exercise responds over the business cycle. For instance, loss of health insurance and reduced access to care, as a result of job loss, may impact healthy behaviors. Numerous studies have shown that physician advice and interventions are successful in influencing patient behaviors such as smoking, drinking, exercise, and diet (U.S. Preventive Services Task Force 2002, 2003). Reduced contact with physicians due to loss in coverage may lead to an increase in unhealthy behaviors. On the other hand, the pure ex ante moral hazard effect operates in the opposite direction; loss of health insurance may promote more healthy behaviors since the individual now bears the full cost of illness and medical care.[11]

3.2 Methodology

Since our objective is to find the effect of local area employment/unemployment on physical activity using more precise measures of exercise and more inclusive measures of activity than prior

[10] The above discussion is conditional on a given demand for health. Note that exercise and other activities directly enter into the individual's utility function and are also inputs into the individual's health production and household production. Thus, the demand for exercise and other activities reflects direct demand as well as input demand derived from the individual's underlying demand for health and other household commodities. For instance, if the individual's demand for health or the demand for commodities such as entertainment decreases with a higher unemployment, then this scale effect translates into a lower demand for exercise and related inputs.

[11] Dave and Kaestner (2009) show that these two opposing effects are generally of similar magnitudes, at least among older adults, such that the net effect of health insurance on health behaviors is close to zero.

studies, we begin with a baseline model similar to that employed by Ruhm(2005) and Charles and DeCicca (2008).[12]

$$Y_{ijmt} = X_{ijmt}\beta + E_{jmt}\gamma + \alpha_j + \theta_m + \lambda_d + \varepsilon_{ijmt} \qquad (12)$$

The specification above corresponds to the reduced-form input demand function noted in equations (10) and (11), and is estimated for total physical activity as well as separately for exercise and disaggregated categories of other activities (see next section). Exogenous shocks to wages (W) and employment (TW_i and TW_j) are captured by local-area labor demand, denoted by E_{jmt}. The vector X_{ijmt} includes the personal characteristics of person *i* residing in area *j* during month *m* and year *t*. All models control for fixed area effects that capture unobserved area-specific factors (α_j), as well as indicators for month (θ_m) and day of the week (λ_d). The latter capture unobserved seasonal factors and shifts in time constraints and the full cost of exercise and other activities across weekdays and weekends. The error term is ε_{ijmt}, which is assumed to be correlated across months within each locality.

We extend this basic model in a number of ways to assess robustness and plausibility and to assess specific issues. First, we estimate models for various subsets of the population to exploit the fact that the effects of the most recent recession were more concentrated among certain population groups. Specifically, the Great Recession caused most of the job-loss among low-educated males relative to college graduates and relative to females.[13] The brunt of the layoffs fell on construction, durable goods manufacturing, and mining, sectors where workers have primarily been low-educated males. With the exception of leisure and hospitality, the relatively less-affected sectors have had larger shares of female

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[12] The only difference is that we do not include year indicators. Since our sample period envelopes the large shock to employment from the financial crisis and the collapse of the housing market leading into the Great Recession, including year indicators would absorb the variation we need to identify the effect of unemployment.

[13] The unemployment rate among less-than-high school graduated males increased by 8.4 percentage points between 2007-2010, compared to a 2.9 percentage point increase among those who have a college degree. The overall increase in unemployment among males between 2007-2010 was about 6 percentage points, compared to 4 percentage points for females (www.bls.gov).

workers and/or higher-educated workers (for instance, educational and health services, financial activities, and other services). Thus, as a dose-response credibility check, we expect the strongest behavioral effects among low-educated males. Separate regressions for men and women are also warranted to allow for the possibility that in some activities, such as childcare, men and women may respond differently to economic fluctuations. We limit the ages to 25 to 55 for the main models so that most respondents will have completed their education and are not close to retirement.

Next, we restrict the sample to individuals whose current or most recent job required a relatively high degree of physical exertion. These estimates are meant to reveal whether a potential increase in exercise for these workers (primarily in the manufacturing, construction, and mining sectors that were most adversely affected during the recession) compensated for the loss in physical exertion at work.

In equation (12), the effect of local-area labor demand (E_{jmt}) captures effects both at the extensive margin (individual becoming unemployed) and at the intensive margin (reduction in hours worked). To assess whether the recession is affecting working hours not only through unemployment but also through the hours of full-time employed workers, and if so, whether this change affects exercise and other behaviors, we also estimate models restricted to full-time workers. Any observed effects for this sample must necessarily operate through a reduction in hours worked among these full-time workers who have not lost their jobs.

We further estimate models separately for persons 65 years of age and older, who are out of the labor force, as a falsification check. Since these persons are not in the labor force and unlikely to reenter, a change in local labor market conditions should have little effect on their time use.

One question is whether the local area employment rate affects time use only through the respondent's own employment or also through the employment of other members of the respondent's family through inter-household spillover effects described above. For example, if a married couple has children, and the husband loses his job, it is possible that he will do more of the housework and childcare, and the wife less, than when he was working. Thus the wife's time use may depend not only on her own but also on her husband's employment status. To investigate this possibility, we consider the following model of the effect of individual-level employment on time use among married couples:

$$Y_{ijmt} = X_{ijmt}\beta + E_{ijmt}\delta_1 + E_{kjmt}\delta_2 + \alpha_j + \theta_m + \lambda_d + \varepsilon_{ijt}, \quad (13)$$

where E_{ijmt} is a dummy that equals one if the respondent is employed and E_{kjmt} is a dummy that equals one if the respondent's spouse is employed. Angrist and Pischke (2008) point out that when the independent variable is a group average, the coefficient on that variable is numerically equal to an instrumental variable estimate of the coefficient on the individual-level variable when it is instrumented by the group average. Applying this reasoning to the estimation of equation (13) implies that because E_{jmt} is a group average of both E_{ijmt} and of E_{kjmt}, γ equals an instrumental variable (IV) estimate of $\delta_1 + \delta_2$ using E_{jmt} as the instrument. Thus equation (12) conflates own with spousal effects of the business cycle on physical activity.

