Finance and Economics Discussion Series
Divisions of Research & Statistics and Monetary Affairs
Federal Reserve Board, Washington, D.C.

Do Constraints on Market Work Hours Change Home Production Efforts?

Geng Li

2009-21

NOTE: Staff working papers in the Finance and Economics Discussion Series (FEDS) are preliminary materials circulated to stimulate discussion and critical comment. The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the research staff or the Board of Governors. References in publications to the Finance and Economics Discussion Series (other than acknowledgement) should be cleared with the author(s) to protect the tentative character of these papers.

Do Constraints on Market Work Hours Change Home Production Efforts?

Geng Li *

Federal Reserve Board

Abstract

We study variations in housework time and leisure consumption when workers are subject to labor market work hours constraints that prevent them from working the optimal number of hours. Using data from two large nationwide longitudinal surveys, we first document that such constraints are widespread—about 50 percent of all households in our sample had been bound by such constraints in at least one year, highlighting the significance of studying household behaviors in labor markets under binding constraints. Our analysis reveals strong heterogeneity and asymmetry in workers' reactions to this type of market constraint that are difficult to reconcile with standard preferences and home production technology. In particular, we find that the ceilings on market work hours induce workers to increase time spent on housework, including cooking, and to reduce vacation time. In contrast, floors on market work hours do not significantly affect time spent on housework, but may boost vacation time. On net, workers constrained by hours ceilings (floors) appear to have more (less) leisure time. Meanwhile, the response to hours ceilings are more pronounced among unmarried households. We also find some evidence that the magnitude of the effects of market hours constraints increases with the persistence of these constraints. Our results are robust to a number of variations in measurement metrics, econometric specifications, sample selection criteria, and data sources. We argue that the empirical results documented in this paper can be taken as additional moments conditions against which equilibrium models with home production are calibrated.

Keywords: Market hours constraints, home production, leisure time.

JEL Classification: D13, J22

*I thank Charlie Brown, Karen Dynan, Dmitriy Stolyarov and seminar participants at the Federal Reserve Board for helpful discussions and comments. Colin Motley provided superb research assistance. I also thank Michael Mulhall and Meredith Richman for editing assistance. The views presented in this paper are those of the author and are not necessarily those of the Federal Reserve Board and its staff.

1 Introduction

Recent years have seen significant progress on three frontiers of research — household time allocation, home production, and labor market frictions. Despite the substantial amount of work conducted in each of these areas, relatively little is known about how they are related. This paper attempts to fill part of this gap. We focus on a specific type of labor market friction, market hours constraints, under which a worker cannot work the desired number of hours. We want to understand whether and to what extent such constraints affect household time allocations on non-market activities. Specifically, we ask the following questions: Does the consumer alter housework hours when he is subject to binding hours constraints in labor market?[1] How does net leisure consumption change in response to such hours constraints? Does the response vary over different demographic groups? Does the response depend on the direction and persistence of these constraints? Answers to these questions will advance our understanding of how households react to labor market frictions and how home production fits into the analytical framework of household time and consumption optimization. In addition, the empirical results presented in this paper will provide useful moments conditions against which equilibrium labor supply models and aggregate fluctuation (for example, RBC) models can be evaluated and calibrated. Furthermore, this study also sheds light on the welfare analysis related to market work hours constraints. For example, the results may speak to extent to which household welfare has been affected by the 35-hour work week that was adopted by France in 2000?

