Timing Constraints and the Allocation of Time:

The Effects of Changing Shopping Hours Regulations in the Netherlands

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May 2003

Abstract

A 1996 change in shopping hours regulations in the Netherlands provides an opportunity to study the effects of timing constraints on total time spent in shopping, working, and other activities as well as the timing of these activities. We develop a simple structural model to make predictions about the effects of imposition and relaxation of a timing constraint on time use patterns, and utilize time diary data from 1995, 1997, and 1999 to examine time use patterns by demographic group before and after the change

Keywords: time allocation, labor supply

JEL classification: D12, J22

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1. Introduction

While labor economists have been interested in constraints on paid work for some time, such constraints have been modeled as constraints on the total amount of time spent working rather than as timing constraints, thereby potentially confounding the quantity and timing effects in empirical estimation. In addition, constraints on time use have been considered primarily for market work (cf. Aronsson and Karlsson 1997 re male labour supply), but not for other activities. Children have been considered as a constraint on paid work (cf. Heckman 1988 re children's operating as a constraint requiring wives to perform a certain minimum quantity of household production), as well as a factor requiring parents to expend time (and money) on child care. But again, this relates to the total amount of time spent on activities rather than on timing. Moreover, the exogeneity of this constraint is debatable.

Spurred in part by the greater availability of time use data, some newer papers have explicitly considered timing issues over short time periods (e.g., daily or weekly as opposed to lifecycle issues involving allocation of activities over years). Hamermesh (2002) considers a range of timing phenomena, including synchronization of spouses' work schedules and income effects in reducing work at less pleasant times (i.e., evening and night work). A number of papers in this conference also incorporate short-period timing issues into their analysis.

In this paper we are able to consider a case that extends the analysis of timing issues and escapes a number of the objections that can be brought against other cases. We consider an explicit, exogenous timing constraint on a particular activity, namely shopping hours regulations, and then consider what happens when the constraint is relaxed. Using time diary data, we are able to consider changes that affect not only potentially the total time (measured

on a weekly basis) devoted to particular activities, but also the way that time may be reallocated across and within days.

Shopping hours regulations have existed throughout time and became particularly constricting in many European countries and in Canada during the 1930s (Rouwendal and Rietveld 1999). While a number of countries have subsequently relaxed their regulations, numerous countries—and local governmental units within countries—continue to constrain the hours during which shops may be open. A number of researchers have considered the effects of such regulations (Huxley 1973, Morrison and Newman 1983, Ferris 1990, Clemenz 1990, 1994, Lanoie, Tanguay, and Vallee 1994, Tanguay, Vallee, and Lanoie 1995, Thum and Weichenrieder 1997, Burda and Weill 1998, Rouwendal and Rietveld 1999). However, none of them have focused on adaptations at the individual level, focusing rather on store-level reactions such as pricing effects, effects on competition (particularly between smaller and larger stores), and in one case, on insider/outsider reactions in the labor market (Wolter 2001).

In the Netherlands, as of 1996 stores were permitted to stay open from 8 am until 10 pm on weekdays, when before they had to close by 6 pm (with the exception of one weekday, usually Thursday or Friday, when they were allowed to stay open until 9 pm). In addition, as of 1996 stores were permitted to open on Sunday afternoons, although this regulation was subject to modification by local governments, who could limit this. So far the only formal analysis of this regulatory change, a report commissioned by the Dutch government (KPMG 1998), relied on interviewing techniques but did not analyze time diary data to track people's changes in shopping.

Meanwhile time use data have been available on an occasional basis for the Netherlands and other countries for some years and have been utilized by other researchers working in an economic framework (cf. Maassen van den Brink and Groot 1997, Bhat and

Misra 1999, Yamamoto and Kitamura 1999), but other researchers have not published work analyzing shopping patterns or particular constraints.[1] No such work is extant for other countries either, although Hamermesh (1996) indicates the potential use of time diary data in the context of considering shopping hours regulations as timing constraints.

Hence our paper fills an interstice between a number of currently unrelated strands of research. We can address the narrow question of how this particular policy change affected individual time use patterns, thereby adding to the literature on shopping regulation effects as well as contributing to the policy evaluation discussion in the Netherlands. But we also consider the larger issue of how one might model timing constraints using fairly detailed time diary data.

In section two we present some general predictions from a simple structural model regarding potential response to the regulatory change. Section three describes the time use data and our use of it to test predictions stemming from the model. Section four shows empirical results, section five provides some discussion, and section six concludes.

2. A structural model of timing decisions

In our work below we consider three activities: market work, shopping, and "leisure" (the aggregate of all other activities). Note that even with only three activities, the number of possible weekly time use patterns that can occur in principle with quarter-hour data collection intervals is extremely large: 3^{672}. The complexity of the analysis would increase greatly with a finer time grid, more activities, multi-person households, data on a monthly or longer basis, and allowing for the possibility of multiple activities per time unit. In an empirical analysis one is therefore bound to limit the level of detail and focus on the aspects that are central to the problem at hand.

