PRELIMINARY—COMMENTS WELCOME

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The Effects of a Gift of Time

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ABSTRACT

How would people spend time if confronted by permanent declines in market work? We identify preferences off exogenous cuts in legislated standard hours that raised employers' overtime costs in Japan around 1990 and Korea in the early 2000s. Using time-diaries from before and after these shocks, we predict the likelihood that an individual would have been affected by the reform. The direct effect on a newly-constrained worker was a substantial reduction in market time, with the freed-up time reallocated mostly to leisure and personal maintenance, and only very slightly to household production. Simulations using GMM estimates of a Stone-Geary utility function defined over time use suggest similar results. In the absence of changing household technology a permanent time gift leads to no change in time spent in household production by the average individual.

I. Introduction

Time spent in market work is the second most important human activity in rich countries (see e.g., Burda *et al*, 2013) after sleep. Nonetheless, it did diminish in the U.S. between 1900 and 1940 (Kniesner, 1976) and dropped sharply from 1950 through 1980 in most of Western Europe (Huberman and Minns, 2007). Given this secular decrease and continuing pressures for further reductions, both to "spread work" Nickell, 2008) and to move society to less of a rat-race equilibrium (Akerlof, 1976; Landers *et al*, 1996), asking what people would do with their extra time if they were confronted with a large decline in market hours remains an interesting question.

The difficulty in answering this question is that changes in individuals' time allocations arise from the interaction of changes in the technology of the production of Beckerian commodities with consumers' preferences for those commodities. That makes it impossible to identify how workers would respond to a permanent cut in market work, or to infer the general equilibrium effects of that cut on time allocation in an entire population, by looking at historical changes. Over time the technologies do change and can explain some of the changing time allocation (Greenwood *et al*, 2005). Those changes might in turn explain the apparent increase in leisure in the U.S. in the last half century that did not accompany any decline in market work (Aguiar and Hurst, 2007), a change that was mirrored in some European countries (Gimenez-Nadal and Sevilla-Sanz, 2013). But the changing technologies prevent one from inferring preferences for different kinds of non-market activities.

Various authors have considered how time allocation responds to temporary changes in the time available for non-market and market activities. Thus Hamermesh (2002) demonstrated that even an abrupt, fully-anticipated and temporary increase in available time (resulting from a switch off summer time) is non-neutral, with a disproportionate fraction of the increase consumed as additional personal maintenance activities, mostly sleep. Burda and Hamermesh (2010) showed that a temporary, but presumably unexpected decrease in market work (resulting from cyclical changes in employment) is disproportionately taken up by increased household production.

In related work (Lee *et al*, 2012) we considered how aggregate patterns of time use changed after these shocks; but no study has examined how individual workers' time allocations respond to an exogenous permanent decline in market work, nor has any looked at the effects of such a decline on time allocation on patterns of time use within households.[1] None could—there have been very few permanent exogenous shocks to market work; and, in any event, the continuing time-diary information required to analyze the impact of these shocks on the distribution of non-market time has rarely been available. A few countries have indirectly imposed changes in hours of work by introducing legislated changes in laws regulating the standard workweek (e.g., France, see Crépon and Kramarz, 2002) or giving union-management negotiators incentives to alter standard hours (e.g., Germany, see Hunt, 1999); but these changes have been small and have, in any case, not always been permanent.

In an effort to reduce work hours, between 1988 and 1997 Japan shortened the standard work week, resulting in a substantial reduction in market work (Kawaguchi *et al*, 2008). Quinquennial Japanese time-diary data are available from 1976, allowing us to examine the impacts of this shock and to account for possible trends in time use that may have been occurring. Korea made a similar change in 2004, and Korean time diaries from 1999 and 2009 enable us to examine time allocation before the legislative change was proposed and after its effects had time to be realized.

The exogeneity of the demand shocks allows us to examine changes in time use in relation to the propensity of an individual to have been affected by the policy change. We use time-diary surveys to measure how someone whose market time became constrained reallocated the reduction in paid work, thus measuring the average effect of the legal change on someone who was directly affected. We specify a utility function that allows using the relationships between the propensity to be affected by the law and changes in time allocations to infer the nature of individuals' preferences for different uses of time. Those

[1]Goux *et al* (2011) examine the impact of the French change in the standard workweek on the labor supply of spouses of workers who were affected by the legislated change. The focus was only on the spouse's hours of market work. Stancanelli and van Soest (2011) study the impact of the discrete jump in incentives to retire in France after one's 60th birthday on time allocations, an incentive that is permanent and well-known to workers while planning the time paths of their allocations of time.

estimates in turn allow checking whether the reduced form yields results consistent with the underlying structure.

II. The Shocks and the Data

A. Legislated Changes in Work Hours

Statutory working hours in Japan had historically been set at 48 per week and 8 per day. In December 1985 a study group organized by the Ministry of Labor published a report suggesting 45 hours per week and 8 hours per day as new statutory working hours.[2] Following this report the Central Labor Standards Commission, consisting of public, employer and employee representatives, recommended setting standard hours at 46 per week temporarily, followed by 44, and eventually dropping to 40. The Commission also requested a temporary exemption for small- and medium-sized firms. In accordance with its recommendation, the law was revised in 1987 and implemented from April 1, 1988.

