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ABSTRACT

The Time and Timing Costs of Market Work, and their Implications for Retirement*

Retirement ages among older Americans have only recently begun to increase after a precipitous fifty-year decline. Early retirement may result from incentives provided by retirement systems; but it may also result from the rigidities imposed by market work schedules. Using the American Time Use Survey of 2003 and 2004, I first examine whether additional market work is neutral with respect to the mix of non-market activities. The estimates indicate that there are fixed time costs of remaining in the labor market that alter the pattern of non-market activities, reducing leisure time and mostly increasing time devoted to household production. Market work also alters the timing of a fixed amount of non-market activities during the day, away from the schedule chosen when timing constraints imposed by market work do not exist. All of these effects are mitigated by higher family income, presumably because higher-income people can purchase market substitutes that enable them to overcome the fixed time costs of market work.

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The reason I am retiring fully is to have control of my schedule, so that I can travel, concentrate on big research projects, etc. Since it's scheduled at certain times, teaching always pushes other activities away. [Comment by astronomy professor]

I. Introduction

Theoretical models and empirical analyses of the allocation of time have nearly universally made the distinction between work and non-work. A few exceptions do exist (e.g., Becker, 1965, and Gronau, 1980; and Kooreman and Kapteyn, 1987, and Biddle and Hamermesh, 1990); but in general such mundane activities as eating, washing or sleeping are implicitly assumed to be aggregable with such activities as enjoying a Mahler symphony or having sex, and their opportunity costs are assumed to be the same. This treatment may be correct; but among many other questions it precludes analyzing such important topics as: 1) The interaction of market work and people's choices about undertaking household production versus enjoying leisure; 2) How spouses interact in choosing how to divide household chores and leisure; and 3) The role of fixed costs of labor-market entry on the mix of non-market activities, an issue that may affect labor-force participation. In this study I concentrate on this last topic.

The importance of making distinctions among types of non-market activities seems especially great for older people. One of the most important problems facing the United States over the next few decades is the declining supply of skilled/experienced workers. Retirement ages have not increased, despite rapid increases in longevity even among older Americans (a 2.4 year increase among males age 65 between 1980 and 2002, a 1.1 year increase among women). Indeed, the labor-force participation rate of males 65+ fell from 33.1 percent in 1960 to 16.3 percent in 1990. Even in 2004 the rate was only 19.0 percent, despite recent drops in stock-

market assets available for retirement. With the baby-boom generation approaching retirement (and reaching it in the 2010s), the problem will be substantially exacerbated.¹

The evidence from studies of older workers' labor supply suggests that it is fairly inelastic with respect to wage increases. To encourage that supply, work opportunities may need to be re-structured to make them consistent with older Americans' desires to have their free time as unconstrained as possible, both in terms of what is done and when it is accomplished. Interestingly, a web-search for "phased retirement" shows that most of the "hits" are on universities' programs: Academics are one of the few groups whose employers' allow them the flexibility that meets the workers' preferences and the employers' demand for skill!

In this study I examine several aspects of the role of the fixed costs of market work in affecting the allocation of non-market time. First, to fix ideas on how these effects might work, I present information on how older Americans use their time and how that allocation differs from that of younger people. This discussion is quite straightforward, and its non-behavioral accounting of time use mirrors what constitutes the overwhelming amount of research on the allocation of time outside the market, including the only available examinations of older workers (Gauthier and Smeeding, 2003; Sayer *et al*, 2001). The bulk of the study focuses on answering the analytical question of how market work—both the amount of time devoted to it and its timing—generates an impediment to Americans' optimization of the amount and sequencing of their non-market activities.

In the first part of the study I analyze how the decision to make the discrete choice of working in the market alters the mix of non-market activities. To the extent that households'

¹The issue is summarized perfectly in the leader in *The Economist*, February 18, 2006, p. 65, "Older workers want to retire later; companies fear they will soon be short of skills. Why can't the two get together?" A recent survey of 1000 American workers suggests that many more wish to phase retirement than believe that their employers will allow them to do so (reported in *Wall Street Journal*, March 25, 2004, p. D3). Gustman and Steinmeier (2004) show that in the Health and Retirement Survey relatively few older workers believe that they will be able to reduce hours to the level that they wish as they age.

allocations of time suggest that entering or remaining in the labor market alters time allocation outside the market, we may infer that the fixed time costs of work make remaining in the labor force unattractive for older workers who would not choose complete retirement given other incentives. The second part concentrates on discovering **when** people perform different activities and examining the determinants of this timing. There is an excellent theoretical study of the timing of activities (Winston, 1982), and some empirical work has been done (Hamermesh, 1999, 2002) on the general population; but there has been no examination of how the timing of different non-market activities interacts with the choice of whether and how much market work to undertake. Given the likely importance of scheduling in employers' demand for labor and the spillovers that these constraints may impose on people's schedules outside the labor market, discovering what scheduling looks like when the constraint of market work is no longer relevant would seem crucial for understanding how this dimension of choice may alter the supply of labor to the market.

II. The Source of All Data: The American Time Use Survey, 2003 and 2004

The usual retrospective records that form the bases for most of the analysis of labor-force behavior in the economics and sociology literature ask individuals how many hours they worked in some recent time period, be it last week (as in the Current Population Survey) or last year (as in the Panel Study of Income Dynamics and the Census of Population). A number of data sets also provide information on how people divide their hours in a typical day (with no information on timing), or the most recent week or month, among a number of non-market activities that are either exhaustive (as in the Health and Retirement Survey) or partial (as in the PSID and other longitudinal household surveys), but that are not constrained to equal the total number of minutes or hours in the day or other time period. A time-budget survey gives respondents a daily log and asks them to indicate when they started each new activity and what that activity was. These are

then coded into a variety of categories. The surveys have the virtue of immediacy and exhaustiveness, both of the time period covered and of the panoply of possible activities.

While there is a very long history of time-budget surveys in the United States (Sorokin and Berger, 1939), the U.S. lagged behind many other countries in developing these surveys from the 1970s through 2000. That changed in 2003 with the fielding of the American Time Use Survey. This data set initially provided time diaries from 1800 individuals each month, one person per household, for a total of 20,720 in 2003 and 13,973 in 2004 (and a similar number in subsequent years). Because the respondents are recent members of the CPS panel, substantial information is also available on their work and earnings, on their families, and on other demographics. Of the respondents in the first two years 8,037 are age 60 or over, so that the ATUS provides by far the largest number of time diaries ever completed by older Americans.²

The choice of how to aggregate the 406 individual activities that are reported in the ATUS is inherently arbitrary. Here I take two approaches to aggregation. At the highest level of aggregation I divide activities into four groups: 1) Market work; 2) Secondary activities, those for which the individual might have purchased market substitutes. These activities satisfy Reid's (1934) third-party rule defining household production. 3) Tertiary activities, those that one must perform for oneself but that are essentially personal maintenance; and 4) Leisure. Also included is a category "Other," which accounts for a few miscellaneous activities and those few minutes in some respondents' days for which no activity is recorded. At a slightly less aggregated level I also break secondary activities down into household work and shopping, and child and other care, including volunteering; and I disaggregate tertiary activities into sleeping, eating and drinking, and personal care.

²See Hamermesh *et al* (2005) for a description of the survey, and Horrigan and Herz (2005) for details on its origins and construction.

Table 1 presents the average time allocations by age in the lower-level aggregates listed above. I present these separately for individuals below age 55, then by five-year age group. Of course, the biggest change with age is the decline in market activity. As is well known, and as the time diaries show, the major declines begin at age 60. What is interesting is how the time that is freed up, roughly 180 minutes among 65-69 year-olds compared to 55-59 year-olds on a typical day, is used. There is essentially no change in the time devoted to personal care. Household production increases by about 30 minutes, sleeping increases by 25 minutes, and time devoted to eating and drinking increases by 10 minutes across this ten-year age range. Of the extra three hours that become available, the overwhelming majority, nearly two full hours, are devoted to additional leisure time. Not only is this the largest absolute change generated by the decline in the time devoted to market work in these aggregates, it is also by far the largest in percentage terms. Clearly, among the activities that might be crowded out by market work, leisure is the main one.³

III. A Model of the Fixed Time Costs of Market Work

Why does an increase in leisure time represent the overwhelming use of the time that is freed up as older people reduce their hours of market? Is this a continuous response; or are there lumpy time costs of market work that have differential impacts on the amounts of time devoted to other activities, impacts whose effects are removed when an individual ceases market work? If the latter, it might explain the discontinuous change from working to retirement.