We study two types of market hours constraints. In one scenario, the worker wants to work more but cannot increase hours at the current job; in the other scenario, the worker wants to work less but cannot reduce hours at the current job. Throughout the paper, we will refer to the former as upside constraints and the latter as downside constraints. Consider a worker subject to a binding upside constraint. Standard labor supply theory predicts that the worker's marginal utility of having an additional hour of leisure should be lower than the marginal utility derived from consuming what he earns should he be allowed to work for an additional hour. To equalize the margins of consumption and leisure, he should spend more time in home production, which diminishes the marginal utility of consumption but lifts the marginal utility of leisure. Theoretically, the implication of the constraint on the net change in leisure consumption is ambiguous because it is possible that his home production hours need to increase by more than the number of additional market hours he wants to work in order to equalize the margins. However, as we will show, under rather general assumptions the standard

[1] We will slightly abuse the terminology and use home production and housework interchangeably.

model predicts that the increase of housework hours is not as large as the reduction in market work hours, and consequently the worker will on net have more leisure time relative to the unconstrained. The above mechanism can be reversed and applied to workers under binding downside constraints. In such a scenario, the model predicts that the constrained workers will reduce housework hours, but on net have fewer hours of leisure time relative to the unconstrained workers.

Using 1968 to 1986 data from a nationally representative longitudinal survey, the Panel Study of Income Dynamics (PSID), we find significant but asymmetric responses of home production and leisure time to market hours constraints. The response varies with the type of constraint and worker marital status. Our results suggest that married household heads that cannot work as many hours as desired on average spend 25 more hours, or 10 percent, a year in general housework. These households also spend more time cooking at home, reducing the eating-out share of their total food expenditure by 0.5 percentage points, or 3 percent. They also tend to reduce vacation time by about 5 percent. On the other hand, we find that the married heads of household that cannot work as few hours as desired do not significantly adjust housework time, but they take slightly more vacation time than comparable unconstrained households. The responses are typically much more pronounced among unmarried workers. Using the Health and Retirement Study (HRS), which has more recent sample coverage, to redo the cooking time analysis, we obtain somewhat stronger results. Our findings are little changed with respect to a sequence of sensitivity and robustness tests. We argue that the asymmetry and heterogeneity we find are difficult to reconcile with standard household preference and home production technology. We subsequently posit several potential factors and directions that future research can pursue to address the asymmetry and heterogeneity documented here.

In addition, we document that the upside and downside constraints have rather different degrees of persistence. The hazard rate of being bound by an upside constraint for an additional year is about 50 percent, which varies little with the number of years the worker has already been constrained. In contrast, the downside constraints are much less persistent, with most only lasting one year. We also find evidence broadly consistent with the notion that the influence of market hours constraints increases with their degree of persistence.

In the rest of the paper, we first briefly review some recent contributions to household time allocations, home production and market hours constraints in Section 2. We then construct a simple model in Section 3 to study how leisure and home production respond to work hours constraints and the related comparative statics. Section 4 introduces the data used, describes sample selection criteria, and provides summary statistics. Empirical results are presented in Section 5. We conclude

in Section 6 by setting up a research agenda.

2 A Brief Review of the Related Literature

Studying home production in the context of labor supply has a long tradition that can be traced back to Becker (1965). In this seminal contribution, Becker established the notion that households can spend time in home production as an alternative to formal market labor supply, and therefore leisure is inaccurately measured by the time spent away from market work. Taking into account home production activities, Aguiar and Hurst (2007), drawing evidence from various time-use surveys, conclude that there has been a substantial increase in leisure time and rather stable market work hours between 1965 and 2003. In a related spirit, House, Laitner and Stolyarov (2008) document that the value of forgone home production can account for about 25 percent of women's market labor earnings.

Becker's insight motivated a vast volume of theoretical studies that find that incorporating home production helps explain a variety of puzzling phenomena. We highlight several examples here.[2] Benhabib, Rogerson, and Wright (1991) establish the observational equivalence between models with and without home production and show that it is possible to have involuntary unemployment and normal leisure at the same time in models with home production. Subsequently, simulation results in McGrattan, Rogerson, and Wright (1997) demonstrate that home production has a significant impact on market variables. Ríos-Rull (1993) incorporates home production into an overlapping generation model with skill acquisition and finds that such a model can deliver both the observed cross-sectional and lifecycle correlation between wages and hours. Baxter and Jermann (1999) show that a home-production-augmented permanent income hypothesis model can generate considerable amount of excess consumption sensitivity. Finally, Greenwood, Seshadri and Yorukoglu (2005) argue that a model with large progress in home production technology is able to account for the substantial increase of female labor participation rate. These studies share two deficiencies. First, the models are typically calibrated with aggregate statistics. It is not clear whether the assumed household preferences and home production technologies can generate the patterns of hours changes we observed in household-level data. Second, most of the papers do not address households' adjustment of home production and leisure under market hours constraints. Our analysis provides empirical results that can be used to assess the significance of these deficiencies.