We attempt to infer the importance of these spillover effects and whether δ_2 is zero by directly estimating equation (13) for married persons. Exogenous shifts in own-employment and spousal employment (E_{ijmt} *and* E_{kjmt}) are captured with gender-specific employment ratios.[14]

All models are estimated with ordinary least squares.[15] Errors are assumed to be correlated within state of residence, and standard errors are therefore adjusted for arbitrary correlation within areas. All models are estimated using the probability weights supplied by ATUS. The use of probability weights is unnecessary and reduces the precision of the estimates if the model is correctly specified and if the sampling scheme is not based on the dependent variable (DuMouchel and Duncan 1983; Winship and Radbill 1994). However, the ATUS oversamples families with children, that is, families for whom

[14] As noted above, these models amount to IV estimates of δ_1 and δ_2, using the gender-specific employment rates as instruments. Due to segregation of genders across industries and sectors (see Table 1), there is substantial variation in each gender's employment ratio independent from the other.

[15] Probit and logit analyses for dichotomous outcomes yield highly similar marginal effects.

“childcare minutes”, one of our dependent variables, is greater than zero. Further, since all the time use and activity variables are mutually determined because of the time constraint, we use weights in all of the models. To mitigate the distorting effect of the sampling scheme on our estimates we include dichotomous indicators for day of the week and the presence of children.

4. Data

4.1 American Time Use Surveys (ATUS)

Analyses are based on individual records from the American Time Use Surveys (ATUS). The ATUS is the first federally-administered continuous survey of time use in the U.S., with the specific objective of measuring how individuals divide up their time across all daily activities. It is nationally-representative and contains over 112,000 observations collected between 2003 and 2010. The ATUS sample is drawn from the monthly Current Population Surveys (CPS), and covers all U.S. residents who are 15 years of age or older and living in households. The CPS selects approximately 60,000 households every month from the civilian non-institutional population. About 7,500 of these retire permanently from the CPS sample each month, after their eighth CPS interview. Two months after households complete their eighth CPS interview attempt, they become eligible for selection into the ATUS sample. Eligible households with a Hispanic or non-Hispanic African-American householder are oversampled to improve the reliability of time-use data for these demographic groups; sampling weights are provided to yield nationally-representative estimates. Unlike the BRFSS and the NHIS which sample only telephone-based households, approximately five percent of the ATUS, in order to make the sample truly representative, consists of CPS respondents that did not provide a telephone number.

The time diary component of the interview contains a detailed account of the respondent’s activities, starting at 4 a.m. the previous day and ending at 4 a.m. on the interview day. Each activity in the time diary component is assigned a six-digit classification code.[16] The first two digits represent one of 17 major activity codes (ranging from personal care to household services to exercise and sports); the next two digits represent the second-tier level of detail, and the final two digits represent the third, most detailed level of activity. For example, the ATUS code for "Rollerblading" is 130122, which is part of code 1301, "Participating in sports", which is part of code 13, "Sports, Exercise, & Recreation".

4.2 Dependent Variables

We combine the information on the type of activity and its duration to construct a standardized and consistent measure of physical activity based on the metabolic equivalent of task (MET). A unit of MET is defined as the ratio of a person's working metabolic rate relative to his resting metabolic rate. METs are measured as calories per kilogram of body weight per hour. For instance, one MET is defined as the energy it takes to sit quietly, and walking has a MET of two, which means that the caloric expenditure of walking is twice that of resting. For the average adult, one MET represents about one calorie per every 2.2 pounds of body weight per hour.[17] As our measure of exertion, we multiply each activity's MET value with the number of minutes that the respondent spent undertaking that activity. We term the resulting variable the "MET-adjusted" activity or MET-adjusted minutes, which reflects both the duration and intensity of each activity. We obtain each activity's MET value from Tudor-Locke et al. (2009).[18] Except for the METs relating to work, these MET values are derived from the Compendium of Physical Activities.[19] For work-related METs, the authors used the Tecumseh

[16] The ATUS has undergone substantive field testing, cognitive research, and follow-up testing to ensure consistency of the sampling frame, minimize reporting errors, and confirm the accuracy of the responses. All cases are 100-percent verified, meaning that two different coders cross-verify and code each case.

[17] The actual caloric expenditure for an individual in a given activity, for a given length of time, depends on the individual's bodyweight. However, the caloric expenditure may not be the best measure of PA since an overweight individual would burn more calories than a lighter individual, performing the same activity, for the same length of time. The PA measure used in this paper does not include bodyweight since the higher caloric expenditure by an overweight individual does not reflect more beneficial PA but rather reflects that fact that the individual is overweight. All PA variables are defined to exclude activities which have a MET of one since the health benefits of PA are related to moderate and vigorous PA. Home PA and work PA have no activities with values equal to one.

[18] Available at the website of the National Cancer Institute (http://riskfactor.cancer.gov/tools/atus-met/).

[19] See http://prevention.sph.sc.edu/tools/compendium.htm.

Occupational Physical Activity Questionnaire classification system, which describes the physical demands of over 500 census occupations.

Our primary outcomes are the number of minutes spent exercising and the exercise minutes multiplied by the MET for each component activity within exercise. We further define a dichotomous indicator for whether the respondent exercised 10 minutes or more on the diary day. Since the ATUS measures exercise daily, this indicator is roughly equivalent to that in Ruhm (2005), which equals one if the respondent exercised 20 minutes per day three or more times a week. We also estimate separate models for the remaining uses of time collected into the following categories: sleeping, personal care, housework, childcare, care of adults, work, education, the purchase of goods and services, eating and drinking, watching television, and socializing and relaxing other than television. We also analyze MET-adjusted total minutes, which the intensity of physical activity undertaken during the day. Unadjusted total minutes are uninteresting since, in theory, they should add up to 1440 for every respondent.

We define "Work" as not only the time spent at a work site but also any socializing, eating, exercising, or other activities that the respondent considers part of the job, as well as time spent on any other income-generating activity, such as income-generating hobbies. Excluded from the definition of work are any activities related to looking for work, even though the ATUS includes these activities under the general category of "Work".