This revision in the law immediately set standard hours at 46 per week. An additional revision in December 1990 further reduced standard hours to 44 from April 1, 1991. The Labor Standards Act was further revised in 1993 to implement 40 hours per week beginning in April 1994. In this reduction process, particular exemptions were given to industries with long work hours and smaller establishment sizes. These exemptions ended by March 1997, by which time the standard had become 40 hours per week uniformly across industries and establishment sizes with only a few exceptions requiring agreement between management and the union representing its workers.[3]

[2] The Labor Standards Act (LSA) in Japan prohibits employers from employing workers exceeding daily and weekly statutory working hours, currently set at 40 hours per week and 8 hours per day (LSA Section 32). Employers can set hours worked to exceed these legal limits only under an agreement with a workers' group that represents the majority of employees (LSA Section 36). Overtime under this agreement must be compensated by at least a 25-percent wage premium (LSA Section 37).See Sugeno (2002, Chapter 3, Section 5) for an overview of the Japanese legal system on standard hours. Hamaguchi (2004, Chapter 12, Section 2) describes the legal process of reducing the standard hours between 1987 and 1997. Umezaki (2008) also describes the process of the LSA revision based on interviews with two government officials who played central roles in it.

[3] Exceptions apply to employees in commerce and service industries in establishments that usually employ fewer than ten workers.

Standard hours in Korea had become 44 per week for all workplaces (Kim and Kim, 2004) by 1991. After the Asian economic crisis in November 1997, reducing statutory weekly working hours from 44 to 40 began to be discussed by the Korean Economic and Social Development Commission. In October 2000 the Commission announced the “Basic Agreement on Work Hour Reduction,” which included: 1) A reduction in work hours to 40 hours per week and 2000 hours per year; and 2) Gradual adoption depending on industry and firm size. In July 2002 the five-day workweek was first officially adopted in the banking and finance sector. In August 2003 the law indicating the schedule for adoption of the five-day workweek passed Congress.

The law mandated introducing a five-day workweek on a phased schedule, with workplaces of more than 1000 employees becoming covered in July 2004, phasing into workplaces with between 20 and 49 employees by July 2008 (and with smaller workplaces still not covered today). The government provided some financial incentives for firms that adopted the five-day workweek before it became mandatory on them, and overtime regulations were also altered to encourage adoption. A fair conclusion from all this is that the movement toward reduced workweeks in Korea was very widespread, perhaps nearly universal by 2009.

B. Time-Diary Data in Japan and Korea

The Japanese Time Use Survey (JTUS) is conducted by the Bureau of Statistics every five years, with the first survey conducted in 1976. The survey initially targeted the entire population age 15 or older, but the JTUS expanded its coverage to individuals age 10 or older from 1996. Each respondent fills out time diaries for two consecutive days, reporting their activities in ten-minute (1976) or fifteen-minute (1986-2006) intervals.[4] The number of pre-coded categories of activity was 17 in 1976, 19 in 1986, and 20 in 1991 and after. The sample is nationally representative with individual survey weights, but it has decreased in scope from about 190,000 persons in 1976 to about 175,000 in 2006. The 1976 surveys

[4]The 1981 survey had a different format from other years. Each respondent directly filled out time spent in each activity in a single day. Perhaps because of this format, the figures for 1981 are not comparable to those from other years, and because of their non-comparability we do not use them.

were conducted over seven consecutive days in October. The1986 and subsequent surveys were fielded over nine-day periods including two weekends in October.

The Korean Time Use Survey (KTUS) is conducted by the National Statistical Office every five years, with the first survey conducted in 1999. The survey targets the entire population aged 10 or older and has a remarkably high response rate (for time-diary surveys), above 90 percent. Each respondent fills out time diaries for two consecutive days, reporting activities in ten-minute intervals. The number of possible activities was 125 in 1999 and 144 in 2009. The sample is nationally representative with individual survey weights, but it decreased from over 40,000 observations in 1999 to barely 20,000 in 2009. The 1999 KTUS was conducted over ten consecutive days early in September. The 2009 survey was also fielded over ten-day periods, but, because of concerns about potential seasonality in time use, it was conducted in both March and September.

The JTUS for 1986 clearly precedes the shock to hours, while the 1996 survey is nearly entirely post-shock. The timing of the surveys does not perfectly bracket the timing of the legislated changes, but it is fairly close. By chance the timing of the KTUS is almost perfect for the purposes of this study: The first survey precedes any possible effects of the cut in demand for market work, and the third takes place after the changes had mostly been realized.

The time-diary surveys from Japan and Korea allow respondents to list far too many different activities for purposes of analyzing the impacts of the legislated changes. We need to combine the basic activities into tractable aggregates. We take the fourfold breakdown: Market work (M); household production (H); tertiary activities (T) and leisure (L), and classify each basic activity in each country into one of these. Market work includes paid employment or self-employment, unpaid employment, job search, commuting and schooling/studying. Household production consists of those activities for which one could find market substitutes (as initially proposed by Reid, 1934). Tertiary activities are those personal maintenance activities, including sleep and eating, that people must typically do at least some of on most days; and leisure activities are those that do not pay, that could not be contracted out and that are not biologically required. For both countries a very few activities were not classifiable, and we prorate the few minutes included in these across the four aggregates in proportion to the time spent in each aggregate.[5] The classifications of the 20 (9) primary sub-aggregates in Japan (Korea) are shown in Appendix Table A.

III. Inferring the Direct Impact of the Imposed Decrease in Market Work

The cut in the standard workweek in Japan and Korea is an imposed shock, the results of which trace out a locus of equilibria that depend upon workers' preferences. This understanding underlies our treatment in this Section, in which we first measure the direct effect—on an individual who was certain to have been affected by the policy—and then infer the structure of the representative affected individual's preferences for allocating time across the four aggregates to simulate the response to a negative shock to M.[6]

A. *Reduced-Form Estimates of the Effect*

Absent longitudinal time-use data covering the periods before and after the demand-induced declines in M, we generate a pair of cross-sections, with the cells based on the demographic characteristics of the time-diary respondents. We use a matching procedure to link observations across cells in the time-use data before the change (1986 in Japan, 1999 in Korea) to observations after the change (1996 in Japan, 2009 in Korea). In the Japanese data we use the two sexes, individual years of age and the three education categories that are available. We treat the Korean data identically except that we use the twelve available categories of educational attainment. There is a substantial number of empty cells (e.g., in Korea, no young people have zero education); in general, however, the immense size of the underlying samples allows the creation of a larger set of aggregate scores than is usual in studies using this method.