[1] There is only a small literature applying economic modelling (either theoretical or econometric) to routine (i.e., grocery) shopping; c.f. Doti and Sharir (1981) for the first paper in this line; Kan and Fu (1997) consider

In this section we develop a structural model that explains how much time an individual spends weekly on market work, shopping, and leisure, and when: during the day or during the evening. We define "day" as the period from 8 am to 6 pm on Monday through Saturday, and "evening" as the period from 6 pm to 10 pm, on Monday through Friday. Thus "day" is roughly defined as the pre-1996 opening times and "evening" as the opening times that were allowed only after the law changed. We do not model timing decisions during the "night" (all hours other than "day" or "evening"). The fraction of people in our sample spending time on market work or shopping during this period is negligibly small in our sample.

We initially make a number of simplifying assumptions. First, we assume that shopping during the day and during the evening are perfect substitutes; similarly for leisure. While it is of course conceivable (and even likely) that this is not the case for all individuals, the assumptions facilitates the separation of the effects of timing constraints from the effects of preferences on timing decisions. Second, we use a simple Cobb-Douglas specification for the utility function. Third, we assume that both before and after 1996, market work can be performed only during the day. An important argument for extending the shopping hours has been that it would enable people with a "full-time" job to shop not only on Saturdays (and the single evening during which shops were open under the pre-1996 regime), but also on weekdays. If people could easily work during evenings, the shopping hours constraint could have been accommodated by shopping during the day and shifting some market work to the evening. This was apparently not an option for most people with full-time jobs. Finally, we ignore any effects the regime change may have had on the efficiency of shopping (for example, shops may have become less crowded after the change) or the cost of goods.

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frequency of shopping, but not the time spent shopping or when shopping is done.

Let M_j, S_j, and L_j denote time spent on market work, shopping, and leisure, respectively, during time frame j, $j \in \{D, E\}$. The total time available during the day (D) and during the evening (E) is denoted by T_D and T_E, respectively. The individual can earn a market wage w per hour; non-labor income is denoted by μ, consumption by y, and full income by $Y \equiv w(T_D + T_E) + \mu$. In the sequel we will use $M \equiv M_D + M_E$, $S \equiv S_D + S_E$, $L \equiv L_D + L_E$, and $T \equiv T_D + T_E$. Note that by assumption $M_E = 0$, hence $M = M_D$.

Consider an individual with preferences represented by the utility function:

$$U(L_D, L_E, S_D, S_E, y) = \alpha_l \ln(L_D + L_E) + \alpha_s \ln(S_D + S_E) + \alpha_y \ln(y) \qquad (1)$$

with $\alpha_l + \alpha_s + \alpha_y = 1$.

Note that shopping might directly generate utility, or it might merely be an input in the household production process. To separate the two interpretations empirically, direct information on the household products or additional assumptions are required; see Kerkhofs and Kooreman (2003) for a recent analysis of identification problems in household production models. Specification (1) is consistent with both interpretations.

The utility function is maximized subject to the following constraints:

$$\begin{cases} L_D + S_D + M_D = T_D \\ L_E + S_E = T_E \\ y = wM_D + \mu \\ 0 \le L_D, S_D, M_D \le T_D \\ 0 \le L_E, S_D \le T_E \end{cases} \qquad (2)$$

The constraints characterize the situation after 1996. The impossibility to shop during the evening before 1996 is expressed as the additional, exogenous constraint $S_E = 0$.

We first derive the behavioral equations for the post-change situation and then analyze the effects of imposing the additional constraint $S_E = 0$. Pre and post change optimal values will be indicated by superscripts 0 and 1, respectively.

Post-change behavior

If neither of the inequality constraints are binding the model implies that the shares of full income Y spent on consumption, shopping, and leisure are $\alpha_y Y$, $\alpha_s Y$, and $\alpha_l Y$, respectively, so that

$$\begin{aligned} M_D^1 &= \alpha_y Y/w - \mu/w \\ S^1 &= \alpha_s Y/w \\ L^1 &= \alpha_l Y/w \end{aligned} \qquad (3)$$

(The price of consumption has been normalized to 1.) Note that the maximization problem only yields the optimal total time spent on shopping, as the individual is indifferent between S_D and S_E; similarly for leisure. Given the individual's indifference, it seems natural to assume that, on average, a fraction $S^1/(S^1 + L^1)$ of both the evening time, T_E, and of the day time that remains after doing market work, $T_D - M_D^1$, is spent on shopping; a fraction $L^1/(S^1 + L^1)$ of both time periods is spent on leisure. Note that (3) implies $S^1/(S^1 + L^1) = \alpha_s/(\alpha_s + \alpha_l)$ and

$T_D - M_D^1 = (1 - \alpha_y)(Y / w) - T_E$.

Thus

$$\begin{aligned} M_D^1 &= \alpha_y Y/w - \mu/w \\ S_D^1 &= \frac{S^1}{S^1 + L^1}\,(T_D - M_D) = \alpha_s(Y/w) - \alpha_s T_E/(\alpha_s + \alpha_l) \\ L_D^1 &= \frac{L^1}{S^1 + L^1}\,(T_D - M_D) = \alpha_l(Y/w) - \alpha_l T_E/(\alpha_s + \alpha_l) \\ S_E^1 &= \frac{S^1}{S^1 + L^1}\,T_E = \frac{\alpha_s}{\alpha_s + \alpha_l}\,T_E \\ L_E^1 &= \frac{L^1}{S^1 + L^1}\,T_E = \frac{\alpha_l}{\alpha_s + \alpha_l}\,T_E \end{aligned} \qquad (4)$$