4.3 Independent Variables

Our main independent variable is the one-month-lagged employment rate, defined as the ratio of employment to the civilian non-institutional population in each state in the month prior to the diary date in the state where the respondent lives. As a check on our results, we also use the local area unemployment rate, with two definitions of "area", the respondent's state and his or her core based statistical area (CBSA). Prior to 2004, the CPS, and hence, the ATUS provided the respondent's metropolitan statistical area (MSA). In 2004 the CPS switched to the use of CBSAs. In order to use a consistent definition of area, we use data only from 2004 onward when the independent variable is the CBSA unemployment rate. Data on the employment and unemployment rates are obtained from the Bureau of Labor Statistics Local Area Unemployment series.[20]

Other independent variables include indicators for gender, education (less than high school, high school, some college, and college), marital status (married, divorced/separated, widowed, never married), race and ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic other race, and Hispanic), age, age-squared, and interactions of gender and race with education.

Not all respondents described their activities in sufficient detail for the ATUS coders to assign an activity code to every minute of the respondent's diary day. The most common reasons for gaps in the time diary are that the respondent's description of his or her activity during a particular minute is too vague to categorize, or the respondent can't remember what he was doing in that minute. The difficulty for estimation is that the number of vaguely reported minutes is correlated with employment status, both over time and across a given monthly sample. The proportion of respondents reporting activities too vague to categorize rose from about 5 % in 2003 to 11 % in 2010, and employed respondents are about one percentage point less likely to report vague activities. The consequence is that if we exclude all respondents with incomplete time diaries we will understate the effect of the business cycle on behavior, because the unemployed are eliminated from the sample at a higher rate than the employed. This suggests using all observations in the analysis. On the other hand, some respondents report activities for only two or three hours a day. As a compromise, we restrict our analyses to observations for which the total minutes reported is at least 1380 minutes, that is 23 out of 24 hours, a sample that includes 94% of possible observations, and include in each specification an indicator that equals one if the respondent's diary is incomplete.

4.4 Summary Statistics

[20] See www.bls.gov.

Table 2 reports the means for key variables across two time periods, the recovery from 2003 to 2007, and the recession from 2008 to 2010. It also presents means with and without applying the survey weights. According to the ATUS documentation, the survey oversamples non-Hispanic African-Americans, Hispanics, and households with children. In addition, about half of the days for which respondents are asked to recall their activities are on the weekend. Comparing the weighted with unweighted means largely bears out this sampling scheme. Assuming that the weighted means represent the population, African-Americans, though not Hispanics, make up a larger portion of the sample than the population, and the minutes spent in childcare in the sample exceeds that of the population by over 25 %. The effect of oversampling weekends is evident in the much lower number of work minutes in the sample than in the population. The higher proportion of women in the sample is not intentional, but reflects their higher response rate.

Table 3 presents weighted means for the entire sample period across our main analysis sample and various population subgroups. For the average individual between the ages of 25-55, work (626 MET-adjusted minutes) constitutes about 26% of total physical activity during the day (2377 total MET-adjusted minutes). Most of the residual comprises sleep (21% of total), housework (12%), television watching (8%), socializing (6%), and childcare and eating/drinking (4% each). Among low-educated males, work-related physical exertion, as expected, represents a larger share (33%) of daily activities. This higher work-related activity also raises their total physical exertion. Work-related physical activity among low-educated women (and women in general) is significantly less relative to males, with some of this difference being compensated by increased housework, childcare, personal care, and other forms of household production.

Comparing the weighted means before and after the recession began in late 2007 (Table 2) prefigures some of our main results. The average number of minutes of exercise rises by about 3% and the percentage of persons who exercise more than 10 minutes per day rises by 0.7 percentage points.

However, in terms of energy expended, the rise in exercise is far outweighed by the decline in the energy spent at work. Exercise METs rise by about 3 while work METs decline by about 19. Much of the time no longer spent at work goes into housework, television watching, sleeping and other low-MET activities. As a result, total METs per day declines by about 14 for the average individual. We discuss these patterns more fully in the next section with respect to the regression results.

5. Results

Table 4 presents estimates of equation (12) for measures of work-related time use, exercise, and total exertion during the day, for the full sample (individuals ages 25-55) and across population subgroups. The effects of local area employment on time use are, not surprisingly, largest on the time spent working, as shown in the first column. Among men and women between ages 25-55, a one percentage point increase in the employment rate raises the number of minutes spent working by 2.5 minutes and MET-adjusted work minutes by 8 (about 1.6% relative to the baseline mean). Comparing rows 2 and 3 (as well as rows 7 and 8) suggests that most of this response is due to the behavior of men, and more specifically, of men with less than a college degree. This is consistent with the job-loss effects of the Great Recession being relatively much more concentrated among males and specifically low-educated males due to the sectors affected (see Table 1).

Rows 4 and 5 indicate no significant effect of local area employment on full-time workers. Thus it appears that the effect of the recession has been almost wholly at the extensive rather than at the intensive margin of working. That is, the reduction in work-related physical activity is due to job-loss rather than a reduction in hours worked among full-time workers.

Since we are especially interested in the effect of the recession on energy use, we also analyze the time use of men whose current or most recent job is relatively physically demanding (MET ≥ 2.5 which captures the top 40% of the most physically demanding jobs). These estimates are shown in row 9. The estimates are practically and statistically the same as row 7, which reflects the tendency of less educated workers to work in industries with a high proportion of physically demand jobs, industries that have been strongly affected by the current recession, as can be seen in Table 1.

Part of the time lost to an increase in working hours evidently comes from exercise. Similar to Ruhm (2005) and Xu and Kaestner (2010), we find that an increase in employment is associated with a decline in the share of the population that exercises moderately (column 3). The size of the effect is also comparable to prior studies. An increase in the employment-population ratio by one percentage point is associated with a decline in the share that exercises by about 0.19 percentage points, similar to the 0.15 percentage point change in Ruhm (2005). This effect is not necessarily small. If this result reflects the behavior only of the one percent who are newly employed, then 19% of them stop exercising when they begin working.