[2]Also, see Greenwood, Rogerson and Wright (1995) for a survey of early contributions.

Most of the existing literature on market work hours constraints has focused squarely on the impact of the constraints on labor market activities and has left home production largely out of the picture. For example, Altonji and Paxson (1988) document evidence that is broadly consistent with the notion that workers demand higher wage compensation for jobs with more restrictive hours. Their subsequent work on market hours constraints, Altonji and Paxson (1992), reveals that the effect of preference changes on work hours is generally much larger for workers who change jobs than for those who do not, consistent with the view that hours constraints effectively limit workers' ability to alter hours without switching jobs. In addition, Paxson and Sicherman (1996) find that hours constraints affect job mobility and dual job holding. They report that, broadly consistent with the theory, workers subject to upside hours constraints are more likely to take a second job at a lower wage, while workers facing downside constraints are less likely to do so but are more likely to switch to a main job with lower required hours. Furthermore, Charles and DeCicca (2007) focus on the extensive margin of market labor supply. They find that downside constrained workers are more likely to retire by some future date compared with their unconstrained counterparts.

Finally, most recently there has been an increasing amount of attention directed to theoretical studies of hours constraints and their welfare and policy implications. Notably, Prescott, Rogerson and Wallenium (2009) show that constraints on workweek length can have different consequences for total hours than for total labor services. They also point out that policies designed to increase the length of the working life may not increase aggregate lifetime labor supply. The relationship between home production and market work hours constraints is an element that can be added to enrich such analysis and, more generally, the welfare analysis of labor market frictions.

3 A Simple Model of Comparative Statics

The intuition that will be explored in this paper — market hours constraints will affect not only market work, but also home production and leisure consumption — has its origin in Becker (1965). In this section, we use a simple static household time–consumption optimization model to characterize how upside and downside market hours constraints affect time spent on home production and leisure. The model can be extended to a multiple-period setup to study the dynamics of the impact of hours constraints. The preference and technology introduced in the model are similar to those used in many previous studies of home production, except that we do not model the investment in household durable goods.

Consider a worker that supplies labor in the market and in home production. Let N, H denote the hours devoted to market work and home production, respectively. His leisure consumption is then equal to $1-N-H$. The worker consumes a bundle that consists of market good, C_M, and home good, C_H. C_M is purchased using market labor income, and C_H is produced with technology $C_H = g(H)$, where $g'(H) > 0$, and $g''(H) \leq 0$. The final consumption bundle, C, is a CES aggregation of C_M and C_H such that

$$C = [\alpha C_M^{\rho} + (1-\alpha) C_H^{\rho}]^{\frac{1}{\rho}}, \tag{1}$$

where $0 \leq \rho \leq 1$, and $1/(1-\rho)$ is the elasticity of substitution between C_M and C_H, a well known relationship in CES aggregation. The market wage rate, w, is assumed to be constant, and is normalized to equal one.[3] Assuming the worker has a standard log preference over consumption and leisure, under both upside and downside constraints on market work hours, the worker's optimization problem can be formulated as

$$\max_{N,H} log(C) + log(1-N-H), \tag{2}$$

subject to

$$\underline{N} \leq N \leq \overline{N}, \tag{3}$$

where $\underline{N}$ and $\overline{N}$ are levels of hours constraints on each side. If the constraints are not binding, plug the CES relationship (1) into equation (2), and the optimization can be written as

$$\max_{N,H} \; log\left\{[\alpha N^{\rho} + (1-\alpha)(g(H))^{\rho}]^{\frac{1}{\rho}}\right\} + log(1-N-H) \tag{4}$$