If non-labor income is larger than the optimal consumption share, i.e., if $\mu > \alpha_y Y$, the individual chooses not to work in the market: $M_D^1 = 0$. The optimal division of time and leisure then follows from maximizing:

$$\alpha_l \ln(L) + \alpha_s \ln(T - L) \tag{5}$$

yielding

$$\begin{cases} S^1 = \dfrac{\alpha_s}{\alpha_s + \alpha_l} T \\ L^1 = \dfrac{\alpha_l}{\alpha_s + \alpha_l} T \end{cases} \tag{6}$$

so that

$$\begin{cases} M_D^1 = 0 \\ S_D^1 = \dfrac{S^1}{S^1 + L^1} T_D = \dfrac{\alpha_s}{\alpha_s + \alpha_l} T_D \\ L_D^1 = \dfrac{L^1}{S^1 + L^1} T_D = \dfrac{\alpha_l}{\alpha_s + \alpha_l} T_D \\ S_E^1 = \dfrac{S^1}{S^1 + L^1} T_E = \dfrac{\alpha_s}{\alpha_s + \alpha_l} T_E \\ L_E^1 = \dfrac{L^1}{S^1 + L^1} T_E = \dfrac{\alpha_l}{\alpha_s + \alpha_l} T_E \end{cases} \tag{7}$$

If non-labor income plus the maximum labor income that can be earned during the day is smaller than the optimal consumption share, i.e., if $\mu + wT_D < \alpha_y Y$, the individual chooses to work the whole day: $M_D^1 = T_D$. The optimal division of time between shopping and leisure then follows from maximizing:

$$\alpha_l \ln(L_E) + \alpha_s \ln(S_E) \tag{8}$$

so that

$$\begin{cases} M_D^1 = T_D \\ S_D^1 = 0 \\ L_D^1 = 0 \\ S_E^1 = \dfrac{\alpha_s}{\alpha_s + \alpha_l}\ T_E \\ L_E^1 = \dfrac{\alpha_l}{\alpha_s + \alpha_l}\ T_E \end{cases} \tag{9}$$

(The other inequality constraints are not observed to be binding and are ignored henceforth.)

Pre-change behavior

We now consider the effects of the additional constraint $S_E = 0$ in the pre-change regime. Note that the specification of the utility function implies that $S > 0$, i.e., individuals cannot function without shopping at all. Combined with $S_E = 0$, this implies $S_D > 0$.

If the total amount of time the individual wishes to spend on market work and shopping is smaller than the day time available, i.e., $S^1 + M_D^1 = (\alpha_s + \alpha_y)(Y / w) - (\mu / w) < T_D$, the restriction $S_E = 0$ does not affect the sum of the day and evening time spent on the three activities. However, as leisure is the only possible activity during the evening, some shopping will shift from the evening to the day, with the same amount of leisure time moving in the opposite direction. More precisely,

$$\begin{cases} M_D^0 = \alpha_y(Y/w) - (\mu/w) \\ S_D^0 = \alpha_s(Y/w) \\ L_D^0 = T_D - M_D^0 - S_D^0 = \alpha_l(Y/w) - T_E \\ S_E^0 = 0 \\ L_E^0 = T_E \end{cases} \tag{10}$$

Comparing with the post-change expression (with $0 < M_D^1 < T_D$), we find that the shopping (leisure) time that moves from the evening (day) to the day (evening) is $\alpha_s T_E /(\alpha_s + \alpha_y)$.

If the total time the individual wishes to spend on market work and shopping is larger than the day time available, i.e., $S^1 + M_D^1 = (\alpha_s + \alpha_y)(Y / w) - (\mu / w) > T_D$, the restriction $S_E = 0$ will reduce the total time spent on each of these two activities, and increase leisure time. The optimal division of time between market work and shopping follows from maximizing:

$$\alpha_s \ln(S_D) + \alpha_y \ln(w (T_D - S_D) + \mu) \tag{11}$$

yielding

$$\begin{aligned} M_D^0 &= \frac{\alpha_y}{\alpha_s + \alpha_y}(Y/w - T_E) - (\mu/w) \\ S_D^0 &= \frac{\alpha_s}{\alpha_s + \alpha_y}(Y/w) \\ L_D^0 &= 0 \\ S_D^0 &= 0 \\ L_E^0 &= T_E \end{aligned} \tag{12}$$

Note that $\frac{\alpha_s}{\alpha_s + \alpha_y}(Y/w - T_E) < \alpha_y(Y / w)$ if $(\alpha_s + \alpha_y)(Y / w) - (\mu / w) > T_D$.

Thus the structural model predicts that in general there will be no change in the total time spent on working, leisure or shopping. Only the timing of activities will be affected when the restriction to shop during evening hours is released: some shopping time will move from the day to the evening, while the same amount of leisure time moves in the opposite direction. Only for those who work (almost) full time will releasing the shopping hours restriction also affect the total time spent on the various activities: these people will spend more time doing market work (during the day). Their shopping time during the day will decrease, while their total shopping time will increase.

The model as presented above applies to single persons. In a simple extension of the present model to two-person households, equation (1) could be replaced by

$$U = \alpha_l \ln(L^1_D + L^1_E + L^2_D + L^2_E) + \alpha_s \ln(S^1_D + S^1_E + S^2_D + S^2_E) + \alpha_y \ln(y) \quad (1')$$

where the superscripts 1 and 2 refer to household members. The utility function is maximized subject to the individual time and inequality constraints and the household budget constraint $y = w^1 M^1_D + w^2 M^2_D + \mu$.