The time spent exercising declines as well. A one percentage point increase in the employment rate reduces the minutes spent exercising by 0.27 minute per day (and by 0.91 MET-adjusted minutes per day). Again, if only the newly employed are affected, they appear to be reducing their exercise by 27 minutes per day. Columns 5 and 6 separate the exercise effect into that realized from less vigorous activities, defined as activities whose MET is 4 or less (such as walking and golfing), and those realized from more vigorous activities whose MET exceeds 4 (such as running, hiking, or playing soccer). The decrease in exercise, resulting from an increase in employment, reflects mainly a decrease in less vigorous activities. Comparing the results among the subgroups, in rows 2 through 9, estimates indicate that the effect is concentrated among those whose employment has been most affected by the recent economic collapse, men with less than a college degree (row 7) and those with relatively physically demanding jobs (row 9).

Though an increase in employment reduces exercise, the decline in energy expended through exercise is more than made up by the increase at work. As shown in column 2, on average, for all persons between 25 and 55, MET-adjusted minutes at work rise by 8, whereas MET-adjusted minutes of exercise declines by about 1. Overall, an increase in employment by one percentage point raises physical exertion during the day by about 2.3 MET-adjusted minutes (column 8). Symmetrically, during a recession, individuals are less physically active since the loss in work activity is not compensated by the increase in exercise (and the increase in other home-based and leisure activities).

Table 4 (column 1) indicates that while MET-adjusted work activity increases by 8, total physical exertion during the day only increases by 2.3. Part of this difference is due to a decline in exercise (by about 1 MET-adjusted minute). Table 5 (MET-adjusted minutes in other time use) and Table 6 (unadjusted minutes in other time use) show models for other activities, that comprise the remainder of this difference. Specifically, Table 6 shows that, in addition to exercise (1 MET-adjusted minute), the difference is partly made up by declines in energy use in childcare (1.6 MET-adjusted minutes), television viewing (1.9 MET-adjusted minute), and sleep (1 MET-adjusted minute) -- all of which are relatively time-intensive activities crowed out by exertion at work.[21] Physical activity associated with purchasing goods/services increases by 0.8 MET-adjusted minute due to a one percentage point increase in the employment rate. This reflects both an income effect, as the demand for goods and services rises with higher earned income, as well as a substitution effect, as time-intensive activities may be substituted with market inputs due to higher time constraints and a higher value of time.

Among less educated men (Table 4, Row 7) and among men whose current or last job was physically-demanding (Row 9), a unit decrease in the employment rate is associated with a decrease in work MET-adjusted minutes by 19. These men respond to the easing of time constraints by raising exercise (2 to 2.6 MET-adjusted minutes). Table 5 (Rows 7 and 9) also show that these men respond by performing more housework (3.1 to 4.7 MET-adjusted minutes), engaging in more childcare (about 3 MET-adjusted minutes), and watching more television (2 to 3 MET-adjusted minutes). However, this

[21] There is also some suggestive evidence that time spent eating and drinking is countercyclical (Table 5, Column 8). While time spent on eating/drinking may not necessarily reflect calories consumed, Dave and Kelly (2010) also find that individuals tend to consume a more unhealthy diet (substituting away from fruits and vegetables into more calorie-laden snacks and fast food) during recessions.

substitution into exercise and other activities does not fully compensate for the loss of physical exertion due to lack of work. Thus, overall, among individuals whose employment was most adversely affected during the Great Recession, total physical activity declines by between 5.0 - 6.3 MET-adjusted minutes for every one percentage point decrease in the employment rate. This is an average population effect. If the effect is realized off only those who have lost their jobs, then total daily physical exertion has declined by about 21-24% for the average laid-off individual.

Table 4 (Rows 3 and 8) show that there is no significant or substantial effect of the employment rate on work activity among women or even among low-educated women. This is consistent with the most recent recession primarily affecting males. However, Table 5 (Row 8) suggests that these women nevertheless responded by altering their time use in other activities. For instance, a decrease in the employment rate results in an increase in sleep and time watching television and a decrease in housework and the time spent on purchasing goods and services. We interpret these effects as suggestive of intra-household spillover effects. The effect of the employment rate for these women likely captures the effects of male employment, or the husband's work status. Due to assortative mating, less-educated women are more likely to marry less-educated males (Groothuis & Gabriel 2010). Since employment among less-educated males was most heavily affected, their job-loss led them to take over some of the childcare, housework, and shopping, freeing up time for their wives.

As a falsification check, row 6 in Tables 4-5 present estimates for individuals over the age of 65 who are not in the labor force. It is validating that we do not find any significant effects of the employment rate on these individuals' exercise or total physical exertion. The only substantial effects that we find for these individuals relate to socializing and television watching. Both effects are in the same direction as that found for other adults who are in the labor force. This suggests that older adults' time use with respect to socializing and television watching is complementary to (and is relatively elastic to) similar time use of other adults.

Appendix Table A1 presents estimates of the state employment rate on time-use, other than exercise and work, measured in minutes rather than MET-adjusted minutes. The general patterns and direction of effects are similar to those estimated for MET-adjusted time use.

Table 6 indicates that among married women, time use outside of work responds to the fluctuations in the business cycle, even when their work time does not, suggesting an effect of their husbands' employment. . The coefficient of the own-gender employment rate picks up effects on time-use that operate through own job-loss, whereas the coefficient of the opposite-gender employment rate captures effects of spousal job-loss conditional on own-employment. It is validating that the effects of the opposite-gender employment rate on work-related exertion (column 1 in Table 6a) is small and insignificant. This adds credibility to the interpretation that the opposite-gender effect is reflecting potential intra-household reallocation of time due to one spouse's shift in work effort.