To examine these issues consider the simplest possible formulation, in which there are three uses of time: M, market work; S, secondary and tertiary activities; and L, leisure. Assume that the individual is single and faces a parametric wage w and unearned income I . Each minute devoted to market work must necessarily reduce the time devoted to other activities by one

³These inferences do not change qualitatively if we adjust for such controls as race, ethnicity and, marital status. The central conclusion—that the main change as workers withdraw from the labor force is an increase in leisure time—still holds.

minute. This is obviously true in reality, but it is a requirement imposed by time-budget data (although by no means necessarily by retrospective subjective data). There may be fixed time costs of market work such that the effectiveness of the remaining time devoted to S and L is reduced by constant fractions μ_S and μ_L when even a small amount of market work is undertaken.⁴ The fixed time costs might, for example, stem from a need to hurry in one's other activities (e.g., racing through one's breakfast in order to get to work on time, foregoing watching *The Tonight Show* in order to be rested for work the next morning). They might induce workers to engage in a different, and perhaps less satisfying mix of other activities (tying a necktie as personal care rather than enjoying sex or a relaxing bath, work-related socializing with colleagues or clients rather than playing a game of tennis with a personal friend).

Assuming no saving, the person's utility is:

$$(1a) \quad U(I, S, L), \quad \text{if } M = 0;$$

and

$$(1b) \quad U(I + w[24 - S - L], \mu_S S, \mu_L L), \quad 0 < \mu_S, \mu_L < 1, \quad \text{if } M > 0.^5$$

The utility cost of the first moment of market work, the fixed (utility) cost of market work, is then:

$$(2) \quad V = U(I, S, L) - U(I, \mu_S S, \mu_L L) > 0.$$

The individual maximizes utility, choosing maximizing time allocations $S^* > 0$ and $L^* > 0$, and $M^* \geq 0$. If $M^* = 0$ is maximizing:

$$(3a) \quad U_2/U_3 = 1;$$

if $M^* > 0$ is maximizing:

$$(3b) \quad U_2/U_3 = \mu_L/\mu_S.$$

⁴These differ from the possible fixed money costs of work discussed by Cogan (1981) and assumed to be absent here.

⁵In this formalization I thus ignore Becker's (1965) notion of substituting goods for time, although I bring it in later in the discussion of the role of differences in unearned income.

Only if:

$$(4) \quad U(I + w[24 - S^* - L^*], \mu_S S^*, \mu_L L^*) - U(I, S, L) > V,$$

for some combination of S^* and L^* does the individual supply positive hours of market work. If s/he does so, if the effective relative price of secondary/tertiary activities and leisure changes from unity to $\mu_S/\mu_L \neq 1$, we will observe that the very first minute of market work alters the relative amounts of secondary/tertiary and leisure activities chosen. Thus while we cannot observe the existence of fixed time costs of work directly, we can observe whether their impact on the individual's allocation of time across other activities is neutral by observing how patterns of time use change in response to an initial moment of market work.

Unlike prices of market goods, the relative price change generated by the existence of fixed time costs of work can differ among individuals. Those who have a higher I might use their additional unearned income to substitute purchased goods and/or services for those secondary activities whose price has risen because the individual has chosen to bear the fixed time costs of working. One benefit of additional unearned income may be to mitigate the impact of the fixed time costs of work.⁶

This discussion suggests that there may be discontinuous changes in the allocation of individuals' time when they do not engage in market work. It also implies that these potential effects will differ depending on the income in the household to which the worker belongs. Taken together, the model provides guidelines for an indirect test for the presence of fixed time costs of work in order to analyze how market work may impose costs on (older) workers.

⁶Fixed money costs of work (Cogan, 1981) create a "hole" in the distribution of hours of market work—it is not worthwhile to supply very few hours to the market. So do fixed time costs. The former, however, create a larger hole for those whose market wage rate is lower. The latter create a bigger gap in the distribution for workers whose value of time is greater.

IV. Testing for the Presence of Fixed Time Costs of Market Work

A. *Basic Results*

Ideally we would test for the impact of fixed costs by finding some kind of instrument that might help to identify the determinants of working in the market only a few hours versus not working. No such instrument is available in the ATUS; nor would one even appear to be imaginable were more data available. While instruments that might determine selectivity into market work have been used with some success (e.g., the now-classic use of the presence of young children by Heckman, 1976), finding an instrument that might convincingly determine selection into only a small amount of market work and that is independent of the mix of non-market activities seems a daunting task.

Given this difficulty, I rely instead on examining how a person's allocation of non-market time changes when s/he crosses the threshold into market work. There are unobserved differences between those who engage in market work and those who do not; but if we still observe an apparent impact of fixed time costs as we restrict the sample to non-workers and those with successively fewer hours of market work, we may be more confident that we are measuring what the theory indicates. Essentially the analyses amount to a regression discontinuity approach to the impact of hours of work on time allocation outside the market.

I thus estimate regressions relating minutes spent in secondary activities, tertiary activities and leisure to minutes spent in market work and an indicator WORK equaling one if any market work is performed. In these three equations the estimated coefficients on the former variable must, except for tiny differences due to the few minutes unaccounted for or unclassifiable in some diaries, sum to -1 . The estimated coefficients on the indicator for positive market work must (again with the minor exception) sum to 0. If the fixed time costs of market work on time allocation outside the market create neutral effects, each of these latter three coefficients will equal zero. Thus a test for neutrality of market work (essentially a test for

whether we can treat all non-market activities as separable from market work) is a test of the null hypothesis on these coefficients differing from each other.

In order to have a sufficient number of people who are working in the market and others who are not, I restrict the sample to people under age 60.⁷ In addition to the measure of market work time and the indicator for market work I also include in the equations describing the allocation of non-market time a quadratic in age and indicators for whether the respondent is African-American or Hispanic and for the presence of children in various age categories (ages 0-2, 3-5, 6-13, 14-17). In equations describing all individuals indicators for gender and marital status are included, while those equations, and the equations describing married people, also include a measure of spouse's hours of market work (CPS-style retrospective data on usual weekly hours, since only one time diary is collected per household). All the equations are weighted so that the estimates reflect behavior on a representative day of the week.

Table 2 presents the estimates of the three equations for the entire sample and then separately by marital status and gender.⁸ The first column in each panel lists the estimated effects of moving from no market work to an infinitesimal amount of work, while the second column shows the effect of adding one additional minute of market work. The results are striking: Among all adults the impact of beginning market work is not neutral across secondary activities, tertiary activities and leisure. The estimates suggest a substantial negative effect on leisure activities and smaller positive effects on secondary and tertiary activities. A test of the equality of the three estimated parameters demonstrates that they are jointly significantly different from each other (and thus *ipso facto* jointly significantly different from zero).

⁷The results hardly differ if all adults in the ATUS survey are included.

⁸In order to examine the impact of differences in family income on the non-neutrality of fixed time costs I restrict the samples to those ATUS respondents for whom a measure of family income is available.

Disaggregating the sample by marital status and gender changes the results somewhat, but the results still show the same significant impacts. Among all four marital/gender categories beginning market work generates a shift of non-market time away from leisure and toward secondary activities. The negative impacts on time spent in leisure activities are not greatly different from each other across the groups: The 23-minute daily decrease in leisure that I estimated results from beginning market work in the entire sample characterizes these subgroups fairly well.⁹

B. Tests for Robustness and Extensions

As noted above, one might well be concerned that the average worker differs unobservably from non-workers, and that, rather than demonstrating the non-neutrality of the fixed time cost of market work, all I have shown is that non-workers in the sample are less productive in both the household and the market, or have a lesser preference for any kind of market work or secondary activities, than workers. I cannot completely refute that possibility. Some insight into the validity of this counter-argument can, however, be obtained by restricting the sample to people who may be more similar, namely those who work zero or relatively few hours in the market. The upper panel of Table 3 restricts the sample respectively to individuals working in the market fewer than 4 hours in a day, or fewer than 2 hours in a day. In both cases we observe, as in Table 2, that there is a significant non-neutrality of beginning market work. As in the results based on the unrestricted sample, and excluding the roughly 8000 people who are observed working 4 hours or more, we again find that beginning market work generates a roughly half-hour reduction in leisure activities. Unlike in the entire sample, however, it also generates a reduction in tertiary activities, and leads to a large increase in secondary activities.

⁹Freeman and Schettkat (2005) compare older U.S. and German time-budget data and claim that longer U.S. hours of market work are offset by reductions in their home production. This may be true in the aggregate; but the results here make it absolutely clear that market and home production are complements at the margin of work at the individual level, with both substitutes for leisure.

The results are nearly identical if we restrict the sample further to exclude the nearly 900 additional workers putting in between 2 and 4 hours of market work on the diary-day.

The results disaggregated by gender and marital status, shown in the bottom two panels of Table 3, look remarkably like those presented for the aggregates of short-hours workers and non-workers. The impacts of starting work are statistically unequal for all four groups and are even more similar to each other than they were for the unrestricted samples for which the results were shown in Table 2. As observed throughout, leisure activities are diminished, while secondary activities increase. The results suggest that the findings for the entire sample are not an artifact of including workers who are far beyond the margin of choice about whether to enter the labor force.¹⁰

Yet another possibility is that those with strong preferences for leisure have inherently different set-up costs for different non-market activities from those whose tastes for leisure are weaker. We can take advantage of the ATUS over-sampling on weekends and its CPS information on weekly hours of market work to examine how the allocation of time of those did not work on a weekend day is affected by their total time devoted to the market on weekdays. To do so I use the CPS weekly hours measure along with an indicator of positive weekly hours, substitute these two variables for the two variables that form the focus of Tables 2 and 3, and re-estimate the equations over weekend respondents who reported no market work on the diary day.