In this two-person model, the relaxation of the shopping hours constraint is even less likely to affect the total time spent on shopping and market work (aggregated over both spouses), since households will be able to accommodate shopping hours constraints by shifting activities from one person to the other. Only if both partners work (almost) full time might an effect on total time spent on the various activities occur.

In a more elaborate model of two-person households, the total time spent on the various activities could be affected, for example if shopping and leisure of both spouses are complements in the household's utility and/or production functions. However, such an analysis is beyond the scope of the present paper, given the unavailability of matched data on couples.

Note that we might expect that groups with timing constraints related to subcategories within leisure, i.e., household work (including child care) might change the most in timing but again not necessarily increase their total time spent shopping. We have not modeled this explicitly, but might consider that women would be more likely to have such constraints if a greater amount of household production, including some that must be done at particular times of day, falls to them whether by custom or comparative advantage patterns within the household. Indeed, in the U.S. both career and noncareer-oriented women often shop in the early evening (Polegato and Zaichkowsky 1994, 1999), implying that if patterns are

comparable for women in the Netherlands, the shopping hours constraint might indeed have been binding for many women in the Netherlands.[2]

3. Data

We look at the effects of the law change by utilizing cross-section time diary data from directly before, directly after, and three years after the law change. Data for 1995 are from the SCP survey, a random sample of 3227 people from the Dutch population over 12 years of age. One individual per household filled out a time diary in fifteen-minute intervals. An entire week of data is available for each person, with over 100 activities coded. Data for 1997 and 1999 are from two CBS surveys, using a comparable sampling methodology, with 4960 people sampled in 1997 and 5641 in 1999. The main differences from the SCP survey are that only one day of data is collected per person, and only 32 activities are coded (and unfortunately no distinction is made between grocery and other shopping). In addition, the 1997 data has only four day-types coded (Monday-Thursday, Friday, Saturday, and Sunday), causing us to aggregate the other years' weekday data to match. In both cases individuals are sampled all year long so the data represent time use patterns over the entire year.

The surveys are relatively comparable in terms of basic demographic composition (to the extent they are different along dimensions for which we stratify below, this will be unimportant; however for looking at the overall figures this is important). The 1997 and 1999 surveys are almost identical in terms of percentage women (51.5% and 51.6% respectively), while the 1995 survey is higher (54.5%). The mean age rises slightly, from 38.8 years in 1995 to 40.5 in 1997 and 41.5 in 1999.[3] Percentage married is very similar

[2] Pashigian and Sun (2000) argue that U.S. stores have responded to women's working more for pay by staying open later, again implying that the shopping hours constraint is binding on at least some women, as women have been working more in the Netherlands as well.

[3] We tried running simple regressions of percentage time use as a function of age and age-squared as well as the time period dummies and found that age was not a statistically significant variable in determining shopping or worktime within this 18 to 65 year old subgroup.

across all three surveys (55.7%, 54.6%, and 55.6% respectively). We limit each years' sample to persons between the ages of 18 and 65 inclusive so as to incorporate people who are most likely to be choosing actively between all three uses of time (as opposed to being retired or not yet in the labor force).

The CBS surveys start at 6 am on the stated day and run up to 6 am on the following day, while the SCP survey starts at 12 am on the stated day and runs up until midnight on the same day. This is not a serious problem for our analysis given that, as assumed in the structural model, it turns out that almost no shopping (or work) occurs in the 12 midnight to 6 am time slot. Therefore we present results regarding daily and weekly time use utilizing only the time after 6 am, and concentrating on the 8 am to 10 pm time period.

Figure 1 illustrates time use using column graphs for the average weekly data for the three samples. In each, the proportion of time in the day-hours interval devoted to leisure, work, and shopping respectively is shown. Starting with the Monday-Thursday composite day and moving through Friday, Saturday, and Sunday, four time periods are shown per day: morning (6-8 am); day (8 am to 6 pm); evening (6-10 pm); and night (10 pm to 12 midnight). In all three years, the vast majority of both work and shopping occurs during the day, with a small amount occurring during the evening.[4] Very little work or shopping occurs on the weekends other than during the daytime on Saturday. The figures show little change in the overall patterns between 1995 and the later years, other than a slight increase in shopping during the evening period on Monday-Thursday.

Although the structural model's condition that no work appear in the time slots outside of daytime is not met entirely, the fraction of time spent on work during the evening

[4] Note that even in the period in which shopping hours constraints are in effect, it is possible to have some shopping during the evening hours. There were occasional exceptions to the rule, occurring mainly in the larger urban areas, allowing for Thursday night shopping and some Sunday shopping, in the latter case particularly during the evenings. In addition, some stores (avondwinkels) during all three sampled years are designed to operate specifically during the evening hours as well as later into the night.

is about six times as small as the fraction spent on work during the day. As we will see below, the fact that some work occurs during the evening causes additional changes in work patterns that are not predicted by the simple structural model, but appear reasonable in light of the expansion of retailing into the evening hours.