For each country in Year B, before the legislated change, we estimate the propensity score for individual i to be affected by the legal change as:

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[5]In Korea the number of prorated minutes was 19, 13 and 19 in 1999, 2004 and 2009 respectively. In Japan the total minutes prorated were somewhat greater: 34 in 1976, 34 in 1986, 34 in 1991, 48 in 1996, 53 in 2001 and 50 in 2006.

[6]Trying to infer a particular effect using both reduced-form and formal structural estimation is unusual, but it is not unheard of in the literature on the supply of hours to the market (e.g., Crawford and Meng, 2011).

$$\text{Prob}(43 \leq M \leq 48 \mid \text{X}) \text{ for Japan; } \text{Prob}(40 < M \leq 44 \mid \text{X}) \text{ for Korea,}$$

where X is a vector of covariates.[7] These workers are directly affected by the policy in a monotonic way. Workers who worked 40 hours or less before the change are not directly affected. Those workers who worked longer than the old standard hours are affected by the law in a complex way, as the legal change may have increased or decreased their hours, depending on the sizes of the substitution effect on hours per worker and the scale effect due to the increased marginal cost of labor. We derive the average probability that an individual with characteristics X in Year B was constrained, and assign that value to the age-sex-education cell in Year P, post the legal change. The identifying assumption here is that the individual with characteristics X would have been constrained with the same probability in Year P if the law had not changed.

Tables 1J and 1K (a tabular notation we use throughout to denote the results for Japan and Korea) show the averages of the propensity scores across the cells, their standard deviations and a few order statistics. (The statistics differ slightly across the days of the week because of slight differences in the number of non-empty cells on each day.) The main point to note for these statistics is that the average probability that an individual is constrained by the legal change is not large; but the variation in the average propensity across the cells is huge, allowing the possibility of inferring that tightening the hours constraint had substantial effects.

Taking the average propensity scores for each age-sex-education cell, and using the changes in time use in the four categories for each cell, we estimate a reduced form relating the change in time use (post- minus pre-shock) to the propensity to be affected. Considerations of the fixed costs of working on a given day suggest that employers have incentives to concentrate their reductions in hours demanded on one or two days rather than across the week.[8] We thus estimate this simple bivariate equation separately

[7]For Japan, weekly working hours are reported only in intervals: Up to 14 hours, 15-34, 35-42, 43-48, 49-59, and 60 or longer. Therefore the best propensity would be $\text{Prob}(43 \leq \text{M} \leq 48 \mid \text{X})$.

[8]There is little work directly measuring fixed daily costs of labor, although a number of studies base the empirical work on this concept (e.g., Cogan, 1981; Hamermesh, 1998).

for weekdays, Saturdays and Sundays. Simple acquaintance with the labor markets in Japan and Korea leads us to expect that the biggest effects of the legal changes in the propensity to be affected by the legislated change in the standard workweek on changes in time use on Saturdays, with smaller effects on Sundays and still smaller effects on weekdays.

Tables 1J and 1K present the estimates of these reduced forms for the two countries. As expected, the effects are largest, and the regression coefficients most significant, for the estimates for Saturdays. Indeed, in Japan the impact of a higher propensity to be affected by the change in standard weekly hours on ΔM on weekdays is actually positive, although statistically insignificant. Except in that one case, however, in those cells in which the propensity to be affected by the legislated change rose more the decline in M was significantly larger.[9]

In Japan (Korea) a ten-percentage-point increase in the probability of being constrained was accompanied by a 37- (60-) minute decrease in minutes of work on Saturday. In Japan this decrease was accompanied by significant increases in all three other aggregates of time use, with the majority of the change represented by additional leisure and only ten percent accounted for by extra home production. On Sundays the only significant increase (or even change) in Japan in response to the 5-minute decline in market work induced by a ten-percentage-point increase in the probability of being constrained was in L. On weekdays H decreased significantly while L rose. In Korea the significant and large declines in M (16 minutes, 60 minutes and 17 minutes in response to a ten-percentage-point increase in the propensity to be affected by the legislated drop in standard hours) were accompanied by significant increases in H throughout the week, and by significant increases in T on weekends.

The crucial inference from the estimates in these tables is that the legislated declines in the standard workweek did lead to cuts in hours of market work that were especially large among workers who would have worked more than 40 hours. The effect on a hypothetically treated worker is estimated

[9] If we look at the extreme centiles of the distributions of the propensity scores, e.g., the 10^{th} and 90^{th}, the results are even stronger. In the former ΔM is close to 0, and there are nearly random changes in the other time-use aggregates. At the 90^{th} percentile ΔM is very large, with its decline being offset entirely by changes in T and L.

to be huge—if a worker were certain to be constrained, essentially all the hours made subject to the overtime penalty would be eliminated. While in both countries the estimates suggest that such a worker used much of the freed-up time to add hours of leisure or personal care, in Korea there is some evidence that the affected workers did reallocate it in part to household production.

One might be concerned that we have merely shown that the changes in M continued downward trends in particular demographic groups from before 1986 (1999 in Korea) and preceded trends thereafter. While the absence of earlier or later data in Korea prevents us from examining this question there, we can conduct a placebo test for the validity of this instrument by examining the relationships between the changes in time use in Japan from 1976 to 1986, and from 1996 to 2006, across age-sex-education cells with different propensity scores (in 1986). If the instrument is valid, there should be no relationship between the changes in market work time over these earlier and later periods and the propensity to be affected by the legislated changes of the late 1980s and early 1990s.