Table 4 presents the results. One should first note that each triad of coefficients should nearly (because of the small miscellaneous category) sum to zero, since there is no market work on the diary day. The first thing to note is that the vector of coefficients on the indicator of

¹⁰Nor are they due to the inclusion of individuals who may usually work longer hours but who are observed on weekends. If the sample in the top panel of Table 2 is restricted to individuals observed on weekdays, the estimated impacts of beginning market work on the three aggregates of activities are 1.24, 25.72 and -26.15 minutes respectively, again significantly different from each other and from 0. When the same restriction is applied to the sample in the left half of the upper panel of Table 3, the results are even more strikingly similar to those that include people whose diary-day covers a weekend day.

positive market work during the week is not significantly different from zero. There appear to be only small differences in set-up costs between non-workers and others on days when no market work is performed. Additional hours of work during the week are, however, not neutral with respect to the allocation of time on a non-working weekend day, however.¹¹ They reduce leisure time on weekends and increase time devoted to secondary activities among those who do no market work on weekends. While not due to fixed costs, this may be one more reason for retirement—the first thing workers do with their “free time” on weekends is catch up on the secondary activities that the rigidities of their market work prevented them from doing during the workweek.

The “story” behind the fixed costs argument is one of setting up to go to work. The examples we gave were mostly classifiable as tertiary activities. If one works at home, the fixed costs that tilt non-market time to tertiary activities might be reduced, so that among at-home workers we would observe smaller effects on tertiary activities at the extensive margin of beginning work. I re-specify each of the equations presented in the top panel of Table 2 to include an indicator for whether and how much market work a person does at home. At the extensive margin of work there are no differences in leisure time between at-home workers and those who work away from home. Working away from home generates an initial extra 17 minutes of time in tertiary activities; but among at-home workers there is no impact at this extensive margin. On the other hand, the impact at the extensive margin on secondary activities is nearly zero for those who work away from home but is 25 minutes for those who work at home. That there are no significant differences at the intensive margin between non-workers and at-home workers on time spent in any of the three categories further suggests the validity of the fixed-cost argument.

¹¹A test of the equality of the three estimated parameters yields $\chi^2 = 14.52$.

Having demonstrated the existence of non-neutral fixed costs of market work using the very broadest aggregates of non-market activity, it is worth discovering along what disaggregated dimensions of non-market activity these effects work themselves out. The upper panel in Table 5 disaggregates leisure into television watching and other leisure. Very clearly, the main effect on leisure of beginning market work is on television watching. This is not surprising, insofar as reducing television-watching is likely to be the least-cost mechanism of accommodating a shift to market work.

The further disaggregations in the bottom panel of Table 5 show the same effects for leisure as in the upper panel. They also indicate that among individuals with children present entering market work increases secondary activity by inducing a substitution of family care of household care. Implicitly the fixed costs of child care are less than those of other household activities, so that entering market work has its main impact with the aggregate of secondary activities in the form of a shift from household care to child care. Among people without children, it is unsurprising that the impact on family care is small and that overall the increase in secondary activities that occurs when market work commences is in the form of additional home work.

Consider the optimizing conditions (3). Specify the utility function in (1a) in Cobb-Douglas form:

$$U(I, S, L) = I^\alpha S^\beta L^\gamma .$$

Let $Z = Z(I, S, L) = U_2/U_3 = \beta L/\gamma S$. Then from (3a) and (3b):

$$[Z_3 - Z_2]\Delta L = \Delta(\mu_L/\mu_S) , \text{ or}$$

$$(5) \quad \Delta(\mu_L/\mu_S) = [2\beta T^*/\gamma S^2]\Delta L,$$

where T^* is the total (fixed) time (24 hours per person).

Remember that, at the point of indifference between working in the market and not, it was the case by assumption that $\mu_L/\mu_S = 1$. Then we can use the estimated impacts of beginning

market work that were generated for the entire sample in the upper panel of Table 2 to infer from (5) the relative size of the loss in efficiency in household production when market work is undertaken. Taking these estimates yields $\Delta(\mu_L/\mu_S) = -0.076$. Implicitly there is a slight drop in the relative efficiency of generating satisfaction from leisure compared to that from secondary/tertiary activities.

Continuing the assumption of a Cobb-Douglas utility function, we can alternatively use the observed change in the mix of secondary/tertiary activities and leisure to infer the loss in utility from undertaking an infinitesimally small amount of market work. The welfare loss, implicitly a measure of the relative size of V in (2), which is implied by our estimated parameters is between 3 and 5 percent. To make entering the labor force worthwhile earnings must be enough to offset this large a loss in utility that is generated by the reduction in the efficiency of household production.

Having demonstrated that the evidence is consistent with non-neutral fixed time costs of market work, we can test whether the change in behavior imposed by these costs can be overcome if the individual has sufficiently high income to purchase market substitutes. We thus expand the specifications in Table 2 to include a measure of household income and its interaction with the indicator for market work. Desiring to maintain parsimony in these interactions, and because the data on household income are categorical, I form the single indicator variable, income above \$50,000 per annum, and use only it. Slightly fewer than 60 percent of married couples in the sample have incomes above this threshold.

The results of re-estimating the equations describing non-market allocations of time are shown for all married people, and for married men and women separately, in Table 6. The interaction terms in each case are of opposite sign from the main effect terms on WORK and are jointly significantly different from zero in all three samples. A higher income moderates the non-neutrality of the fixed time costs of market work, allowing the individual to avoid giving up

leisure and adding secondary or tertiary activities when he/she enters the labor market. Indeed, the results suggest that having a household income above the \$50,000 threshold suffices to overcome completely the non-neutrality of the fixed time cost of market work. The results for married women, the majority of whose household incomes stems from their husband's earnings and from unearned income, are especially convincing of the impact of fixed time costs and of the role of higher income in enabling the household to offset those costs.¹²

We can use the estimates in Tables 2 and 6 to measure the impact of market work on the allocation of time outside the market. For the entire sample used in those estimates, the average worker cuts his/her secondary time by 36 percent, tertiary time by 7 percent and leisure by 42 percent compared to an otherwise identical non-worker. Among workers in households with incomes above \$50,000, however, the corresponding decreases are 54 percent, 8 percent and 36 percent. Higher incomes enable families to purchase market substitutes for their secondary time and mitigate the reduction in leisure that occurs when they work in the market.

The estimates in this Section do not prove the existence of non-neutral fixed time costs of market work. In several ways, however, particularly the consistent pattern of a shift from leisure activities to secondary activities when market work hours are few but positive and the apparent diminution of that shift as household incomes increase, they are consistent with this type of fixed cost. They suggest that market work imposes some additional constraints on those who choose it, constraints that increase the incentives for complete withdrawal from the labor force rather than a gradual reduction in market hours as people become eligible for public and/or private pensions.

¹²If we restrict the sample to married women observed on weekdays and working fewer than 240 minutes on those days, which cuts the sample by 75 percent, we still observe the same general results—a moderation of the apparent non-neutrality of fixed time costs as income increases.

V. The Timing of Activities

Yet another potential non-neutral effect of additional market work and the fixed cost of beginning market work on time use at home is on the temporal pattern of daily activities. That is, conditional on the amount of an activity (secondary, tertiary or leisure) that is undertaken over the day, are the times at which those non-market activities are performed affected by the amount of market work and by the fixed cost of beginning market work? In other words, is there an *instantaneous* non-neutrality of market work on household activities analogous to the *integrative* impacts that were demonstrated in Section IV?

To examine this possibility I estimate equations:

$$(6) \quad P_{At} = H(A; \text{WORK}; M; X), \quad A = S, T, L; t=1, \dots, 96,$$

where P_{At} is an indicator equaling one if activity A was performed during quarter-hour t, and X is a vector of controls. These equations are analogous to those estimated in Section IV, except that here I am holding constant the total amount of time spent in activity A to concentrate on how its diurnal distribution is affected by market work. The sum of the coefficients on the A across the t should equal zero, since total time spent in A over the day is $15\sum P_{At}$. Thus conditional on A the coefficient estimates of M show whether an additional minute of market work alters the temporal pattern of the activity A. Similarly, again conditional on A, the estimated coefficients on WORK show whether the discrete choice to begin market work alters the temporal pattern of the activity A. These estimates thus provide tests of the impact of the fixed costs of market work on the timing of household activities.