It is straightforward to derive the unconstrained first-order conditions (FOCs):

$$\frac{\alpha}{C^{\rho}} N^{\rho-1} = \frac{1}{1-N-H} \tag{5}$$

for optimal market work hours, and

$$\frac{1-\alpha}{C^{\rho}} [g(H)]^{\rho-1} g'(H) = \frac{1}{1-N-H} \tag{6}$$

for optimal home production hours. In both FOCs, the right hand side (RHS) term is the marginal utility of leisure. These two FOCs demand that at the equilibrium the worker derives the same marginal utility from an additional unit of working or leisure time. Furthermore, he is also indifferent

[3]This paper focuses on a partial equilibrium model, where market wage rate is constant. In a general equilibrium model, such as models of aggregate fluctuations, it will be important to take into account wage rate changes induced by wide spread market hours constraints.

between working in the labor market or at home should he choose to work. We use N^* and H^* to denote the unconstrained optimal market work and housework hours.

Now consider the scenario where the upside constraint in equation (3) is binding. The maximization problem should be rewritten as

$$\max_{H} \; log\left\{\left[\alpha\overline{N}^{\rho}+(1-\alpha)(g(H))^{\rho}\right]^{\frac{1}{\rho}}\right\}+log(1-\overline{N}-H). \tag{7}$$

Accordingly, we have only one FOC,

$$\frac{1-\alpha}{C^{\rho}}[g(H)]^{\rho-1}g'(H)=\frac{1}{1-\overline{N}-H} \tag{8}$$

for the optimal home production hours. Noticing $N^* > \overline{N}$, we have

$$\frac{1-\alpha}{C^{\rho}}[g(H)]^{\rho-1}g'(H)\Big|_{H=H^*} > \frac{1}{1-\overline{N}-H^*}. \tag{9}$$

The equality of FOC (9) can be restored if the worker increases hours in home production. This is because on the left hand side (LHS), a higher level of home production increases consumption level C and lowers the value of $[g(H)]^{\rho-1}$ and $g'(H)$, whereas on the right hand side (RHS), a higher H induces a higher marginal value of leisure. Therefore, letting H^U denote the optimal hours of home production under a binding upside market hours constraint, it is unambiguous that $H^U > H^*$. Conversely, letting H^D denote the optimal hours of home production under a binding downside market hours constraint, it is easy to show $H^D < H^*$ in the model above.

As mentioned in the introduction, what can be somewhat ambiguous is the effect of market hours constraints on leisure time. To fix the idea, we consider the scenario of a binding upside constraint. The derivation can be reversed for a downside constraint. The net effect on leisure depends on whether the increase in housework hours is greater or smaller than the decrease in market work hours due to the upside constraint. Suppose that the worker increases housework hours by $\Delta = N^* - \overline{N}$ so that his total time of leisure is unchanged, we can evaluate the LHS of equation (9) at such a level of $H = H^* + \Delta$, noting that the RHS of equation (9) is exactly the marginal value of leisure at the unconstrained equilibrium. If LHS < RHS, we can infer that the worker has overshot in increasing his housework hours, and therefore, at the constrained equilibrium, the worker should consume more leisure. This is equivalent to assessing

$$\frac{1-\alpha}{C^{\rho}}[g(H)]^{\rho-1}g'(H)\Big|_{N^*,H^*} \; - \; \frac{1-\alpha}{C^{\rho}}[g(H)]^{\rho-1}g'(H)\Big|_{N^*-\Delta,H^*+\Delta} \gtrless 0. \tag{10}$$

Therefore, it is sufficient to solve under what conditions

$$\frac{d}{d\Delta}\frac{(1-\alpha)[g(H^*+\Delta)]^{\rho-1}g'(H^*+\Delta)}{[\alpha(N^*-\Delta)^\rho+(1-\alpha)(g(H^*+\Delta))^\rho]}<0 \tag{11}$$

holds. Explicitly working out the differentiation, we achieve the sufficient condition below[4]

$$\alpha\rho(N^*-\Delta)^{\rho-1}(N^*+H^*)<[C(N^*,H^*)]^\rho], \quad \forall\Delta; \tag{12}$$

Furthermore, if $\rho=1$ this condition can be simplified to $\alpha>0.5$. The intuitive interpretation of the LHS of the above relationship is the first order Taylor expansion of the αN^ρ term in the CES aggregation by $H^*+\Delta$ around $N=\overline{N}=N^*-\Delta$.