Table 2J presents the estimates impacts of the propensity scores for 1986 on ΔM from 1976 to 1986 and from 1996 to 2006, and then calculates what are essentially double-differences from the estimates reported for ΔM in Table 1J. As the table shows, during the decade before the law changed there is actually a positive, but statistically insignificant relationship between ΔM and the propensity score. Moreover, underlying our conclusion that the main impact of the law was on market work time on Saturdays, the double-difference in the parameter estimates is very large and highly significant—what had been a positive relationship between the change in market work and the propensity score in the previous decade became negative during the "experimental" period among those people most likely to have been in the "experimental" group. During the decade after the "experiment" the changes in M in relation to the differences in the probability of being constrained were tiny on weekdays, Saturdays and Sundays. The relationship between ΔM and the probability held neither in the decade before 1986 nor in the decade after 1996.

B. A Structural Model

The results in the previous sub-section justify using the changes in time use around the time of the legislated cuts to estimate the utility functions describing affected workers' preferences for different uses of time, and to use the estimated preferences to simulate how the gift of time generated by the exogenous decline in market work of a given size might be reallocated across alternative uses. We assume that an agent allocates time according to the following Stone-Geary utility function:

$$\text{Max } \alpha \log(\mathrm{H} - \underline{\mathrm{H}}) + \beta \log(\mathrm{T} - \underline{\mathrm{T}}) + \gamma \log(\mathrm{L} - \underline{\mathrm{L}}) + \delta \log(\mathrm{C} - \underline{\mathrm{C}}) \quad (1)$$

where $\mathrm{H} + \mathrm{T} + \mathrm{L} + \mathrm{M} \equiv 1440$, total minutes in the day. We use this formulation to allow for the possibility of non-homothetic preferences and thus disproportionate responses to the income effect of the extra non-work time.[10] Consider the case in which M is exogenous and fixed at the legal limit, $\overline{\mathrm{M}}$. Consumption C is determined by labor income, which we assume for now did not decrease in either country due to the policy change.[11] With that assumption and the evidence supporting it, we assume, absent any other information, that the relative demands for H, T and L were unaffected by changes in incomes with which they are combined in household production. Hence we focus on the allocation of time across H, T, and L in response to the policy changes that reduced M.

The interior solutions are:

$$\begin{aligned} \mathrm{H}^* &= \frac{\alpha}{\alpha+\beta+\gamma}\left(1440 - \underline{\mathrm{T}} - \underline{\mathrm{L}} - \underline{\mathrm{H}} - \overline{\mathrm{M}}\right) + \underline{\mathrm{H}} \\ \mathrm{T}^* &= \frac{\beta}{\alpha+\beta+\gamma}\left(1440 - \underline{\mathrm{T}} - \underline{\mathrm{L}} - \underline{\mathrm{H}} - \overline{\mathrm{M}}\right) + \underline{\mathrm{T}} \quad (2) \\ \mathrm{L}^* &= \frac{\gamma}{\alpha+\beta+\gamma}\left(1440 - \underline{\mathrm{T}} - \underline{\mathrm{L}} - \underline{\mathrm{H}} - \overline{\mathrm{M}}\right) + \underline{\mathrm{L}} \end{aligned}$$

The effects of an exogenous unit change in M on H is $\alpha' = \alpha/[\alpha + \beta + \gamma]$, with β' and γ' respectively defined analogously. Since we can observe H*, T* and L*, and we know the change in M, we can

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[10]Prowse (2009) estimates a Stone-Geary function over several uses of time with British time-use data.

[11]In Japan real annual earnings grew by 4.1 percent per annum in the quinquennium 1981-86, and by 4.6 percent per annum during the next quinquennium. Quinquennial growth did slow to 1.6 percent per annum between 1991 and 1996, but there is no evidence that earnings dropped in response to the policy change. Presumably the continuing real growth of the Japanese economy was in part consumed in the form of reduced market work, with real earnings still growing, albeit more slowly than might otherwise have occurred. In the quinnenia ending in 1999, 2004 and 2009 real earnings in Korea grew by 2.5 percent, 4.7 percent and 2.4 percent respectively, suggesting similar conclusions as in Japan.

recover the subsistence levels, assuming one of the three is identically zero.[12] We assume that $\underline{H} = 0$—nobody must perform household production. Solving and rearranging yields:

$$\begin{pmatrix} \underline{T} \\ \underline{L} \end{pmatrix} = \begin{pmatrix} 1-\beta' & -\beta' \\ -\gamma' & 1-\gamma' \end{pmatrix}^{-1} \begin{pmatrix} \overline{T^*} - \beta'(1440-\overline{M}) \\ \overline{L^*} - \gamma'(1440-\overline{M}) \end{pmatrix} \quad (3)$$

Suppose that we estimate the following equations:

$$\begin{aligned} \Delta T_i^* &= \beta' \Delta M_i^* + c_T + u_{Ti} \\ \Delta L_i^* &= \gamma' \Delta M_i^* + c_L + u_{Li} \end{aligned} \quad (4)$$

where c_T and c_L are constants.[13] Then equation (4) allows us to infer the β' and γ' and the subsistence levels. We estimate the model in (4) for the two countries using the cell-based averages of the changes in time use in the four aggregates. Because the change in the constraint bound differently on different days of the week, as the estimates in Tables 1 showed, the parameters are estimated separately for weekdays, Saturdays and Sundays.[14] The first, third and fifth columns in Tables 3J and 3K present the least-squares estimates. In addition to the standard errors of the estimates, the implied subsistence levels and their changes are shown, along with bootstrapped confidence intervals around them.