The other condition, that everyone has some shopping time, is generally but not completely true: In 1995, nine percent of the sample reports no time shopping during the sample week. However, for the sample as a whole, a nontrivial amount of weekly time is spent in shopping, namely 222 minutes, or 3.7 hours per week. Of this total, 60 percent occurs during the day period on a weekday, while 7.4 percent occurs on a weekday evening. A negligible amount occurs during the early morning and late night periods over the whole week (less than one minute in each period per day). The median shopping time is 195 minutes, and the mode is 210 minutes per week (3 and a half hours).[5]

4. Results

We present results for the sample as a whole and for the four subsamples of women and men, unmarried and married. In addition, we consider single women and men who work over 35 hours a week. We use the nonparametric method of simply considering whether the "treatment" and "control" groups have different proportions of time spent in shopping and work (and therefore also leisure).

For each case we show a pooled test result (where the 1997 and 1999 data are pooled) and also separated test results for 1997 and 1999 separately as compared to 1995. Rather than creating synthetic weekly data for the 1997 and 1999 samples, we show results separately for the day and evening periods for the four day-types (Monday-Thursday combined, Friday, Saturday, and Sunday). We do calculate below a total time spent in both

shopping and work during an average week in each of 1997 and 1999 to compare to the 1995 figures cited above. Table 1 shows the results.

Unmarried men and women

Unmarried men are essentially unchanged except for an increase in shopping time on Sunday afternoons by 1999. Unmarried women increase their worktime on Sunday afternoons by 1999. If women are more likely to work in retailing, this is consistent with a story in which women work in stores on Sundays. Perhaps it took a longer time for both store owners and shoppers to take advantage of the Sunday afternoon openings, so that this option was not actually used in 1997.

Unmarried women show a consistent pattern of shopping more on Monday through Thursday evenings in both 1997 and 1999. They also shop more on Friday evenings in 1999.

Married men and women

Married men shop slightly more on Monday through Thursday evenings. They also reduce their daytime work and increase their daytime shopping during this period, a result not predicted by the simple model. They increase their work during Friday and Saturday evenings and Saturday afternoon, although this effect occurs only in 1997 and disappears by 1999, even as the daytime work reduction persists.

Like unmarried women, married women show a consistent pattern of shopping more on Monday through Thursday evenings in both 1997 and 1999, and they also shop more on Friday evenings in 1999. Married women consistently increase their work on Monday through Thursday evenings. Again, this is consistent with a story in which women are more

[5] Travel time is coded as time spent shopping if shopping occurs as the use of time right after a period spent in travel.

likely to work in retail and therefore experience a net increase in employment.[6] While our simple model did not allow for employment in the evening period, it is clear that this is a major potential outcome of increasing retail hours. Total retail employment need not necessarily increase (depending on relative staffing and productivity of workers), yet we would expect to see retail employment spread out over a longer daily time period once shopping hours constraints are lifted.

Unmarried men and women with full time jobs

Table 2 contains results for the subsamples of unmarried men and women who work over 35 hours a week during weekday daytimes. As shown in Table 2, the strong results are for the women. The women both increase their worktime during the day and increase their shopping time during the evenings, leading to an increase in total shopping time. This result is driven by the change from 1995 to 1999, while the 1997 results are inconclusive. Perhaps the longer time period was necessary for people to be able to make this adjustment in their desired work (and shopping) hours. The daytime adjustment comes out of leisure time rather than out of shopping time, as shopping remains basically unchanged.

Summary of results

Hence we see that the empirical results are roughly consistent with our simple structural model, although they also imply potential extensions of the model that would allow us to explain the increase in evening employment for some groups and changes in allocation of work and shopping between household members.

Interestingly, increased work on Friday nights occurs in both 1997 and 1999 for the full sample, although the particular composition of workers changes from year to year,

[6] This result of increased retail employment was predicted and found empirically by Burda and Weil (1998).

switching apparently from married men and women to unmarried women between 1997 and 1999.

Hence the average change relative to 1999 in total worktime over the week is 1 minute in 1997 and 9 minutes in 1999, while the average weekly change in total shopping time is 21 minutes for 1997 and 30 minutes for 1999. The minimum change in total time allocated to each activity is consistent with the prediction of our simple model, with the increase in time spent shopping consistent with the idea that a nonnegligble subset of people are constrained in terms of the total amount of shopping that they would like to be doing under the shopping laws regime. Note the increase in evening work may also imply that the lifting of the shopping hours restrictions also lifts the binding constraint on evening employment, which we did not model explicitly. Unmarried women increase both total shopping time and total work time, as do married women., while married men increase their shopping time (45 minutes weekly) but decrease their work time substantially (by 174 minutes on average over the two years).

In general we conclude that women appear to be the most affected by the lifting of the shopping time constraint.

5. Discussion

Are there other exogenous factors that would tend to change the allocation of time between these three categories that lead us to either over or underattribute changes in time use to the shopping laws changes? In particular, given that we do record some effects, we need to consider simultaneously changing factors that could have caused effects in the direction that we observe.