The own-employment effects are consistent with the above-discussed results -- a decrease in the own-gender employment rate reduces work-related physical exertion. This is substituted by increases in exercise, sleeping, housework, childcare, and watching television. The effects of opposite-gender employment are generally oppositely signed for activities wherein the husband's and wife's time are substitute inputs -- for instance, housework, childcare, and shopping. Thus spousal job-loss allows the spouse to take over some of these household production activities, and frees up the spouse's time which then appears to be spent on personal care, socializing and relaxing, and sleeping. Some of these latter effects are imprecisely estimated due to limited sample size. The substitution away from high-MET activities, resulting from spousal job-loss, such as housework and shopping into low-MET activities such as socializing/relaxing and sleep leads to a small decrease in total physical exertion, though this latter effect is also statistically insignificant.

Appendix Table A2 present estimates based on the state-level unemployment rate. The unemployment rate is defined only among respondents in the labor force, as opposed to the employment rate, which is defined for all individuals ages 16 and over. The results are qualitatively similar to those discussed above. As the unemployment rises, exercise rises as well, but not nearly enough to compensate for the reduced energy expenditure due to the loss of employment. As in Table 3, the effect is largest among men, and specifically, among men with less than a college degree and with relatively physically demanding jobs. The effects on other activities and time use follow the same patterns as shown in Tables 4-5. Estimates based on CBSA-level unemployment rates (not reported) show similar magnitudes and direction of effects, though standard errors are inflated due to reduced precision in CBSA-level unemployment measures and a restricted sample limited to individuals who reside in a CBSA.

6. Discussion

This study investigates the impact of the business cycle on exercise, work-related physical exertion, and other modes of physical activity during the day. We expand upon prior studies and contribute to the literature along several respects. First, we utilize more precise measures of exercise (and all other physical activities) that reflect information on the duration as well as intensity of each component activity than has been employed in past studies. Second, prior work has focused exclusively on exercise, which typically makes up only about 4% of total physical exertion. The general presumption is that, because exercise improves health, if unemployment increases exercise it must also improve health. Yet, a person may be laid off from a physically demanding job, exercise more, and still be less physically active than when employed. Thus, the relevant question is whether unemployment leads persons to become more physically active. This is the question that we study using the time use reported in the ATUS for all activities along with estimates of the physical exertion required by different activities. We utilize all waves of the ATUS (2003-2010), spanning the period that enveloped the Great Recession.

Consistent with previous studies, we find that recreational exercise tends to increase as employment decreases. In addition, we also find that individuals substitute into television watching, sleeping, childcare, and housework. However, this increase in exercise as well as other activities does not compensate for the decrease in work-related exertion due to job-loss. Thus, total physical exertion, which prior studies have not analyzed, declines. This decrease in total physical exertion may partly explain the positive association often found between unemployment and psychological depression (Lawlor 2001, Gill 2010). Models further indicate that the largest behavioral responses occurred among low-educated males, which is validating given that the Great Recession led to some of the largest layoffs within the manufacturing, mining, and construction sectors.

While prior work has hinted at the importance of spillover effects within the household, studies have either bypassed these channels (for instance, Xu and Kaestner 2010) or conflated own-employment and spousal-employment effects into a single effect among married individuals (Ruhm 2005). We find some evidence that individuals' time use does respond to shifts in spousal employment due to the joint nature of household production. Specifically, own job-loss leads to an increase in time devoted to childcare and housework, which frees up time spent on these activities by the spouse.

Recent evidence (Dave and Kelly 2010) suggests that individuals reduce their consumption of fruits and vegetables and substitute into relatively high-fat, high-calorie consumption during recessions. Compounding with these effects, our findings that total physical exertion also declines may have adverse implications for these individuals' bodyweight. One qualification to this is that the average individual does substitute partly into greater sleep as a result of job-loss owing to the greater availability of time. To the extent that work may be stressful and crowd out sleep, this increase in sleep may be health promoting, ceteris paribus.

Due to the concentration of low-educated workers in boom-and-bust industries such as manufacturing and construction, the drop in total physical activity during recessions is especially problematic for vulnerable populations and may play a role in exacerbating the SES-health gradient during recessions. Future work should consider the long-term implications of these shifts in exercise, time-use, and total physical exertion resulting from short-term economic fluctuations.

Table 1
Unemployment, education, gender, and Work-related MET
2009 – 2010

Industry	Unemployed at ATUS interview (%)	Average Work MET	College or more (%)	Percent Female
Construction	15.1	3.3	12.3	7.6
Durable Manufacturing	10.8	2.2	26.0	27.0
Leisure and hospitality	10.2	2.3	17.2	54.2
Mining	9.3	3.2	22.1	6.0
Wholesale and retail trade	9.3	2.1	19.8	44.5
Agriculture, forestry, fishing, and hunting	8.9	2.4	11.9	20.5
Professional and business services	8.5	2.0	50.0	40.8
Financial activities	7.0	1.9	45.6	55.3
Information	6.7	2.0	45.1	38.9
Other service	6.6	2.5	26.6	49.0
Transportation and utilities	6.2	2.4	19.7	23.0
Nondurable Manufacturing	6.0	2.4	21.8	38.1
Educational and health services	5.1	2.3	49.5	75.2
Public administration	2.1	2.1	46.1	48.0