The estimates are fairly satisfactory for Japan.[15] One should note that, although a few of the implied subsistence levels on weekdays and Sundays in Table 3J do not make much sense, the data and estimates for Saturdays for Japan generally imply a gratifyingly constant set of preferences, with the subsistence levels being remarkably unchanged from before the demand shock to afterwards. The least-squares results suggest that it is reasonable to use the Japanese estimates to simulate how people would reallocate their time in response to an exogenous decline in work time.

[12]Unlike in the estimation of Stone-Geary utility functions over goods, where all the parameters are identifiable because of different prices for each good, with the price of unit of time being the individual's wage rate, we must fix one parameter.

[13]The assumption of unchanging preferences implies that the constant terms should be zero.

[14]Implicitly we are assuming that the agent's utility function is separable across the days of the week. Some indirect evidence for other countries (Ichino and Sanz de Galdeano, 2005) suggests that this may be incorrect. Given the complexities of the estimation presented here, we leave the estimation of an intertemporal aggregator function for future work.

[15]We evaluate the estimates at the sample averages of T^* and L^* ($\overline{T^*}$ and $\overline{L^*}$) in 1996 for Japan and 2009 for Korea. We set $\overline{M}$ at 480 minutes for weekdays and at 0 for Saturdays and Sundays.

The results for Korea, shown in Table 3K, are somewhat less satisfying. Although the parameter estimates are statistically significant for both Saturdays and Sundays (remember, the shock to work-hours on Sundays was larger in Korea than in Japan), they imply that the subsistence levels $\underline{T}$ and $\underline{L}$ changed across the years. Since our crucial identifying assumption is that there is an exogenous shock which changes outcomes in the presence of unchanging preferences, the changes in the subsistence levels are disturbing.

Why might the estimates for Korea imply changing subsistence levels? One possibility is that the underlying utility functions for the three types of day are not separable, and that our treatment of them is leading to biased estimates of the sub-utility functions for each type of day. Another possibility arises from the fact that we have treated goods and time as separable, ignoring the underlying household production functions. If changes in the relative prices of goods are differently complementary with H, T and L and thus are not absorbed into the constant terms, estimation limited to time-use data could mistakenly indicate that underlying preferences have changed even when no change has occurred. For example, perhaps the expansion of child-care facilities, a substitute for household production (child care), altered the constant term in the equations describing H and caused the implied exogenous decrease in $\underline{H}$. Without a complete set of goods prices that we believe are uniquely assignable to the time-use aggregates, we cannot solve this problem.[16]

One may also argue that ΔM_i^* is endogenous, since the actual decline in M may depend, for example, on ΔH. Thus exogenous shifts in fertility might alter time devoted to household production (e.g., fewer children means less time in household education and childcare), leading to a rise in hours of market work. The introduction of such common household technologies as dishwashers and clothes dryers in each of these countries around the times of the shocks to market hours could also have affected market work time. As another example along a different dimension, the expansion of PCs in the household might have led to more leisure-time spent web-surfing, reducing market work time.

[16]With narrower time-use categories it might be possible to make a link between expenditures on goods and time, as in Gronau and Hamermesh (2006), although even there some of the links are quite arbitrary. With the more highly aggregated time-use categories used here the exercise would be even less credible.

To address these concerns, we use the propensity score as an instrumental variable. The propensity score should be significantly and negatively correlated to ΔM_i^*, since the score indicates the propensity with which the average person in the cell has his/her working hours constrained by the new legal limit. The necessary assumption is that the propensity score is uncorrelated with the error term, which will be satisfied because variation in it is identified from the distribution of hours before the policy change. We then use the instrumental variable to estimate the equations jointly by GMM. The GMM estimates are shown in the second, fourth and sixth columns of each table. While a number of the least-squares parameter estimates seemed inconsistent with the underlying theory, this is less so with the GMM estimates. This improvement underscores the importance of accounting for the potential endogeneity between other uses of time and market work.

The purpose of this formal estimation was to obtain estimates of structural parameters to simulate the impacts of an imposed shock to market hours on the distribution of affected workers' time use. The size of the shock is arbitrary; but for convenience we base the simulation results on the average changes in M in the two countries on the particular day. Because we saw that the biggest shocks were on Saturday, and because the small shocks on weekdays were not closely related to the propensity scores, our simulations concentrate on presenting changes in time allocation on Saturdays.

Table 4 shows the effects of the shocks to M on the other three time-use aggregates on Saturdays. For each of ΔH, ΔT and ΔL we list the change in minutes arising from the change in behavior with the existing utility function, and then that arising from changes in subsistence levels (which seems inconsistent with an unchanging set of preferences). For Japan the estimates do imply the required constant preferences—almost none of the simulated changes arise because underlying subsistence levels change. This is particularly true with the GMM estimates—again showing the need to account for endogeneity. Nearly 2/3 of the decline in M results in an increase in L, with most of the rest of the decline leading to an increase in T. Almost none of the decline in M causes an increase in H. In Korea the results are less encouraging—much of the decline in M is simulated to have occurred through changes in preferences. Nonetheless, the simulations do show that 2/3 of the minutes freed up by the drop in M are used in increased tertiary time, with most of the rest spent as increased leisure.

C. Accounting for Consumption

The theoretical model in Sub-section B includes consumption spending along with the time uses H, T and L in a system representing the production of commodities in the household. Because the time-use surveys did not contain information on spending, in our estimation we implicitly assumed throughout that choices about the use of time are separable from goods spending. This is not likely to be the case; but whether neglecting spending matters for purposes of evaluating the impact of the time gift on time use is an empirical issue.