One factor is that changes may have occurred that would have the effect of either increasing or decreasing the time spent in paid work. For instance, changes in nonlabor

income would reduce time spent in paid work, while wages have an ambiguous effect depending on elasticity of labor supply. We use national data to track general trends in hourly earnings and weekly hours worked over this four-year period (Statistics Netherlands 2003; www.cbs.nl). Over this period, real hourly earnings rise somewhat, by 2.3 percent from 1995 to 1997 and by 6 percent from 1995 to 1999. The rise is greater for women reporting an earnings rate; 3.8 percent from 1995 to 1997 and 8.3 percent from 1995 to 1999. At the same time, a decline in weekly hours worked occurs, with a drop of 3.1 percent from 1995 to 1997 and a drop of 4.0 percent from 1995 to 1999. This decline is smaller but continuing for men (2.4 percent lower from 1995 to 1997, 3.0 percent lower from 1995 to 1999) and larger at first for women (4.2 percent lower from 1995 to 1997) and then rising (3.4 percent lower from 1995 to 1999, for a rise of 0.4 percent from 1997 to 1999). This is telling given that married men in our sample do show a large drop in time worked over this period. These national trends not automatically imply more time spent in shopping however, even if the decline in work time could be considered as potentially exogenous to the change caused by shopping hours changes (probably a reasonable assumption).

One might also wonder if there were changes in substitutes for current forms of goods procurement, for instance increased availability of internet shopping. This might have the effect of increasing or decreasing total time spent in shopping (supposedly it would not be used at all if it did not allow for more efficient shopping) and might have a particularly significant effect in changing the timing of shopping as one can place orders around the clock. Thus shopping hours constraints would be nonbinding on internet shopping, just as they are already nonbinding on catalogue shopping (although not all catalogue outlets allow for around-the-clock order placement). We are not too worried about the role of internet shopping in changing time devoted to shopping during this period, as internet shopping was

in its infancy in 1996 and also is shown, at least in the U.S. context, to be more of a substitute for catalog shopping than for store shopping (Ward 2001).

Thus, while we cannot be sure that there are not other changes occurring simultaneously with the shopping laws changes that can either account for the observed changes or are offsetting part of the effects of the shopping laws, the narrowness of the time frame and the absence of major macroeconomic or demographic shocks during this time frame make our story more plausible.

6. Conclusion

Most of the results are consistent with the predictions of the simple structural model: for the majority of people, there is only a change in timing, not amount, of shopping; for the work-constrained group, there is an increase in total shopping which is concentrated in the evening period, while work increases.

Various extensions, more or less straightforward, are suggested by these results. One extension is to consider whether groups with potentially coordinated production, for instance married persons, have different behavior than singles.[7] We have no prediction from our structural model regarding this question as our model deals with single production only, only a hypothesis that married persons' total time allocation might vary less across the two states. Differences for married persons suggest the need to extend our simple model as suggested above in order to consider coordinated production (and potentially consumption as well). As stated above, we would prefer using matched couple data for such a study, which are not readily available.

We plan to follow up on this study by looking at longer-term adjustment using the 2000 SCP survey, which will be directly comparable to the 1995 survey in terms of survey

[7] E.g., Blacklock and Smallwood (1987) model the intrahousehold decision as to who does the routine shopping.

questions and structure. This will allow us to look at more detailed categories of time use as well as additional detail regarding weekdays, and weeklong behavior for individuals. For instance, changes in time spent on activities contained within the residual "leisure" category, in particular time spent in nonmarket work, could be considered in more depth.[8] It will also be interesting to see if shopping and work patterns demonstrate any reversion by 2000, as some more recent discussion in the Dutch press indicates a potential tapering-off of both openness and usage of stores during evening hours (Klok 2002).

A broader extension of this type of work would consider other cases where timing constraints exist in addition to or instead of quantity constraints. It would also be interesting to model potential preferences for contiguous blocks of time to be spent in the same activity (potentially so as to reduce the costs of switching from one activity to another, or if productivity increases with duration of activity) or other types of explicit timing preferences, and consider whether the observed patterns are consistent with such preferences.

[8] In particular, time spent in household production other than shopping could be considered; cf. Jenkins and O'Leary (1995) for a model of determinants of domestic work time.