The raw ATUS data for 2003 are presented in sequence, with each activity having a particular starting time (coded to the minute). For purposes of analysis, as is implicit in (6) I combine the data into periods of 96 quarter-hours, examining what each respondent was doing

during each quarter-hour beginning at 4AM and ending at 3:59AM the next day.¹³ Before proceeding to the estimation, and analogous to the presentation in Sections II and IV, I first provide information on the temporal patterns of activities among people under age 55 and 55 or over. Clearly, there is a massive amount of information here; the only useful approach is to present it graphically, which I do throughout the rest of this Section.

Figures 1a-1d show the daily patterns of market work, secondary activities, tertiary activities and leisure for people under 55 and those 55+.¹⁴ (The graphs present the mean fractions of people in the group engaged in the activity at the particular quarter-hours.) Most of the differences between the two age groups are the unsurprising result of the higher incidence of market work among the younger sub-sample. The diurnal patterns of market work are identical between the two age groups, with the downward shift among the older group at each point being nearly directly proportional to their lower market participation.¹⁵

The time patterns of tertiary activities differ little across these two groups; and even the timing of leisure differs little once we account for differences in market work, a mainly daytime activity. The main interesting difference is in the temporal pattern of secondary activities. Younger people perform their secondary activities (household production) disproportionately during the late afternoon and evening when they are less likely to be working; older people, perhaps to avoid congestion costs at times when more younger people are at their workplaces, perform these activities disproportionately during the prime daytime hours.

Strikingly, the difference in the pattern of the timing of secondary activities by age is observed even among those whose time diaries showed no market work and who responded to

¹³Where more than one activity was in progress during a quarter-hour, I included the one which comprised the majority (or plurality) of the 15 minutes. In the very few instances where more than two activities were in progress for the same length of time I coded the first of them as representing the quarter-hour.

¹⁴All the data and coefficients presented in the Figures in this Section are based on statistics that have been weighted to provide information on a representative day of the week.

¹⁵This finding is consistent with the evidence in Hamermesh (1999) on self-reported work patterns by age in the CPS.

the CPS question about usual hours of work by saying theirs were zero. Even non-working younger people engage in household production disproportionately in the late afternoon and early evening, at times when older Americans disproportionately engage in leisure activities. Since the main difference in the kinds of leisure undertaken across age groups is that older people watch more television, the differences reflect the greater attractions of prime-time television to older audiences. Differences in the timing of tertiary activities by major age group are slight—those under or over 55 sleep, eat, etc. at roughly the same times. The only significant differences are that older Americans are more likely to engage in tertiary activities between 11PM and 4AM, and less likely to do so from 8AM to 11AM. Since sleep accounts for most tertiary time use, these differences reflect older Americans going to bed and waking up earlier than younger people.

In Figure 2a I present the temporal patterns of the coefficients on the variable WORK from the three sets of probits (6). Each point represents a regression coefficient at a particular quarter-hour of the day, and around each point is a 95-percent confidence interval. The very fact of being in the labor market, even for only a few hours in a day, causes significant displacement in the timing of activities conditional on the total amount of the activity that is undertaken. Particularly interesting are the displacement of leisure away from prime working hours and the displacement of secondary activities to late afternoon and early evening. In addition to increasing the amount of secondary activities and reducing leisure, as shown in Section IV, the engaging in labor-market activity also causes temporal displacements in the performance of these activities.

Figure 2b presents the same kind of information, but for the coefficients on M from the estimates of equations (6). It shows that additional time devoted to market work, conditional on being in the labor market, has especially large effects on the timing of tertiary activities. The marginal effect of another minute of market work is biggest on sleeping, eating, etc. during

normal waking hours. The effects on leisure are also large and significant, and indicate that additional minutes of market work shift leisure away from prime daytime working hours. The impacts of an additional minute of work time on the timing of secondary activities are smaller, with the biggest shift being toward conducting secondary activities during evening hours.

For each of the three major aggregates of non-market activities Figures 3a-3c show the coefficients at each quarter-hour on the indicator WORK and an interaction of that indicator with the indicator of family income above \$50,000 per year. The underlying probits and samples are identical to those partly described in Figures 2a and 2b, except for the addition of this interaction and a main-effect term in the indicator of income exceeding \$50,000. The question is whether the impact of labor-market participation differs between otherwise identical workers who are in higher- or lower-income households.

A test of the role of income in mitigating the disruptions to scheduling that are produced by market work is whether the confidence intervals around the dotted lines in Figures 3 include the zero line. While they do in many cases, in many others they do not. More often than not, however, the coefficients on the interaction term between higher income and WORK are of opposite signs, suggesting that additional family income does reduce the disturbance to the timing of household activities generated by labor-force participation. The correlation of the coefficients on WORK and its interaction with family income in the equations for secondary activities is +0.19 (48 of 96 opposite signs), not significantly different from zero; the correlation of the two coefficients in the equation for tertiary activities is -0.61 (63 opposite signs); that for leisure is -0.38 (53 opposite signs). The correlation and number of opposite-signed coefficients in the equations describing tertiary activities are significantly different from what is expected under the null hypothesis of randomness, as is the correlation coefficient for the estimates for leisure. These results suggest that people in higher-income households are able to use their

income to overcome some of the set-up costs that market work imposes on the timing of non-market activities.

The final set of figures, 4a and 4b, is analogous to Figures 2a and 2b, except the sample is restricted to individuals whose diaries describe weekend days when they did no market work, but who report positive hours of market work for the week. Here, analogous to the integrative analysis in Section IV that were reported in Table 4, the purpose is to examine whether it is market work *per se* that alters schedules, or whether workers' home schedules differ from others' schedules for reasons not having to do with time spent in the market on the particular day. Comparing these figures to Figures 2a and 2b, there are only slight effects on the timing of a given amount of other activities over the weekend of having worked in the market on weekdays. What matters most for the determination of the timing of non-market activities is the amount of work on the particular day. As was true for the fixed costs of market work in Section IV, there is only weak evidence that those who work only on weekdays behave on the weekends any differently from otherwise identical people who do not work during the week at all.

VI. Conclusions

Using a recently available data set of time diaries of Americans I have tried to provide a new answer to the question of why the drop-off from market work to leisure is so rapid and pronounced among older Americans. Those data show that the overwhelming majority of the reduction in market work as people pass age 60 is taken up by increases in leisure—increases in household production are relatively small, as are increases in time spent in personal activities, such as sleeping and eating.

A model in which working in the market alters the relative efficiency of home time in different activities provided one way of rationalizing the discontinuity in market work that is implicit in the fact of retirement. More generally, this approach offers a way of thinking about the nature of separability between market work and non-market activities. Using the same data

set I show that among Americans under age 60 the mere fact of participation in the labor market, even for a short while, alters both the distribution of non-market activities and their timing. Neither the discrete move to participation nor marginal increases in hours of work are neutral with respect to the kinds of activities undertaken outside the market, even when we confine the analysis to the three broad aggregates secondary activities, tertiary activities and leisure. Working in the market increases the amount of secondary activities performed relative to the amount of leisure consumed. Also, the diurnal distributions of these three major aggregates are altered on working days when a person enters the labor market and when s/he increases hours of market work. That all of these impacts are mitigated by the ability to purchase market substitutes suggests further that they arise from the presence of non-neutral fixed costs of market work.

While incentive effects of government and private pension programs have been pointed to as rationalizing sharp reductions in market work after age 60, the approach here offers an alternative explanation, one based on the nature of household production and its interaction with the demand side of the labor market for older workers. Coupled with the implied relative change in the efficiency of household activities if an individual engages in market work, firms' inability or unwillingness to increase the flexibility of work scheduling may be one reason for the existence of sharp reductions in market work among older people. To the extent that this explanation makes sense, it offers a much different prescription for inducing skilled older workers to remain in the labor force from the usual ones. Instead of concentrating on incentives in pension plans, offering firms incentives to encourage increased flexibility of work timing so as to mesh better with the apparent desire of workers to enjoy more leisure activities and to time them more flexibly might at least partly vitiate the disincentive effects that market work produces on household activities.

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Table 1. Mean Time Use by Age, ATUS 2003 and 2004 (Minutes per Representative Day)*

| Activity | Age | | | | | |
|----------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| | <55 | 55-59 | 60-64 | 65-69 | 70-74 | 75+ |
| Market work: | 260.94 (1.84) | 255.18 (5.43) | 168.18 (5.58) | 82.13 (4.45) | 49.50 (3.86) | 14.90 (1.54) |
| Secondary: | | | | | | |
| Household production | 156.31 (1.04) | 186.10 (3.42) | 201.60 (3.91) | 218.64 (4.21) | 220.64 (4.79) | 202.31 (3.13) |
| Family care | 78.59 (0.81) | 40.10 (1.87) | 48.74 (2.36) | 46.80 (2.48) | 38.46 (2.41) | 31.49 (1.72) |
| Tertiary: | | | | | | |
| Sleep | 506.69 (0.86) | 494.48 (2.41) | 507.92 (2.67) | 516.81 (2.76) | 528.09 (3.03) | 541.40 (2.40) |
| Personal care | 46.29 (0.35) | 50.47 (1.19) | 50.51 (1.54) | 50.44 (2.02) | 46.61 (1.67) | 50.43 (1.50) |
| Eating and drinking | 68.46 (0.39) | 77.15 (1.49) | 83.33 (1.95) | 86.43 (1.58) | 92.42 (1.69) | 90.38 (1.29) |
| Leisure: | | | | | | |
| TV Watching | 134.72 (0.94) | 164.65 (3.24) | 187.65 (3.92) | 217.80 (4.46) | 234.14 (4.98) | 251.84 (3.79) |
| Other: | | | | | | |
| | 10.46 (0.28) | 12.26 (1.24) | 12.26 (1.12) | 16.29 (1.11) | 16.28 (1.36) | 21.51 (1.31) |
| N = | 23958 | 2698 | 2101 | 1812 | 1469 | 2655 |

*Standard errors of the means in parentheses. The estimates in all tables are weighted to reflect equal numbers of observations on each of the seven days of the week.