To examine this question further we obtained data from consumer expenditure surveys conducted at or near the times when the relevant time-use surveys were conducted. For Japan we use the National Survey of Family Income and Expenditure (*Zenkoku Shouhi Jittai Chosa*) for 1984 and 1994, presenting data on monthly household expenditures calculated from account books kept from September to November. The sample includes only two- or more person-households. For Korea we use the Household Income and Expenditure Survey (*Gagye Donghyang Chosa*) of 1999 and 2009, showing monthly household expenditure.[17] Using each data set we estimate adult-equivalent spending based upon the OECD equivalence scales (www.oecd.org/dataoecd/61/52/35411111.pdf)

We then impute these spending totals to each adult in the household to measure each person's C. For Korea we use each adult's age, sex and educational attainment and the estimates of the equations describing the probability of being constrained obtained in Sub-section A to estimate C in each cell for 1999 and then 2009 (with C measured in thousands of 1999 Korean won). Changes in these are then matched to the changes in the time-use categories in each cell across the two years. The Japanese expenditure consumer expenditure surveys do not contain information on the respondents' educational

[17]We recognize that, unlike for Korea, for Japan the match of years in the Family Income and Expenditure Surveys to those in the JTUS is not perfect. We cannot do anything about this difficulty other than to note that the survey dates differ by only two years and that we hope that spending patterns by age-sex-prefecture did not change greatly between the dates of the expenditure and time-use surveys.

attainment. We therefore use age, sex and location (prefecture) to re-estimate the propensity scores for Japan from the JTUS and the same variables to estimate average consumption per adult equivalent (with C measured in yen at 2010 prices). For each age-sex-location cell we match the average C in 1984 to the averages of M, H, T and L for 1986, and similarly for C in 1994 and time use in 1996. We then can examine changes in C and the time-use categories across the two sets of years.

As a first step we estimate the reduced-form relationships between ΔC and the propensity score across the cells to examine whether and by how much spending changed differentially depending upon the likelihood that the hours constraint affected the individual. For Japan the estimated impact on C of a one standard-deviation (0.1) increase in the propensity score is -¥63 (s.e. = 9.33); the analogous parameter estimate for Korea is (1000)₩0.447 (s.e. = 0.10). We might expect a negative relationship, since we have shown that the constraint was binding and did reduce M, and we do observe that in Japan, but we observe the opposite in Korea.[18] Nonetheless, for both countries the estimated impacts are minute, amounting to less than one-tenth of a percent of average expenditures.

Given the small estimated impacts of the imposed changes in market work time, it is unlikely that expanding the structural model to include C will alter our inferences about the underlying utility parameters or their implications for the impacts of the change in M. Nonetheless, we estimated expanded Stone-Geary models for both countries to examine whether the absence of expenditure information might have biased the inferences in Sub-section B. Appendix Tables BJ and BK contain the estimates of these models. The estimated response parameters on C are statistically significant in the GMM estimates; but while both the estimated subsistence levels and response parameters on T and L change, these changes are not qualitatively important. Even accounting for (imputed) goods spending, the inference remains that in both countries the time freed up from market work is reallocated toward tertiary time or leisure, and not toward increased household production. Our results are robust to the inclusion of goods expenditures.

[18]In Korea the government tried to protect workers by keeping total salaries constant after the reduction of working hours. This might explain why the tiny effect we do observe is positive.

IV. Family Effects

Throughout we have treated each person as an individual, ignoring any of the ways in which the legislated change might affect others in the family of a newly-constrained worker. Such an effect might occur, for example, if the time gift to the worker allows him (or her) to substitute for his (her) spouse's time in household production, so that both spouses share the extra leisure that is made possible. As another example, the reduction in the market time of the constrained spouse may be fully offset by an increase in market work by the other spouse. With two spouses and the four aggregates of time use, if one spouse's market work is reduced by a given amount, there are 2^5 independent changes in time allocation that can occur within the couple.

Examining the impact of an exogenous shock to work hours allows us to study household bargaining in ways that have previously not been possible. There are huge theoretical and empirical literatures on the underlying structure of preferences and power that determine allocation of a couple's time (e.g., Becker, 1991; McElroy and Horney, 1981; Bourgignon and Chiappori, 1991). There is also substantial empirical research on how spouses' bargaining power and resources, usually as measured by their wage rates, affect the distribution of time in the household (e.g., Friedberg and Webb, 2006; Kimmel and Connelly, 2007). All of the empirical research, however, has had to rely on cross-section differences in proxies for bargaining power to infer the nature of intra-household decision-making about time allocation. Responses to the exogenous shock to one spouse's market time that is provided by the legislated changes in Japan and Korea allow us to identify how a change in resources of one spouse is propagated through the household's decisions about both spouses' time use, and thus to infer the nature of decision-making within the household more carefully than has heretofore been possible.

[FINISH LATER]

V. Conclusions and Implications

It is impossible to infer how people would react to freedom from work from historical information on time use: Any long-term change in time-use patterns is determined endogenously through the changing incentives produced by changing household technology and changing returns to market work. To circumvent this simultaneity we have relied upon the sudden and sharp changes in labor demand generated by discrete and permanent legislated cuts in the standard workweek that gave employers a strong incentive to shorten hours per worker. Using time-diary data for Japan and Korea from before and after the legislation, we first show that time spent in market work by those likely to have been directly affected by the legislation diminished sharply immediately following the legislation's effective date. In Japan those likely to have been affected by the legislation used the extra time to increase leisure activities, while similarly affected Koreans used it to increase both household production and leisure activities. A structural utility model yields parameter estimates that we use in simulations to infer how a shock to market work would be spent. For both countries the results of simulations match those of the non-structural approach, suggesting further that we have identified the behavior of individuals choosing (under a demand constraint) how to allocate their time.