Table 2 Weighted And Unweighted Means				
Variable	Years 2003 – 2007		Years 2008 – 2010	
	Mean, weighted	Mean, unweighted	Mean, weighted	Mean, unweighted
Exercise > 10 minutes (%)	17.4	16.7	18.1	17.0
Minutes exercising	17.7	17.4	18.3	17.7
Exercise minutes X MET	86.9	85.5	89.9	86.5
Minutes exercise <=4 METS	7.7	7.3	8.1	7.5
Minutes exercise > 4 METS	10.0	10.2	10.2	10.2
Work minutes	210.2	166.4	203.9	162.9
Work minutes X MET	486.7	376.1	467.8	368.1
Total minutes X MET	2285.5	2254.1	2271.1	2240.2
Housework minutes	110.4	123.1	108.0	118.9
Housework minutes X MET	283.5	317.9	276.5	305.7
Minutes in childcare	25.4	32.3	25.1	32.6
Television minutes	156.6	162.4	168.1	176.0
Minutes sleeping	512.2	521.4	515.8	526.4
Age in years	43.3	45.4	44.0	46.3
Female (%)	51.5	56.5	51.1	55.9
High School (%)	30.6	27.3	29.5	26.2
Less than HS (%)	19.4	17.5	18.2	15.9
Some college (%)	24.9	26.6	24.8	26.9
College or more (%)	25.0	28.6	27.4	31.0
Married (%)	55.0	53.1	53.4	49.8
Divorced (%)	10.8	15.3	11.2	16.6
Widowed (%)	5.4	8.0	5.6	8.9
Never married (%)	28.7	23.6	29.8	24.7
Non-Hispanic white (%)	71.1	72.1	69.2	67.4
Non-Hispanic black (%)	11.4	11.8	11.7	13.9
Non-Hispanic other (%)	4.9	4.6	5.2	4.9
Hispanic (%)	12.5	11.5	14.0	13.8
Unemployed at ATUS interview (%)	6.8	6.1	9.5	8.4
Lagged UR state unemployment rate(%)	5.2	5.3	8.1	8.0
Lagged state employment rate (%)	62.8	62.8	60.3	60.4
Lagged CBSA unemployment rate(%)	4.8	4.8	8.1	8.1

Table 3 Weighted means of time use variables MET-adjusted Minutes per day									
	Ages 25 to 55	Ages 25 to 55 Men	Ages 25 to 55 Women	Ages 25 to 55 Men Full-time worker	Ages 25 to 55 Women Full-time worker	Ages Over 65 Out of the labor force	Ages 25 to 55 Men Less than College	Ages 25 to 55 Women Less than College	Ages 25 to 55 Men Job MET >= 2.5
Sleep	500.1	493.5	506.5	483.5	493.5	536.5	499.6	514.6	513.6
Personal care except sleep	92.8	78.3	107.1	78	113.5	102.4	78.6	108	76.4
Housework	281.9	222.8	339.9	207.7	266.9	411.6	229.9	361.7	269.2
Childcare	100.9	66.9	134.2	66.7	85.6	16.6	58.7	123.4	68.6
Care of HH and non-HH adults	18	19.6	16.5	17.2	11.5	21.3	22.1	18.3	25.4
Work, excluding job search	625.6	782.7	471.4	903.2	680.7	0	829	451	737.1
Education	16.3	12.7	19.7	6.9	12.6	3.5	10.8	17.5	14.8
Purchasing goods & services	60.9	45.5	76	44.2	68.9	68.5	44	73.3	52.6
Eating & drinking	97.1	101.2	93.1	103.2	92.5	122.8	95.8	87.4	100.5
Television	188.3	207.6	169.4	182.9	146.4	346.1	232.1	192.1	246.3
Socializing & relaxing except television	145.6	143.1	148	128.3	130.6	280.6	142.6	145.9	165.3
Exercising	72.5	90.3	55.1	89.6	53.8	63.9	80.4	42.5	96.9
All other	177.2	182.2	172.4	184.3	173	136.6	171.7	160.4	181.5
Observations	62554	27829	34725	23336	19723	14118	17693	21983	18882

	Table 4 Effect of employment rate on time use and MET-adjusted time use Work, Exercise, and Total Activities							
Outcome	(1) Work Minutes excluding job search	(2) Work Minutes X MET	(3) Exercise > 10 minutes per day	(4) Exercise Minutes	(5) Exercise Minutes X MET	(6) Minutes exercise <=4 METS	(7) Minutes exercise > 4 METS	(8) Total minutes X MET
Ages 25 to 55								
1	2.5***	8***	-.0019*	-.27*	-.91	-.19*	-.082	2.3**
	(.7)	(1.6)	(.0011)	(.15)	(.75)	(.096)	(.11)	(.99)
Ages 25 to 55, Men								
2	4.5***	14***	-.0028	-.45	-1.5	-.35**	-.099	3.1
	(.85)	(2.3)	(.0019)	(.3)	(1.5)	(.17)	(.23)	(2.3)
Ages 25 to 55, Women								
3	.84	2.7	-.001	-.099	-.37	-.027	-.072	1.8
	(1.1)	(2.2)	(.0015)	(.14)	(.7)	(.091)	(.096)	(1.3)
Ages 25 to 55, Men, Full-time worker								
4	.93	4.1	-.0023	-.11	.081	-.27	.16	1.6
	(.89)	(2.4)	(.002)	(.31)	(1.5)	(.17)	(.23)	(2.8)
Ages 25 to 55, Women, Full-time worker								
5	-.88	-.95	-.0032	-.25	-1.4	-.046	-.2	.11
	(1.5)	(3.3)	(.0024)	(.15)	(.89)	(.091)	(.13)	(1.9)
Over 65, Out of the labor force								
6	0	0	-.00061	-.1	-.23	-.0077	-.095	-1.6
	(0)	(0)	(.002)	(.26)	(1.1)	(.22)	(.2)	(2)
Ages 25 to 55, Men, Less than college								
7	5.1***	19***	-.005**	-.53	-2	-.34*	-.19	5*
	(1.1)	(3.2)	(.0022)	(.35)	(1.7)	(.18)	(.28)	(2.7)
Ages 25 to 55, Women, Less than college								
8	1.3	3.9	-.0016	-.12	-.77	.063	-.18	2.6
	(1.3)	(2.7)	(.0014)	(.13)	(.65)	(.097)	(.12)	(1.7)
Ages 25 to 55, Men, Job MET >= 2.5								
9	4.8***	19***	-.0044**	-.65	-2.6	-.4**	-.24	6.3**
	(1.2)	(3.4)	(.0022)	(.41)	(2)	(.18)	(.35)	(2.6)

* Significant at 10 percent ** Significant at 5 percent *** Significant at 10 percent. Each cell represents a separate regression model. Coefficients on the state employment rate are presented with standard errors adjusted for arbitrary correlation within areas reported in parentheses. All models control for state, month, and day indicators, in addition to indicators for gender, education, marital status, race and ethnicity, age, age-squared, and interactions of gender and race with education.