Table 2. Impacts of Market Work on Daily Minutes of Other Activities, ATUS 2003 and 2004, Individuals <60 (Minutes per Representative Day)

| All Individuals | | | | | | |
|------------------------|-------------------|-------------------|----------------------|------------------|-------------------|----------------|
| | WORK | Minutes of Work | R ² | | | |
| Secondary Activities | 17.98 (3.96) | -0.379 (0.007) | 0.405 | | | |
| Tertiary Activities | 3.76 (3.28) | -0.208 (0.006) | 0.170 | | | |
| Leisure | -22.64 (4.14) | -0.396 (0.007) | 0.437 | | | |
| $\chi^2(2); N =$ | 31.34 | 23673 | | | | |
| Married Men | | | Married Women | | | |
| | WORK | Minutes of Work | R ² | WORK | Minutes of Work | R ² |
| Secondary Activities | 18.23 (7.36) | -0.374 (0.011) | 0.338 | 15.63 (7.75) | -0.493 (0.015) | 0.420 |
| Tertiary Activities | 12.98 (5.57) | -0.218 (0.009) | 0.225 | 0.92 (5.67) | -0.185 (0.011) | 0.149 |
| Leisure | -32.96 (7.43) | -0.389 (0.011) | 0.433 | -15.62 (7.11) | -0.307 (0.014) | 0.259 |
| $\chi^2(2); N =$ | 19.98 | 6001 | | 5.36 | 7044 | |
| Single Men | | | Single Women | | | |
| | WORK | Minutes of Work | R ² | WORK | Minutes of Work | R ² |
| Secondary Activities | 24.78 (8.34) | -0.255 (0.015) | 0.183 | 37.61 (8.07) | -0.371 (0.015) | 0.305 |
| Tertiary Activities | 7.25 (8.57) | -0.242 (0.015) | 0.156 | -6.02 (7.31) | -0.210 (0.014) | 0.147 |
| Leisure | -36.03 (10.51) | -0.484 (0.019) | 0.485 | -30.73 (8.89) | -0.407 (0.017) | 0.428 |
| $\chi^2(2); N =$ | 13.11 | 4617 | | 22.13 | 6011 | |

*All the estimating equations here and in Tables 3-6 include a quadratic in age, and indicators for African-American and Hispanic and the presence of children in various age categories. Those for all workers also include indicators for marital status and gender; they and the equations for married individuals in Tables 4 and 6 also include a measure of spouse's hours of market work.

Table 3. Impacts of Market Work on Daily Minutes of Other Activities, ATUS 2003 and 2004, Individuals <60 Working Short or Zero Hours (Minutes per Representative Day)

| | All Individuals with <4 Daily Hours of Market Work | | | All Individuals with <2 Daily Hours | | |
|----------------------|---|-------------------|----------------|-------------------------------------|-------------------|----------------|
| | WORK | Minutes of Work | R ² | WORK | Minutes of Work | R ² |
| Secondary Activities | 54.28 (7.81) | -0.625 (0.061) | 0.290 | 53.70 (10.78) | -0.607 (0.179) | 0.288 |
| Tertiary Activities | -22.38 (6.20) | -0.094 (0.049) | 0.024 | -14.04 (8.54) | -0.300 (0.142) | 0.021 |
| Leisure | -30.14 (8.16) | -0.294 (0.064) | 0.232 | -37.71 (11.26) | -0.109 (0.187) | 0.228 |
| $\chi^2(2); N =$ | 49.47 | 14951 | | 24.34 | 14093 | |

**Married with <4 Daily Hours
of Market Work**

| | Men | | | Women | | |
|----------------------|-------------------|-------------------|----------------|-------------------|-------------------|----------------|
| | WORK | Minutes of Work | R ² | WORK | Minutes of Work | R ² |
| Secondary Activities | 65.22 (15.13) | -0.713 (0.127) | 0.069 | 44.97 (14.54) | -0.703 (0.115) | 0.121 |
| Tertiary Activities | -24.94 (10.10) | -0.007 (0.085) | 0.020 | -8.85 (10.14) | -0.171 (0.081) | 0.036 |
| Leisure | -36.96 (15.28) | -0.316 (0.128) | 0.063 | -34.94 (13.22) | -0.113 (0.105) | 0.083 |
| $\chi^2(2); N =$ | 19.67 | 3110 | | 9.85 | 4954 | |

**Single with <4 Daily Hours
of Market Work**

| | Men | | | Women | | |
|----------------------|-------------------|-------------------|----------------|-------------------|-------------------|----------------|
| | WORK | Minutes of Work | R ² | WORK | Minutes of Work | R ² |
| Secondary Activities | 46.62 (17.39) | -0.395 (0.132) | 0.133 | 71.89 (15.64) | -0.658 (0.117) | 0.236 |
| Tertiary Activities | -20.64 (17.16) | -0.139 (0.130) | 0.015 | -41.01 (13.71) | -0.033 (0.103) | 0.021 |
| Leisure | -27.02 (21.78) | -0.495 (0.165) | 0.121 | -27.53 (17.21) | -0.317 (0.129) | 0.177 |
| $\chi^2(2); N =$ | 7.63 | 2942 | | 23.52 | 3945 | |

Table 4. Impacts of Market Work on Daily Minutes of Other Activities on Weekends, ATUS 2003 and 2004, Individuals <60 with No Weekend Work

| | WORK | Weekly Work Hours | R ² |
|-------------------------|-----------------|----------------------|----------------|
| Secondary Activities | -7.41 (9.50) | 0.942 (0.222) | 0.185 |
| Tertiary Activities | 7.08 (7.27) | 0.091 (0.170) | 0.034 |
| Leisure | -0.68 (9.92) | -1.031 (0.232) | 0.131 |
| $\chi^2(2); N =$ | 1.23 | 8,874 | |

Table 5. Impacts of Market Work on Daily Minutes of Other Activities, ATUS 2003 and 2004, Individuals <60 (Minutes per Representative Day)

All Individuals*

| | WORK | Minutes of Work | R ² |
|----------------|------------------|-------------------|----------------|
| TV Watching | -18.42 (3.35) | -0.146 (0.006) | 0.143 |
| Non TV Leisure | -4.23 (4.11) | -0.249 (0.007) | 0.285 |

$\chi^2(3)$; N = 43.25 23,673

Children Present

No Children Present

| | WORK | Minutes of Work | R ² | WORK | Minutes of Work | R ² |
|---------------------------|------------------|-------------------|----------------|------------------|-------------------|----------------|
| Home work And Shopping | -11.45 (4.74) | -0.274 (0.008) | 0.328 | 13.29 (4.68) | -0.251 (0.008) | 0.252 |
| Family and Other Care | 24.45 (4.42) | -0.158 (0.008) | 0.192 | 4.44 (4.68) | -0.066 (0.005) | 0.037 |
| Tertiary Activities | 1.83 (4.31) | -0.201 (0.008) | 0.183 | 7.10 (4.88) | -0.222 (0.009) | 0.155 |
| TV Watching | -10.51 (4.20) | -0.138 (0.007) | 0.140 | -21.79 (5.10) | -0.163 (0.009) | 0.138 |
| Non TV Leisure | -5.34 (5.10) | -0.211 (0.009) | 0.151 | -3.72 (6.26) | -0.281 (0.011) | 0.322 |

$\chi^2(4)$; N = 37.77 11,058 26.33 12,615

*This model also includes equations describing secondary and tertiary activities.