By affecting the market work of one spouse (typically the husband) more than the other, the legislated changes enable us to infer how an exogenous shock to one spouse's bargaining ability affects how both spouses allocate time, and thus what preferences look like within a couple. **[FINISH LATER]**

Assuming that technical change in the intermediate future will make an hour of household production relatively still less productive, as it has over the past century, our results suggest that it is unlikely that people will spend more time in those activities. They suggest instead that at current margins additional tertiary time and leisure are more enjoyable that additional time spent in household production, so that those changes in technology would instead result in expansions along those margins.[19]

[19] This observation is not necessarily inconsistent with the hypothesis that international differences in time spent in market work are offset because of differences in service prices by full substitution toward home production (Freeman and Schettkat, 2005).

The results also shed light on a number of related issues that have been studied by labor and other economists. A large literature (beginning with Ruhm, 2000) has considered whether health improves in recessions, with the argument being that work is stressful and that time away from work allows people to invest in health. Our results suggest that an enforced long-run reduction in market work does not lead to substitutes that may be equally stressful, but instead to activities that might be stress-reducing and perhaps health-improving.

[PARAGRAPH ON IMPLICATIONS FOR HOUSEHOLD BEHAVIOR]

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Table 1J. Reduced-form Estimates of Changes in Time Use on the Treatment Propensity Score, Japan*

	Weekdays		Saturdays		Sundays	
	(N=447)	R^2	**(N=481)**	R^2	**(N=484)**	R^2
ΔM	0.30	0.006	-3.66	0.334	-0.47	0.021
	(0.19)		(0.23)		(0.15)	
ΔH	-0.51	0.022	0.35	0.011	-0.22	0.004
	(0.15)		(0.15)		(0.16)	
ΔT	-0.14	0.004	0.83	0.088	0.20	0.006
	(0.11)		(0.12)		(0.16)	
ΔL	0.35	0.009	2.49	0.280	0.49	0.018
	(0.17)		(0.18)		(0.16)	
Mean propensity	0.11		0.11		0.11	
SD propensity	(0.09)		(0.09)		(0.09)	
[10^{th}, 90^{th}]	[0.004, 0.24]		[0.003, 0.24]		[0.003, 0.24]	

Table 1K. Reduced-form Estimates of Changes in Time Use on the Treatment Propensity Score, Korea*

	Weekdays		Saturdays		Sundays	
	(N=994)	R^2	**(N=783)**	R^2	**(N=757)**	R^2
ΔM	-1.58	0.014	-5.95	0.135	-1.71	0.013
	(0.43)		(0.54)		(0.54)	
ΔH	1.56	0.041	2.59	0.084	1.62	0.042
	(0.24)		(0.31)		(0.28)	
ΔT	0.06	<0.001	0.94	0.017	0.69	0.007
	(0.17)		(0.26)		(0.30)	
ΔL	-0.05	<0.001	2.41	0.033	-0.60	0.002
	(0.33)		(0.47)		(0.48)	
Mean propensity	0.06		0.07		0.07	
SD propensity	(0.08)		(0.09)		(0.09)	
[10^{th}, 90^{th}]	[0.002, 0.17]		[0.003, 0.18]		[0.003, 0.20]	

*Estimated by weighted least squares, with weights equal to the average population sizes of the cells across the two years.

Table 2J. Placebo Test Results, Japan, 1986-1976 and 2006-1996 Compared to 1996-1986

	Minutes Worked on:		
Years:	Weekdays	Saturday	Sunday
1986-1976	1.64	1.26	0.68
	(0.13)	(0.15)	(0.16)
Difference from 1996-1986	-1.34	-4.92	-1.15
	[-1.66, -1.01]	[-5.46, -4.40]	[-1.62, -0.75]
2006-1996	0.23	-0.50	0.12
	(0.21)	(0.20)	(0.18)
Difference from 1996-1986	0.07	-3.16	-0.59
	[-0.30, 0.49]	[-3.77, -2.54]	[-0.96, -0.23]

Note: 90 percent confidence intervals based on bootstrap with 500 repetitions are reported in brackets.

Table 3J. Structural Estimates of Equation (4), Japan*

	Weekdays		Saturday		Sunday	
	OLS	GMM	OLS	GMM	OLS	GMM
α'	0.382	1.683	0.194	0.095	0.287	-0.462
	(0.034)	(0.869)	(0.023)	(0.042)	(0.041)	(0.365)
β'	0.122	0.477	0.216	0.226	0.178	0.427
	(0.026)	(0.376)	(0.018)	(0.029)	(0.031)	(0.242)
γ'	0.497	-1.16	0.591	0.679	0.535	1.035
	(0.035)	(1.059)	(0.020)	(0.038)	(0.040)	(0.316)
$\overline{H^*}$	132		148		154	
	(0.800)		(0.722)		(0.742)	
$\overline{T^*}$	641		662		701	
	(0.827)		(0.649)		(0.734)	
$\overline{L^*}$	301		396		466	
	(0.998)		(1.118)		(1.122)	
$\underline{T}$	656	603	324	310	-421	844
	[369, 1727]	[567, 636]	[225, 409]	[53, 426]	[-1814, 101]	[757, 1340]
$\underline{L}$	3232	278	-382	-427	-2428	930
	[1838, 8549]	[232, 322]	[-599, -165]	[-1152, -88]	[-5973, -1250]	[757, 1340]
ΔSubsistence level T	2	2	13	8	9	6
	[1, 3]	[0, 3]	[10, 15]	[-2, 13]	[7, 11]	[3, 8]
ΔSubsistence level L	10	5	38	21	18	12
	[8, 12]	[3, 7]	[33, 43]	[-1, 33]	[15, 23]	[6, 15]

*Standard errors in parentheses. Bootstrapped 90-percent confidence intervals in brackets, based on 500 resamplings.