We subsequently present two parameterized examples with different CES aggregation and home production technologies. In the first example we assume that $\rho=0$, the Cobb-Douglas CES aggregation of market and home goods, and a linear home production technology, i.e., $g(H)=\omega H$. Taking $\alpha=0.6$ and assuming marginal productivity of home production is equal to that of market work, $\omega=w=1$, the optimization problem can be simplified to the familiar form of

$$\max_{N,H}\ 0.6\log(N)+0.4\log(H)+\log(1-N-H). \tag{13}$$

It is easy to solve for the unconstrained optima $N^*=0.3$, $H^*=0.2$ and $L^*=0.5$. It is interesting to observe that the hours of market work and home production derived from this causally parameterized model match rather well with the data. The mean annual hours of market work and home production for all households are 2,600 and 1,600, roughly 30 and 20 percent of total time endowment, respectively. However, as we will show in the next section, housework hours are very different between single and married households. Our simple model does not capture such difference. For any binding upside constraint $\overline{N}$, we obtain $H^U=\frac{2}{7}(1-\overline{N})$ and the constrained optimal time of leisure is equal to $\frac{5}{7}(1-\overline{N})$. Because $\overline{N}<N^*$, the worker will have more leisure time under a binding upside constraint. Conversely, he will have less leisure time under a binding downside constraint.

In the second example, we assume that $\rho=1$, the linear combination of market and home goods, and a concave (square root) home production technology. The optimization problem is

$$\max_{N,H}\ log(N+\sqrt{H})+log(1-\overline{N}-H), \tag{14}$$

and the unconstrained optima are solved to be $N^*=\frac{1}{8}$, $H^*=\frac{2}{8}$ and $L^*=\frac{5}{8}$. For any binding upside constraints $\overline{N}$, we have

$$H^U=\frac{1}{18}\Big[4\overline{N}^2-6\overline{N}+6-\sqrt{(4\overline{N}^2-6\overline{N}+6)^2-36(1-\overline{N})^2}\ \Big]. \tag{15}$$

[4]The algebra is tedious but straightforward.

It is easy to show that $H^U - H^* < N^* - \overline{N}$. For example, if $\overline{N} = 0.1$, we have $H^U = 0.266$, implying that leisure consumption will increase by about 0.01.

In these examples we assume that the marginal disutility of working at home is the same as that of working in the labor market. As Benhabib, Rogerson and Wright (1991) point out, it is entirely possible that the former is greater than the latter if the market work environment tend to be more pleasant than that of housework. If this assumption is included, we will have an even larger admissible set of parameters that will induce more leisure time under upside constraints and less leisure time under downside constraints, relative to the comparable unconstrained workers. It should also be noted that in the model above, the implied reactions of homework hours and leisure are symmetric with respect to the directions of the constraints. We summarize the testable predictions of the model as the follows: facing upside market hours constraints, workers will increase housework hours and generally also enjoy more leisure time; facing downside market work hours constraints, workers will decrease home production hours and generally also enjoy less leisure time.

4 Data

4.1 The PSID and the HRS

The main data source for our analysis is the PSID. We also make some use of the HRS data to extend our analysis to more recent years. Both the PSID and the HRS are nationwide longitudinal household surveys conducted by the Institute of Social Research at the University of Michigan. In addition to employment, income and demographic variables, both surveys collect information about market hours constraints and home production. The PSID (for the relevant questions) and HRS cover different periods of time and focus on different cohorts of the population. The PSID data we use in this paper were collected annually from 1968 - 1986 and were not designed to follow a specific cohort. In contrast, the HRS data were collected every other year starting in 1992 for a sample of people mostly born in the 1930s.