Table 6. Impacts of Market Work on Daily Minutes of Other Activities, ATUS 2003 and 2004, Individuals <60, with Income Interactions (Minutes per Representative Day)

| All Individuals | | | | |
|------------------------|------------------|-----------------------------|------------------------|----------------------|
| | WORK | WORK x Income>50K | Minutes of Work | R² |
| Secondary Activities | 29.35 (4.46) | -23.93 (4.23) | -0.379 (0.007) | 0.406 |
| Tertiary Activities | -0.74 (3.70) | 9.52 (3.50) | -0.208 (0.006) | 0.171 |
| Leisure | -30.83 (4.66) | 17.26 (4.42) | -0.396 (0.007) | 0.438 |
| $\chi^2(3); N =$ | | 10.32 | 23673 | |
| Married Men | | | | |
| | WORK | WORK x Income>50K | Minutes of Work | R² |
| Secondary Activities | 34.96 (9.17) | -28.18 (8.88) | -0.376 (0.011) | 0.342 |
| Tertiary Activities | 12.79 (6.94) | 0.63 (6.72) | -0.217 (0.009) | 0.226 |
| Leisure | -47.32 (9.24) | 24.05 (8.97) | -0.388 (0.011) | 0.435 |
| $\chi^2(3); N =$ | | 11.25 | 6001 | |
| Married Women | | | | |
| | WORK | WORK x Income>50K | Minutes of Work | R² |
| Secondary Activities | 23.17 (9.55) | -12.72 (8.53) | -0.494 (0.015) | 0.421 |
| Tertiary Activities | 2.82 (6.99) | -2.96 (6.24) | -0.185 (0.011) | 0.149 |
| Leisure | -26.56 (8.75) | 18.25 (7.81) | -0.306 (0.014) | 0.261 |
| $\chi^2(3); N =$ | | 2.64 | 7044 | |

Figure 1a: Fraction Doing Market Work by Age, Qtr. Hours
(means with 95% confidence intervals)

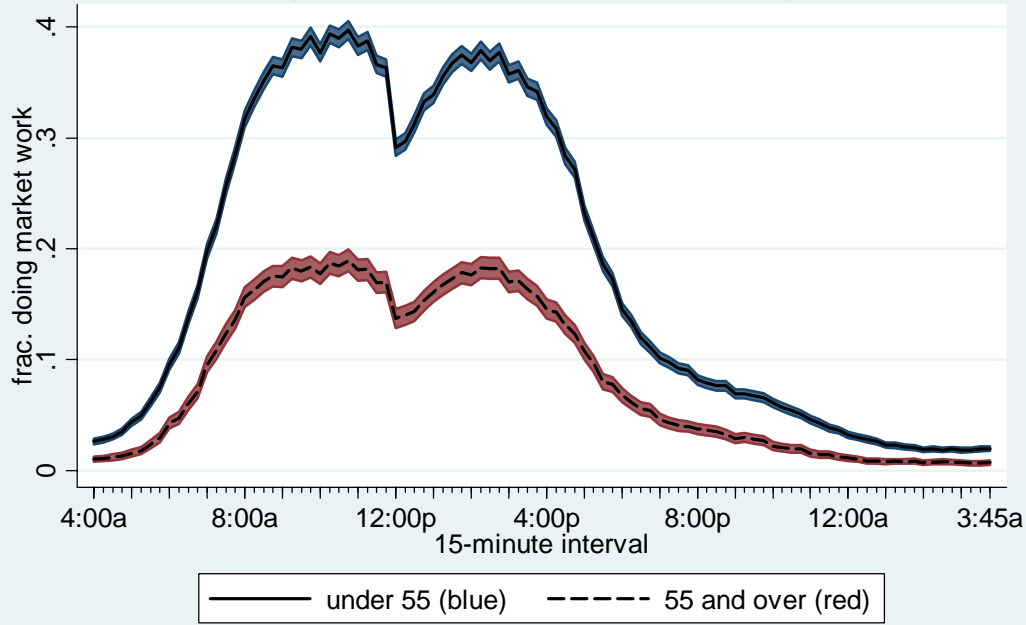


Figure 1b: Fraction Doing Secondary Activities by Age, Qtr. Hrs.
(means with 95% confidence intervals)

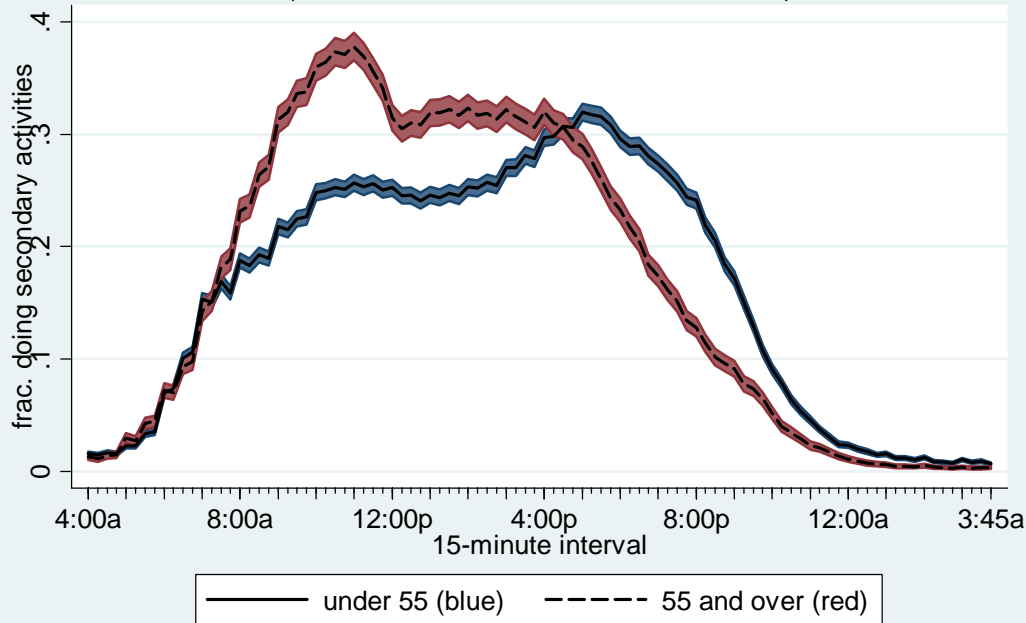


Figure 1c: Fraction Doing Tertiary Activities by Age, Qtr. Hours
(means with 95% confidence intervals)

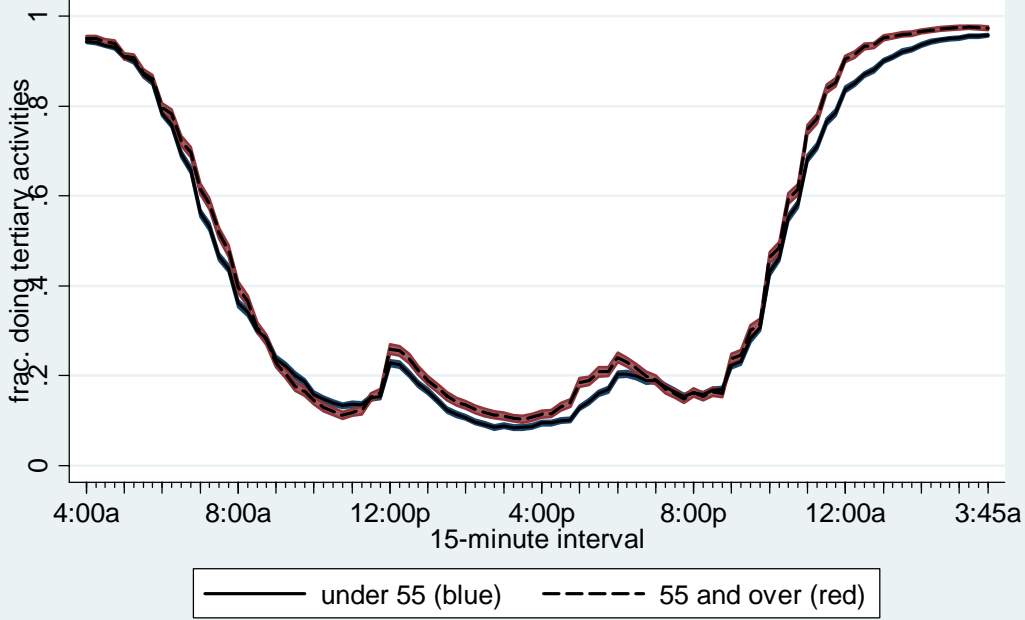


Figure 1d: Fraction Doing Leisure Activities by Age, Qtr. Hours
(means with 95% confidence intervals)