Table 3K. Structural Estimates of Equation (4), Korea*

	Weekdays		Saturday		Sunday	
	OLS	GMM	OLS	GMM	OLS	GMM
α'	0.306	0.993	0.259	0.436	0.145	0.946
	(0.015)	(0.220)	(0.017)	(0.049)	(0.019)	(0.328)
β'	0.126	0.039	0.122	0.158	0.222	0.405
	(0.012)	(0.103)	(0.015)	(0.047)	(0.019)	(0.166)
γ'	0.567	-0.032	0.619	0.406	0.633	-0.351
	(0.016)	(0.200)	(0.019)	(0.060)	(0.023)	(0.396)
$\overline{H}^*$	130		151		152	
	(1.362)		(2.261)		(2.211)	
$\overline{T}^*$	652		694		725	
	(0.853)		(1.669)		(1.642)	
$\overline{L}^*$	287		374		432	
	(1.610)		(2.830)		(2.812)	
$\underline{T}$	57	123	-128	-65	-711	-89
	[35, 65]	[98, 147]	[-285, -121]	[-154, 50]	[-864, -456]	[-310, 97]
$\underline{L}$	323	658	-727	140	-1738	934
	[263, 337]	[614, 695]	[-1053, -578]	[-54, 334]	[-2215, -1158]	[604. 1152]
ΔSubsistence level T	45	38	70	70	47	51
	[43, 48]	[35, 41]	[67, 75]	[67, 74]	[40, 54]	[47, 56]
ΔSubsistence level L	11	-23	17	14	-35	-15
	[7, 20]	[-27, -17]	[5, 31]	[6, 22]	[-54, -18]	[-22, -9]

*Standard errors in parentheses. Bootstrapped 90-percent confidence intervals in brackets, based on 500 resamplings.

Table 4. Decomposition of the Change in Market Work on Saturdays (minutes and percentage distributions)

	Japan		Korea	
	OLS	GMM	OLS	GMM
Observed ΔM (minutes)	*87*	*87*	*104*	*104*
ΔH via α' (H1)	17	8	27	45
ΔH via change in subsistence level (H2)	-10	-3	-23	-37
ΔT via β' (T1)	19	20	13	16
ΔT via change in subsistence level (T2)	2	1	59	57
ΔL via γ' (L1)	51	59	64	42
ΔL via change in subsistence level (L2)	8	1	-37	-20
H1+H2	7	6	4	9
Fraction of total ΔM	0.08	0.06	0.04	0.08
T1+T2	21	21	72	73
Fraction of total ΔM	0.24	0.24	0.69	0.70
L1+L2	59	60	28	22
Fraction of total ΔM	0.68	0.69	0.26	0.21

APPENDIX Table A. Classification of Sub-aggregates into M, H, T and L

	Japan*	Korea**
Market Work M	Work	Working and Work-Related Activities
	Schoolwork	Educational Activities
	Commuting to/from school or work	Non-school Educational Activities
	Studying and Researching	
Household Production H	Housework	Household Services
	Child Care	Caring for Household Members
	Child care	
	Shopping	
Tertiary Activities T	Sleep	Personal Care (includes Sleep)
	Personal Care	
	Meals	
	Medical Examination or Treatment	
Leisure L	TV, Radio, Reading	Volunteer Activities
	Rest and Relaxation	Socializing and Leisure
	Hobbies and Amusements	
	Sports	
	Volunteer and Social Activities	
	Social Life	
Prorated	Travel Other than Commuting	Other Activities
	Caring and Nursing	
	Other Activities	
	*Schoolwork was first included in 1996, Caring and Nursing from 1991. Non-commuting travel is prorated across H, L and medical treatment. The rest is prorated across all aggregates.	**Travel for each activity is added to the appropriate aggregate.

APPENDIX BJ. Structural Estimates with Consumption on Saturdays, Japan

	OLS	GMM
α'	0.167	0.176
	(0.06)	(0.029)
β'	0.205	0.203
	(0.008)	(0.038)
γ'	0.629	0.621
	(0.009)	(0.043)
δ'	13.159	109.353
	(5.441)	(29.723)
H*	148	
	(0.722)	
T*	662	
	(0.649)	
L*	396	
	(1.118)	
$\underline{T}$	497	490
	[363, 662]	[384, 551]
$\underline{L}$	130	106
	[-107, 612]	[-95, 273]
ΔSubsistence level T	-8	-6
	[-16, -7]	[-21, 2]
ΔSubsistence level L	-4	0
	[-28, -4]	[-27, 21]

Notes: Standard errors in parentheses. Bootstrapped 90-percent confidence intervals in brackets, based on 500 resamplings

APPENDIX BK. Structural Estimates with Consumption on Saturdays, Korea

	OLS	GMM
α'	0.209	0.433
	(0.019)	(0.064)
β'	0.180	0.183
	(0.019)	(0.071)
γ'	0.611	0.384
	(0.023)	(0.090)
δ'	-0.062	-0.850
	(0.067)	(0.249)
H*	99	
	(2.432)	
T*	693	
	(2.547)	
L*	381	
	(4.399)	
$\underline{T}$	-458	-175
	[-678, -355]	[-371, 3]
$\underline{L}$	-1197	119
	[-1709, -971]	[-238, 452]
ΔSubsistence level T	51	62
	[40, 58]	[52, 71]
ΔSubsistence level L	-47	2
	[-74, -34]	[-14, 16]

Notes: Standard errors in parentheses. Bootstrapped 90-percent confidence intervals in brackets, based on 500 resamplings