Table 5
Effect of employment rate on MET-adjusted time use
Other Activities

Outcome	(1) Sleep	(2) Personal care except sleep	(3) Housework	(4) Minutes in childcare	(5) Care of HH and non-HH adults	(6) Education	(7) Purchasing goods / services	(8) Eating & drinking	(9) Television	(10) Socializing & relaxing except TV	(11) All other
Ages 25 to 55											
1	-.97**	.12	-.36	-1.6***	-.31	.36	.79*	-.39	-1.9***	-.096	-.57
	(.41)	(.24)	(1.3)	(.47)	(.39)	(.36)	(.42)	(.26)	(.68)	(.62)	(.42)
Ages 25 to 55, men											
2	-.59	-.044	-3.2*	-3***	-.43	.68	.01	-.47	-2.2**	.092	-.6
	(.57)	(.33)	(1.7)	(.65)	(.61)	(.5)	(.44)	(.4)	(.92)	(1.1)	(.82)
Ages 25 to 55, women											
3	-1.4***	.25	2.5	-.35	-.18	.093	1.5**	-.32	-1.8**	-.4	-.43
	(.48)	(.36)	(1.7)	(.71)	(.51)	(.49)	(.68)	(.31)	(.91)	(.81)	(.66)
Ages 25 to 55, men, full-time worker											
4	-.5	-.29	-1.1	-2.2***	.24	.78**	.55	-.51	-.96	.45	.72
	(.6)	(.37)	(1.7)	(.59)	(.72)	(.32)	(.45)	(.44)	(.88)	(1.1)	(.84)
Ages 25 to 55, women, full-time worker											
5	-.44	-.37	2.4	.49	.44	.63	1.3*	-.26	-1.5	-.22	-.13
	(.59)	(.36)	(1.5)	(.68)	(.31)	(.56)	(.67)	(.45)	(.99)	(.96)	(.72)
Over 65, out of the labor force											
6	-1.2	-.73	-2.9	-.35	.88	.6**	.83	.22	-4.9***	6.2***	-.15
	(.91)	(1.2)	(2.9)	(.68)	(.57)	(.25)	(.62)	(.41)	(1.8)	(1.8)	(1)
Ages 25 to 55, men, less than college											
7	-.36	-.18	-4.7**	-3.4***	-.52	.02	.26	-.77*	-1.7	.016	-.54
	(.6)	(.47)	(2)	(.72)	(.77)	(.45)	(.48)	(.43)	(1.3)	(1.5)	(1.3)
Ages 25 to 55, women, less than college											
8	-2.2***	.82*	2.8	-.73	-.2	-.55	1.6*	-.071	-2.2**	.5	-.6
	(.64)	(.47)	(2)	(.95)	(.7)	(.63)	(.87)	(.34)	(1.1)	(.69)	(.76)
Ages 25 to 55, men, job MET >= 2.5											
9	-.85	-.07	-3.1	-2.9***	-.92	.82	.44	-.46	-2.7*	-.14	-.59
	(.63)	(.48)	(2.3)	(.85)	(.9)	(.8)	(.56)	(.49)	(1.4)	(1.5)	(1.1)

* Significant at 10 percent ** Significant at 5 percent *** Significant at 10 percent. Each cell represents a separate regression model. Coefficients on the state employment rate are presented with standard errors adjusted for arbitrary correlation within areas reported in parentheses. All models control for state, month, and day indicators, in addition to indicators for gender, education, marital status, race and ethnicity, age, age-squared, and interactions of gender and race with education.

Table 6a
Effect of employment rate among married persons ages 25 to 55
Own-gender and Opposite-gender employment effects on MET-adjusted time use

Outcome	(1) Work	(2) Exercise	(3) Sleeping	(4) Personal Care	(5) Housework	(6) Childcare	(7) Adultcare
Employment rate Own gender	6.348***	-1.271**	-0.827***	0.337	-2.163**	-1.260**	-0.038
	(1.20)	(0.61)	(0.23)	(0.21)	(0.86)	(0.55)	(0.30)
Employment rate Opposite gender	-0.854	0.263	-0.164	-0.270	1.638*	0.059	-0.179
	(1.38)	(0.52)	(0.26)	(0.19)	(0.90)	(0.48)	(0.22)

* Significant at 10 percent ** Significant at 5 percent *** Significant at 1 percent. Coefficients on the state employment rate among persons 25-55 of the respondent's gender and the opposite gender are reported, with standard errors adjusted for arbitrary correlation within areas reported in parentheses. All models control for state, month, and day indicators, in addition to indicators for gender, education, marital status, race and ethnicity, age, age-squared, and interactions of gender and race with education.

Table 6b
Effect of employment rate among married persons ages 25 to 55
Own-gender and Opposite-gender employment effects on MET-adjusted time use

Outcome	(8) Education	(9) Purchasing goods & services	(10) Eating & Drinking	(11) Television	(12) Socializing & Relaxing	(13) All Other	(14) Total Physical Activity
Employment rate Own gender	-0.060	-0.217	0.119	-1.466***	1.100**	0.535	1.294*
	(0.19)	(0.21)	(0.16)	(0.37)	(0.43)	(0.36)	(0.70)
Employment rate Opposite gender	0.130	0.875***	-0.072	0.204	-0.582	-0.546	0.519
	(0.17)	(0.27)	(0.13)	(0.41)	(0.44)	(0.34)	(0.91)

* Significant at 10 percent ** Significant at 5 percent *** Significant at 1 percent. Coefficients on the state employment rate among persons 25-55 of the respondent's gender and the opposite gender are reported, with standard errors adjusted for arbitrary correlation within areas reported in parentheses. All models control for state, month, and day indicators, in addition to indicators for gender, education, marital status, race and ethnicity, age, age-squared, and interactions of gender and race with education.