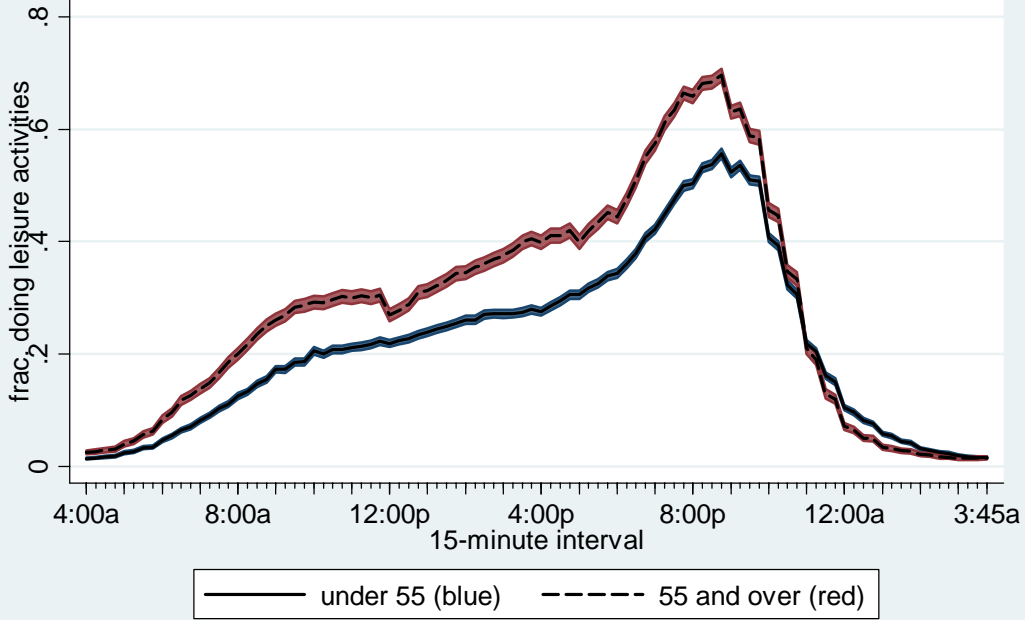


Figure 2a. Effect of Beginning Market Work on Activity Type

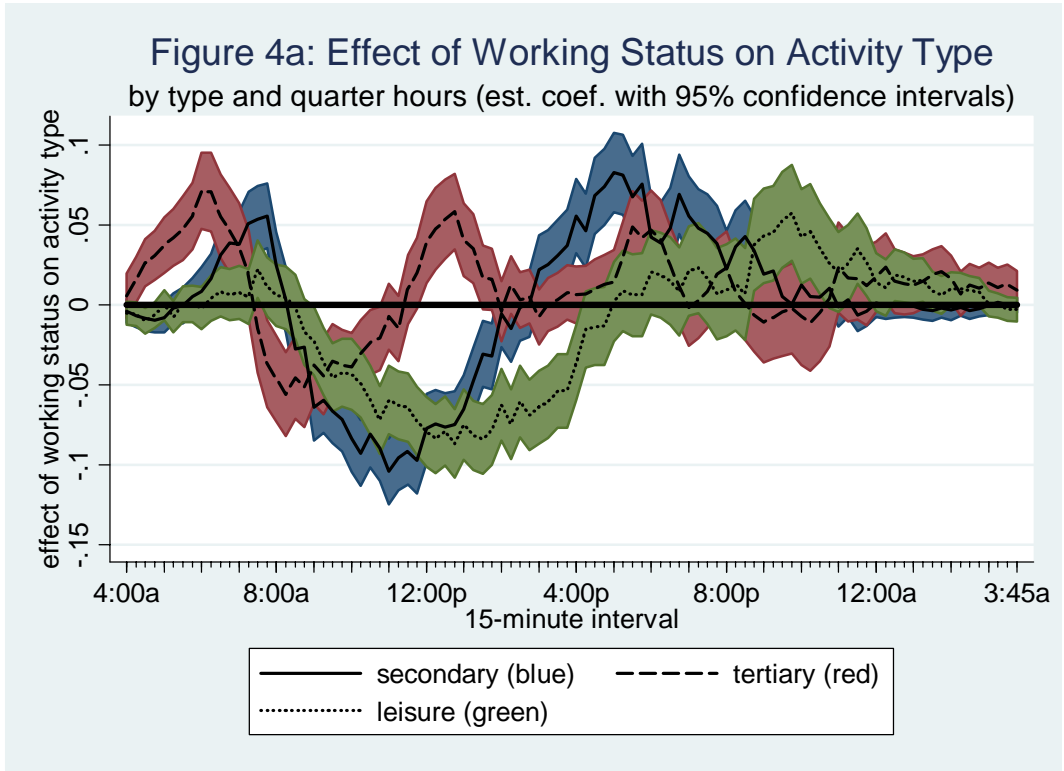


Figure 2b. Effect of Additional Minutes of Market Work on Activity Type

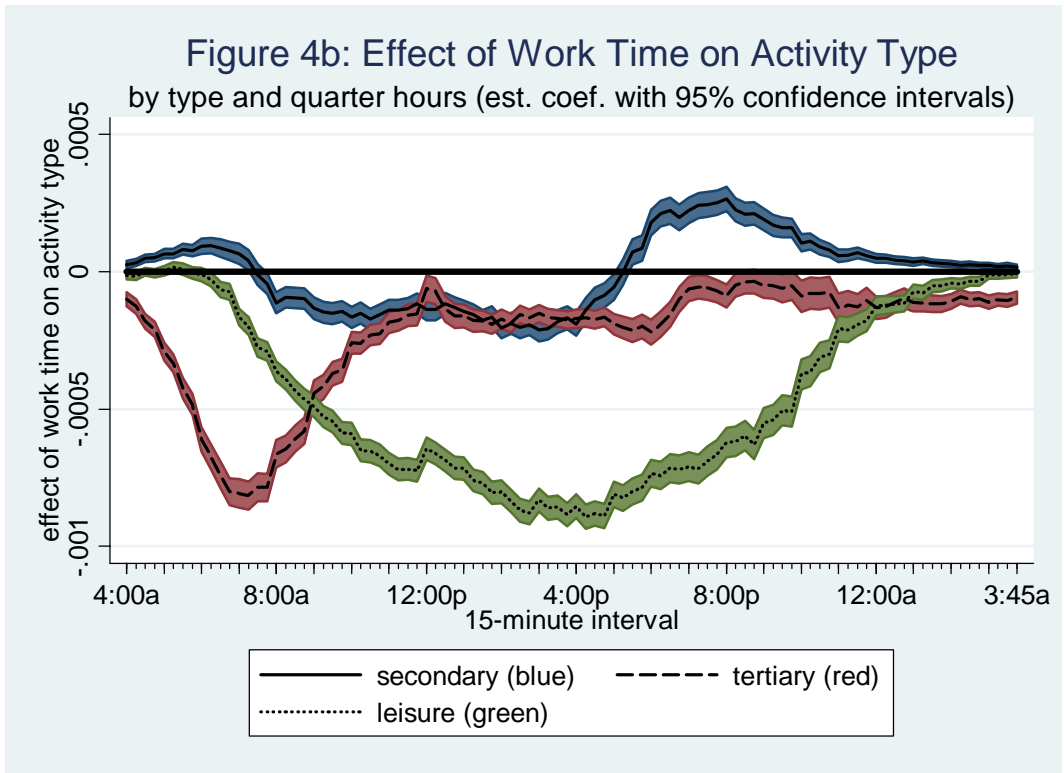


Figure 3a. Effects of Work Status and High Family Income on the Timing of Secondary Activities

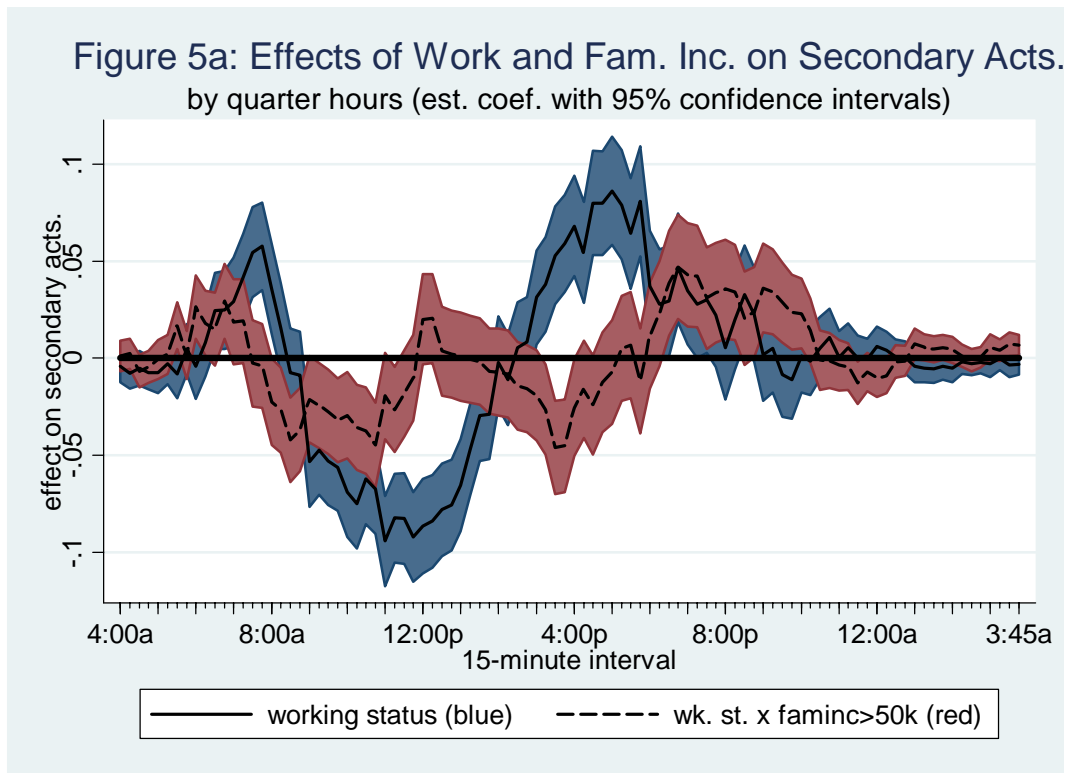


Figure 3b. Effects of Work Status and High Family Income on the Timing of Tertiary Activities