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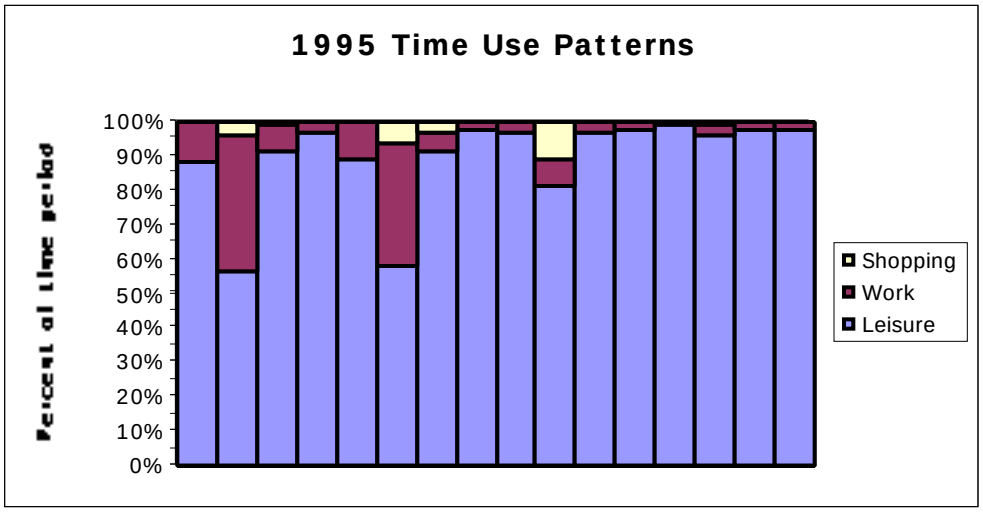
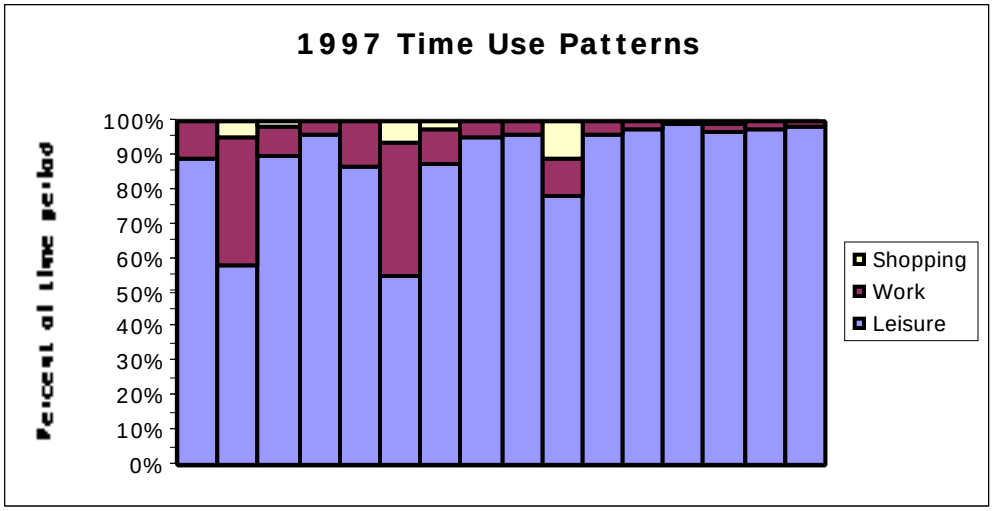
Figure 1: Time use across days and time periods within days (left to right: 6-8 am, 8 am-6 pm, 6-10 pm, 10-12 pm for Mon-Thurs., Friday, Sat., Sunday)





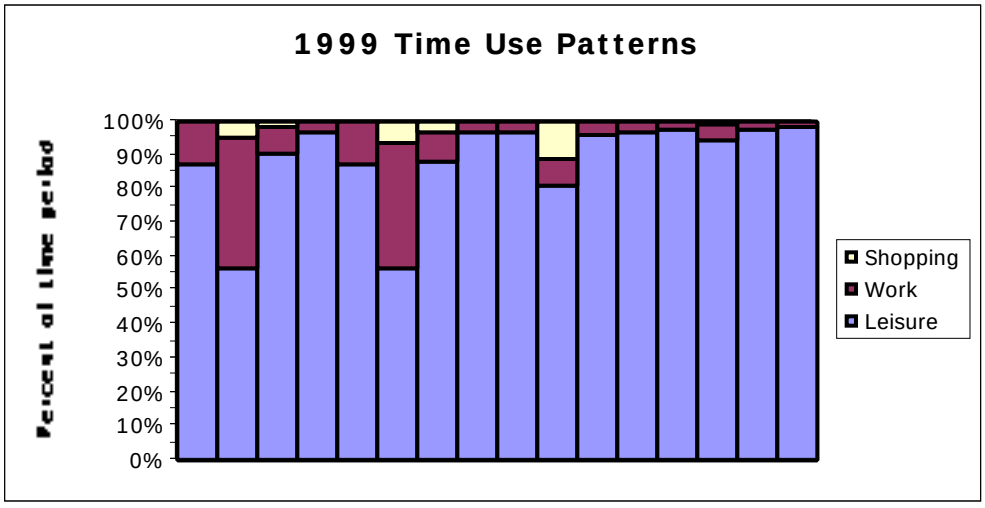


Table 1: Percentage of time during period spent in work and shopping, 1995, and changes, 1997, 1999, and combined 97/99