Table 1 summarizes relevant information collected by the PSID and the HRS. From 1968 to 1987 the PSID asked the following four questions regarding household heads:[5]

1. "Would you have liked to work more if you could have found more work?"

[5]The exact language of the questions varied slightly.

2. "Was there more work available on (any of your jobs) so that you could have worked more if you had wanted to?"

3. "Would you have preferred to work less even if you had earned less money?"

4. "Could you have worked less if you had wanted to?"

We count the head as being upside (downside) constrained if the head reported that he/she wanted to, but was not able to, work more (fewer) hours. Similar upside constraints questions were asked for wives between 1971 and 1976. The HRS asked essentially the same set of questions in all waves from 1992 to 2006. The distinction between the two surveys is that the PSID questions refer to the year prior to the survey, whereas the HRS questions refer to the time of the survey.[6] One advantage of the HRS data is that in addition to this qualitative questions, this survey also asked the constrained households what their desired number of market work hours was, a question not asked by the PSID. Because the hours constraints questions in the PSID were discontinued after 1987, our analysis using the PSID data is confined to the episode before 1987 even though the housework information is at large available after that.

We use two metrics of time spent on home production. The direct measure is the household reported annual hours of housework, which the PSID collected for head and wife separately from 1969 to 1986.[7] The indirect measure is the ratio between expenditures on eating out and total food expenditure, henceforth food-out ratio.[8] The food-out ratio can be constructed for both the PSID and the HRS sample and for almost all waves.[9] Therefore, we can use the HRS sample to corroborate the PSID results that were estimated using a sample that covered a somewhat earlier period. We can infer the changes of leisure time by netting out the changes of market and housework hours.

[6]This is part of the reason why we can only use the HRS data to a rather limited extent. The HRS does collect extensive time usage information. However, these data were collected in the "off-year", i.e., one year after the main survey. Consequently, the time usage information do not refer to the same year as the hours constraints questions. As we will show, the constraints are not very persistent. Therefore, we can not use much of the HRS time usage information.

[7]From 1969 to 1974, the PSID asked annual housework hours of husband and wife (or unmarried head) in the previous year. From 1976, the PSID began to ask current weekly hours of housework of head and wife. This question was skipped in 1982. The PSID also released annual hours that are imputed using weekly hours. Consequently, the annual housework hours variables are available during 1969 – 1973, 1976 – 1981, and all waves after 1983. As will be noted in the sample selection procedure, we remove the households if the imputed annual hours are very different from 52 times the reported weekly hours.

[8]The food expenditure questions were asked in the PSID referring to the survey year. We make necessary adjustment to make sure that all variables in the merged data refer to the same year.

[9]The only exception is that the PSID did not ask food-out expenditure separately in 1968 and skipped the entire food expenditure question in 1973. See Charles, Danziger, Li and Schoeni (2008) for more details about the food expenditure variables in the PSID data.

Furthermore, for all waves the PSID asked household head and wife how many weeks of vacation they took in the previous year, which we shall use as an alternative measure of leisure consumption.

4.2 Sample Selection and Summary Statistics

We restrict the PSID sample to households whose heads are older than 25 but younger than 65 and worked more than 500 but fewer than 3000 hours in a year. We trim off the household with annual total family or labor income lower than $1,200 or higher than $100,000, which is roughly the top and bottom half percent of the income distributions.[10] We also remove the households that have extremely high (above $10,000) or extremely low (below $100) annual food expenditure. In addition, we restrict the sample to heads and wives who have worked fewer than 3,000 hours per year in housework. Moreover, a household will be removed from our sample if the imputed annual housework hours are different from 52 times the reported weekly housework hours by more than 26 hours.[11] Finally, we remove a household from the sample if either the head or wife took more than 27 weeks of vacation in a year. The HRS data are subject to most of the same sample selection criteria.[12] At the end, the PSID pooled sample has 54,370 observations, while the HRS pooled sample has 15,532 observations.