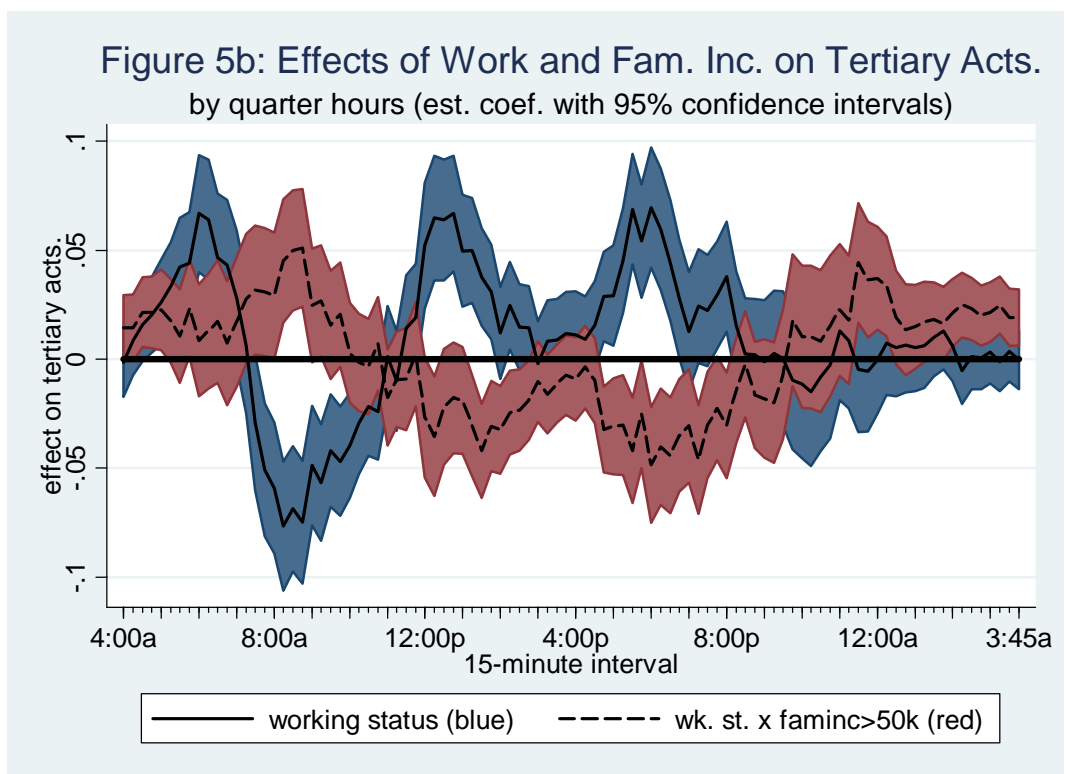


Figure 3c. Effects of Work Status and High Family Income on the Timing of Leisure

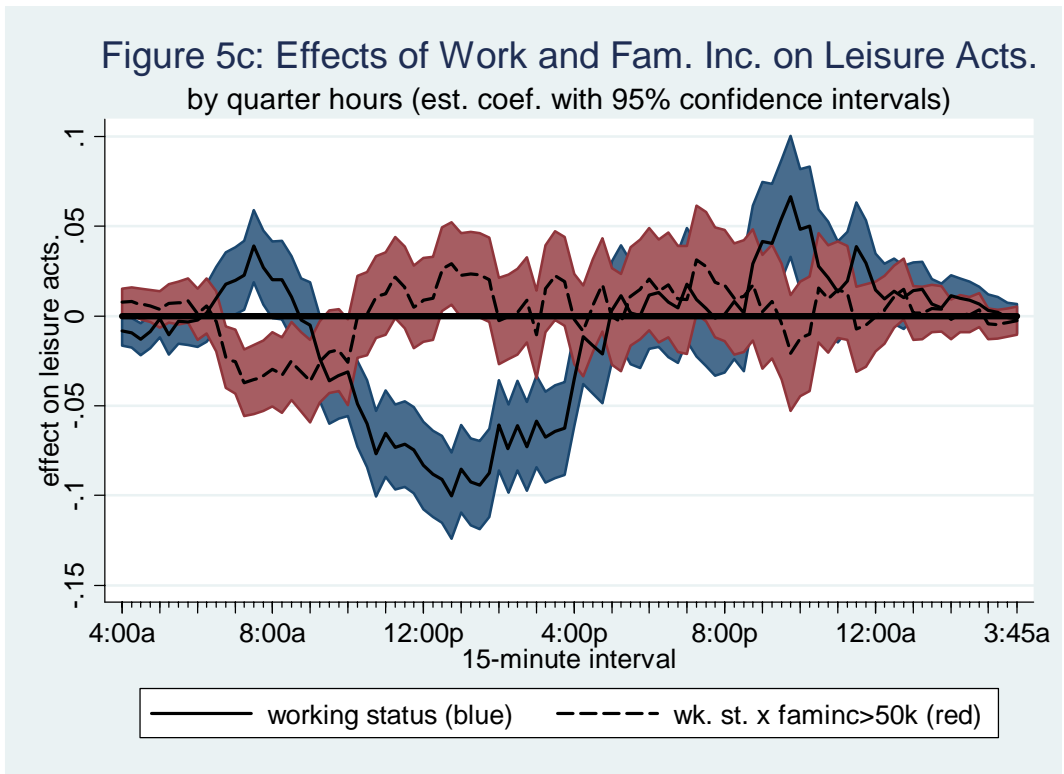


Figure 4a. Effect of Positive Market Work on the Timing of Activities

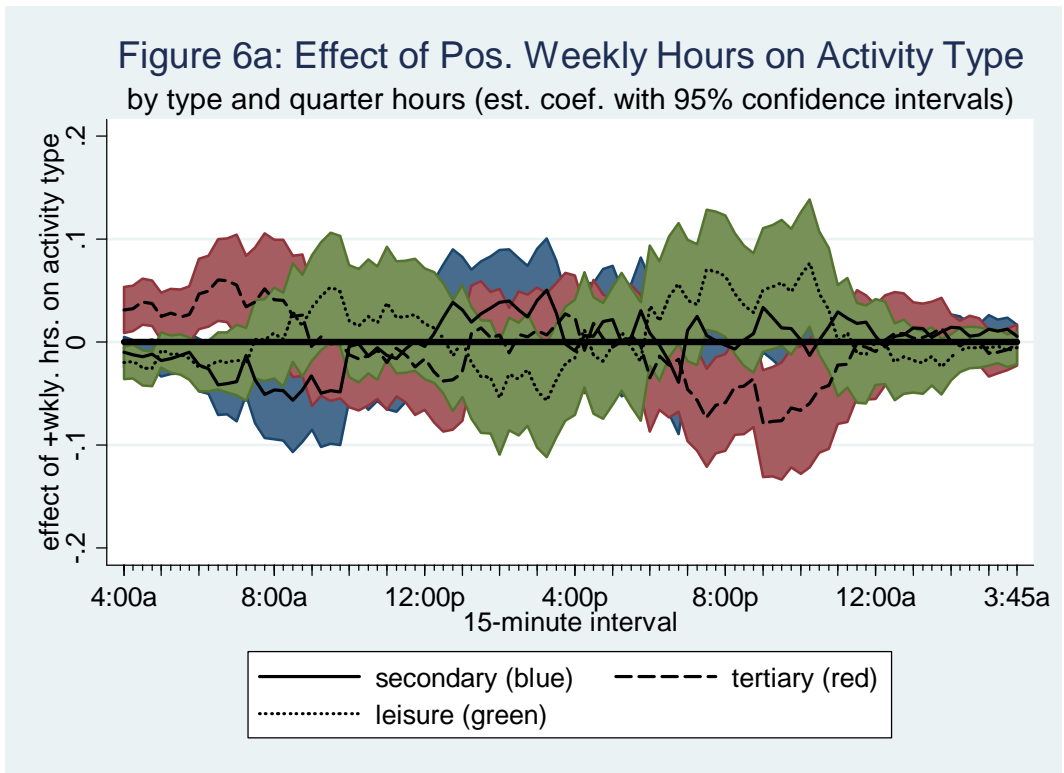


Figure 4b. Effect of Additional Weekly Hours on the Timing of Activities