	Monday-Thursday				Friday				Saturday				Sunday			
	daytime		evening		daytime		evening		daytime		evening		daytime		evening	
	work	shop	work	shop	work	shop	work	shop	work	shop	work	shop	work	shop	work	shop
all persons	N=15,657				N=3776				N=3751				N=3993			
1995	**39.4**	**4.3**	**7.7**	**0.7**	**35.6**	**5.9**	**6.0**	**2.8**	**7.7**	**10.8**	**2.7**	**0.1**	**3.1**	**0.8**	**2.5**	**0.0**
1997	**-2.2**	**0.6**	**1.3**	**0.6**	3.0	0.3	**3.4**	-0.1	**3.0**	0.0	1.0	0.1	-0.8	-0.1	-0.3	0.0
1999	-1.1	**0.8**	0.8	**0.6**	1.6	0.2	**2.6**	0.2	0.3	0.3	0.9	**0.2**	**1.4**	0.2	-0.2	0.0
pooled 97/99	**-1.6**	**0.7**	**1.0**	**0.6**	2.2	0.2	**2.9**	0.0	**1.6**	0.1	0.9	**0.1**	0.2	0.0	-0.2	0.0
unmarried men	N=2854				N=686				N=691				N=709			
1995	**50.3**	**2.6**	**12.4**	**0.9**	**46.8**	**3.5**	**9.5**	**2.4**	**11.5**	**9.8**	**4.2**	**0.1**	**3.9**	**0.8**	**3.7**	**0.2**
1997	-1.6	-0.1	-2.0	0.0	-3.3	-0.4	-1.1	0.5	1.6	-0.3	0.7	0.1	-0.2	-0.4	-1.5	-0.2
1999	0.6	0.4	-1.1	0.4	-0.2	0.4	2.7	-0.6	2.7	-1.2	0.3	0.3	0.5	**1.1**	0.2	-0.2
pooled 97/99	-0.4	0.2	-1.5	0.2	-1.6	0.1	1.0	-0.1	2.1	-0.7	0.5	0.2	0.1	0.2	-0.8	-0.2
unmarried women	N=3292				N=791				N=787				N=835			
1995	**34.4**	**4.8**	**6.3**	**0.9**	**31.1**	**6.6**	**5.8**	**2.3**	**9.6**	**11.5**	**3.3**	**0.1**	**3.3**	**0.7**	**2.3**	**0.0**
1997	-2.4	**1.7**	0.3	**1.3**	4.8	0.7	2.0	0.6	2.8	-2.2	-0.7	-0.1	-0.5	0.7	0.0	0.0
1999	0.3	0.7	1.4	**0.8**	5.6	0.5	**5.9**	**2.5**	-3.3	1.3	-0.9	0.1	**3.5**	0.3	1.5	0.0
pooled 97/99	-1.0	**1.2**	0.9	**1.0**	5.3	0.6	**4.2**	**1.7**	0.0	-0.6	-0.8	0.0	1.3	0.5	0.7	0.0
married men	N=4283				N=1059				N=1010				N=1093			
1995	**60.1**	**2.2**	**10.8**	**0.5**	**54.6**	**3.5**	**8.0**	**2.8**	**8.4**	**8.8**	**2.7**	**0.1**	**4.0**	**0.8**	**3.4**	**0.0**
1997	**-8.1**	**1.2**	**2.9**	0.3	-0.2	0.4	**6.0**	0.0	**7.8**	0.5	**3.2**	0.4	-2.1	-0.4	0.0	0.0
1999	**-8.4**	**0.9**	0.4	0.4	-5.9	0.9	0.2	-1.3	0.3	1.1	2.3	0.1	0.5	-0.4	-1.1	0.0
pooled 97/99	**-8.3**	**1.1**	1.5	**0.4**	-3.1	0.7	**3.0**	-0.7	**3.8**	0.8	**2.7**	0.2	-0.9	-0.4	-0.5	0.0
married women	N=5228				N=1240				N=1263				N=1356			
1995	**21.0**	**6.4**	**3.7**	**0.6**	**17.8**	**8.6**	**2.7**	**3.4**	**4.0**	**12.4**	**1.6**	**0.1**	**2.0**	**0.8**	**1.2**	**0.0**
1997	-1.2	0.2	**1.5**	**0.7**	1.5	1.3	**2.9**	-1.1	0.1	1.2	0.4	0.0	-0.2	-0.2	-0.2	0.0
1999	0.8	**1.2**	**1.3**	**0.8**	1.9	-0.2	2.0	0.8	0.4	0.3	0.9	0.3	1.5	0.3	-0.4	0.0
pooled 97/99	-0.1	**0.7**	**1.4**	**0.7**	1.7	0.5	**2.4**	-0.1	0.3	0.8	0.6	0.1	0.6	0.0	-0.3	0.0

Statistically significant results at the five percent significance level are in boldface.

Table 2: Percentage of time during period spent in work and shopping, 1995, and changes, 1997, 1999, and combined 97/99, unmarried full-time workers only

	Monday-Thursday				Friday			
	daytime		evening		daytime		evening	
	work	shop	work	shop	work	shop	work	shop
all	N=2427				N=531			
1995	**89.9**	**1.1**	**12.0**	**1.2**	**89.3**	**1.4**	**10.4**	**4.0**
1997	-0.7	**0.4**	-0.3	0.4	-1.0	-0.7	0.3	2.2
1999	**1.4**	-0.1	1.3	**1.2**	**2.1**	0.2	5.3	1.1
pooled 97/99	0.5	0.1	0.6	**0.9**	0.7	-0.2	3.0	1.6
men	N=1407				N=307			
1995	**90.4**	**0.8**	**13.6**	**1.0**	**89.5**	**1.2**	**9.5**	**4.0**
1997	**-1.6**	**0.5**	-1.2	0.2	-1.4	-0.7	1.2	1.2
1999	0.9	-0.3	1.8	**1.2**	1.4	0.0	**7.7**	-2.4
pooled 97/99	-0.2	0.0	0.5	0.7	0.1	-0.3	4.7	-0.8
women	N=1020				N=224			
1995	**89.4**	**1.4**	**10.0**	**1.4**	**89.1**	**1.7**	**11.5**	**4.1**
1997	0.7	0.3	0.7	0.9	-0.5	-0.5	-1.0	3.7
1999	**2.0**	0.2	-0.2	**1.3**	**3.0**	0.5	1.9	**5.9**
pooled 97/99	**1.4**	0.3	0.2	**1.1**	1.4	0.0	0.6	**4.9**

Statistically significant results at the five percent significance level are in boldface.