Table 2 presents summary statistics of the relevant variables in the two pooled cross-section samples. All income and expenditure variables are deflated using the 1982-1984 Consumer Price Index. We notice that in the PSID sample, upside constraints are binding much more frequently than the downside constraints. Nearly 20 percent of our sample observations reported that they were not able to increase work hours when they wanted to. However, fewer than 6 percent of the sample were not able to decrease hours when they wanted to. In contrast, the two constraints bind with about the same likelihood (10 percent) in the HRS data. We suspect that several factors contributed to this difference. First, older households on average have more assets that can be used to smooth consumption in an income disruption, weakening their demand for more work hours. Second, it is possible that older workers are more likely to be under a downside constraint because of health-related reasons. Indeed, after restricting the PSID sample to those older than 50, we have a lower percentage for upside constrained households, but a higher percentage for downside constrained

[10] Keep in mind that this is a sample collected in 1970s and early 1980s.

[11] The PSID does not present details on how the annual hours were imputed. The distribution of the difference between the imputed annual hours and weekly hours $\times$ 52 has three modes – 0, -26, and 26. The assumption we make is that the non-zero differences are most likely to be $\pm$ 26 mainly due to rounding.

[12] The only exception is that age is restricted to be younger than 70 for the HRS sample because it surveys primarily older households. Applying the PSID age restriction does not change the result qualitatively.

households.[13] Second, part of the remaining difference may be attributed to the structural and institutional changes in the labor markets because some of the HRS data were collected twenty years after the PSID data. Moreover, we also compute the share of households that had ever been constrained. For the PSID sample, 46 percent of sample households had been upside constrained, more than doubling the share of ever-downside-constrained households. About half of the sample households were never constrained during the period between 1967 and 1986. For the HRS sample, the corresponding fractions of ever-upside- and ever-downside-constrained household heads were 19.4 and 15.2, respectively. Of the heads in the HRS sample, 67.5 percent were never constrained from 1992 to 2006.[14] All said, our data suggest that there had been a significant fraction of workers bound by market work hours constraints, calling for more research on household behavior and labor markets under binding constraints. In particular, it is possible that such widespread binding constraints can have considerable general equilibrium effects in labor markets.

As introduced earlier, the PSID has upside market hours constraints information for both head and wife between 1970 and 1975. It is interesting to observe that head and wife upside constraints are positively correlated, with the correlation coefficient equal to 0.1 and statistically significant (not shown in the table). We interpret this positive correlation as evidence suggesting that part of the upside constraints are driven by changes in household preferences, which affect both head and wife. The changes occurred on the employer's side typically affect only one member of the household unless both head and wife work for the same employer.

Because of the difference between the two surveys discussed above, the PSID households, on average, are younger and more likely to be married than the HRS households. They also tend to have lower education attainment and larger family size. Nevertheless, for heads, the two samples demonstrate similar demographic variations by market-hours-constraints status. As the table suggests, the upside-constrained households are more likely to be non-white, have lower education attainment and larger family sizes. These households also earn a substantially lower income, and their heads work fewer hours. Wife market work hours show somewhat different patterns in the two surveys. The PSID wife hours are generally much lower than those in the HRS data, potentially due to the increase of women labor participation rate over the last several decades. Also, the PSID wife hours do not vary much with the constraint status, while in the HRS sample, the upside-constrained households have significantly lower wife market work hours.

[13]The percentage of UC and DC became 14.3 percent and 6.4 percent, respectively

[14]Part of the discrepancy can be explained by the differences in ages and sample lengths of the two surveys.

Looking at the housework and leisure time related variables, we notice that the upside-constrained households apparently spend less on eating out. The difference is rather pronounced in both surveys, despite the fact that the HRS households on average have a higher food-out ratio. The distinction between the PSID and the HRS statistics is that the PSID unmarried households have a much higher food-out ratio than the married households, while no such gap was found in the HRS sample. The discrepancy is primarily due to the very different age composition in the two surveys. In addition, the PSID data show that the upside-constrained household heads spent more hours in home production and took fewer days of vacation time than the unconstrained heads, whereas the differences for the downside-constrained heads are not as pronounced, and are not always conforming with the model prediction. Finally, married heads spend substantially less time on housework than unmarried heads.