Appendix Table A1
Effect of employment rate on time use minutes
Other activities

Outcome	(1) Sleep	(2) Personal care except sleep	(3) Housework	(4) Minutes in childcare	(5) Care of HH and non-HH adults	(6) Education	(7) Purchasing goods / services	(8) Eating & drinking	(9) Television	(10) Socializing & relaxing except TV	(11) All other
Ages 25 to 55											
1	-.97**	.15	.049	-.38*	-.095	.18	.37*	-.23	-1.5***	.048	.013
	(.41)	(.15)	(.43)	(.19)	(.14)	(.19)	(.21)	(.17)	(.51)	(.42)	(.25)
Ages 25 to 55, Men											
2	-.59	-.012	-1*	-1***	-.087	.35	-.046	-.28	-1.6**	.25	-.12
	(.57)	(.24)	(.59)	(.25)	(.16)	(.27)	(.22)	(.27)	(.69)	(.71)	(.44)
Ages 25 to 55, Women											
3	-1.4***	.28	1.1	.23	-.097	.032	.73**	-.19	-1.4**	-.23	.18
	(.48)	(.22)	(.65)	(.29)	(.22)	(.25)	(.34)	(.2)	(.68)	(.52)	(.41)
Ages 25 to 55, Men, Full-time worker											
4	-.5	-.13	-.39	-.77***	.13	.4**	.2	-.31	-.72	.4	.72
	(.6)	(.25)	(.57)	(.22)	(.2)	(.18)	(.23)	(.29)	(.66)	(.64)	(.45)
Ages 25 to 55, Women, Full-time worker											
5	-.44	-.17	.84	.52**	.19	.3	.7**	-.14	-1.1	-.037	.4
	(.59)	(.21)	(.57)	(.25)	(.12)	(.3)	(.33)	(.3)	(.74)	(.62)	(.45)
Over 65, Out of the labor force											
6	-1.2	-.5	-.59	.041	.59***	.25*	.45	.16	-3.7***	4.1***	.55
	(.91)	(.91)	(1.1)	(.21)	(.22)	(.13)	(.32)	(.28)	(1.3)	(1.2)	(.6)
Ages 25 to 55, Men, Less-than-college											
7	-.36	-.045	-1.4**	-1.2***	-.16	-.019	.12	-.49*	-1.3	.3	-.19
	(.6)	(.32)	(.63)	(.27)	(.2)	(.25)	(.23)	(.29)	(.98)	(.98)	(.69)
Ages 25 to 55, Women, Less-than-college											
8	-2.2***	.65**	1.2*	.083	-.098	-.3	.8*	-.023	-1.6**	.28	.045
	(.64)	(.29)	(.72)	(.41)	(.28)	(.32)	(.44)	(.23)	(.8)	(.48)	(.44)
Ages 25 to 55, Men, Job MET >= 2.5											
9	-.85	-.0062	-.89	-.94***	-.22	.41	.15	-.26	-2*	.28	-.097
	(.63)	(.35)	(.73)	(.33)	(.24)	(.43)	(.28)	(.33)	(1)	(.97)	(.61)

* Significant at 10 percent ** Significant at 5 percent *** Significant at 10 percent. Each cell represents a separate regression model. Coefficients on the state employment rate are presented with standard errors adjusted for arbitrary correlation within areas reported in parentheses. All models control for state, month, and day indicators, in addition to indicators for gender, education, marital status, race and ethnicity, age, age-squared, and interactions of gender and race with education.

Appendix Table A2 Effect of state unemployment rate on time use							
Work Minutes excluding job search	Work Minutes X MET	Exercise > 10 minutes per day	Exercise Minutes	Exercise Minutes X MET	Minutes exercise <=4 METS	Minutes exercise > 4 METS	Total minutes X MET
Ages 25 to 55 (n=62,554)							
-2.3***	-7.1***	.00076	.16	.51	.13*	.033	-2.5**
(.59)	(1.5)	(.00092)	(.12)	(.6)	(.076)	(.089)	(.98)
Ages 25 to 55, Men (n=27,829)							
-3.9***	-12***	.002	.4	1.4	.35**	.055	-3.4
(.65)	(2.2)	(.0017)	(.25)	(1.3)	(.13)	(.2)	(2.2)
Ages 25 to 55, Women (n=34725)							
-.96	-2.8	-.00029	-.052	-.23	-.072	.019	-2.1
(.88)	(1.8)	(.0014)	(.12)	(.62)	(.077)	(.085)	(1.3)
Ages 25 to 55, men, Full-time worker (n=23,336)							
-.64	-2.8	.0015	.12	.091	.28*	-.16	-1.7
(.77)	(2.7)	(.0019)	(.28)	(1.4)	(.15)	(.2)	(3)
Ages 25 to 55, Women, Full-time worker (n=19723)							
.2	-.17	.00086	.09	.59	-.01	.1	-.71
(1.2)	(2.8)	(.0026)	(.14)	(.82)	(.078)	(.11)	(1.6)
Over 65, Out of the labor force (n=14,118)							
0	0	.00073	.053	.12	.026	.027	.64
(0)	(0)	(.0022)	(.3)	(1.2)	(.22)	(.18)	(1.7)
Ages 25 to 55, Men, Less than college (n=17,693)							
-4.4***	-16***	.0041**	.37	1.3	.35**	.024	-5.1*
(.99)	(3.5)	(.0017)	(.29)	(1.5)	(.16)	(.26)	(3)
Ages 25 to 55, Women, Less than college (n=21,983)							
-1.5	-4*	.00054	-.042	-.01	-.11	.068	-2.5
(1)	(2.2)	(.0012)	(.11)	(.56)	(.093)	(.1)	(1.6)
21983	21983	21983	21983	21983	21983	21983	21983
Ages 25 to 55, Men, Job MET >= 2.5 (n=18,882)							
-4.3***	-17***	.004**	.59*	2.4	.38**	.21	-6.3**
(1.1)	(3.4)	(.0018)	(.34)	(1.7)	(.16)	(.3)	(2.5)

* Significant at 10 percent ** Significant at 5 percent *** Significant at 10 percent. Each cell represents a separate regression model. Coefficients on the state unemployment rate are presented with standard errors adjusted for arbitrary correlation within areas reported in parentheses. All models control for state, month, and day indicators, in addition to indicators for gender, education, marital status, race and ethnicity, age, age-squared, and interactions of gender and race with education.

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