5 Econometric Analysis

We now estimate the effects of market work hours constraints on housework hours, food-out ratios and vacation time using various model specifications and econometric techniques.

5.1 Housework Hours

5.1.1 Cross-section Analysis

We first examine how housework hours change in response to constraints on head market work hours. Because for married households, both heads' and wive's housework hours can adjust in response to heads' market hours constraints, we estimate the model separately for married and unmarried households. To begin with, we first estimate effects of market hours constraints using the pooled cross-section sample. Because we have not controlled for potential household-specific effects, we should be mindful that the coefficients of upside and downside constraints dummies should be interpreted only as the average difference of housework hours between constrained and unconstrained workers that are otherwise identical. The following two models will be the baseline specifications that will be used repeatedly in the rest of our study.

$$HWHead = \alpha + \beta_u UC + \beta_d DC + \gamma Z_{head} + \theta Income + \phi W_{head} + \tau Year \tag{16}$$

for single household heads, and

$$HWHead = \alpha + \beta_u UC + \beta_d DC + \gamma Z_{head} + \gamma' Z_{wife} + \theta Income + \phi W_{head} + \phi' W_{wife} + \tau Year \tag{17}$$

for married household heads, where UC and DC are upside and downside constraint dummies indicating whether the head was constrained in a particular year. The demographic vector Z_{head} includes a head age polynomial, race, and education. In addition, we follow Altonji and Paxson (1992) and include detailed information about family composition as well as head disability status to more precisely control for households' preference with regard to housework. In particular, we include number of children by age groups (younger than 2, between 3 and 6, between 7 and 12, and between 13 and 18), and number of adults. For unmarried households, we also control for gender of the head as males and females may have different tastes for housework.[15] For married households, Z_{wife} contains demographic information about the wife, including an age polynomial, wife's education, and dummies indicating whether she works full time or part time. $Income$ is a dummy vector indicating the family income decile in a year. Using decile dummies rather than income levels allows us to control for income effects in a nonlinear and nonparametric way. W is the market hourly wage rate. We choose not to include market work hours of either the head or the wife as a control because market and housework hours are likely simultaneously chosen by (unconstrained) households.[16] Finally we include a vector of year dummies to control for year fixed effects, and thus capture the secular trend in housework hours.

Because the distribution of housework hours exhibits a heavy mass at its lower bound, zero, in addition to the OLS regression, we also estimate equation (16) and (17) using a Tobit regression to correct for the potentially censored distribution of dependent variables. The unmarried sample results, except coefficients of income decile- and year-dummies, are reported in columns (1) and (2) of table 3. We note that for this subsample the OLS and Tobit results are essentially the same. This is because among unmarried heads, fewer than ten percent of the sample have zero housework hours, implying a trivial bias of the linear estimators. Examining the estimated coefficients of control variables we find that younger children demand more housework time than older children, that whites and college graduates tend to spend fewer hours on housework, and that, female unmarried heads tend to spend substantially more time (270 hours per year) on housework than male heads.

The most striking feature of the results is the asymmetric response of housework hours to market work hours constraints. The upside-constrained single workers, as our model predicts, spent 50 more

[15]The PSID routinely treat the male of a married household as the head, therefore we only control for head gender for unmarried households.

[16]We should be mindful that the wage rate is calculated as the quotient between total labor income and total market hours worked. In this sense, wage rate may not be exactly exogenous in the model because total market hours can be jointly determined with housework hours. However, our estimates do not change significantly when wage rates are not used as controls.

hours per year in housework than the unconstrained single workers. This is a difference of 8 percent of the sample average housework hours.[17] Nevertheless, downside-constrained workers do not appear to have spent fewer hours in housework compared with the unconstrained. Our point estimate of β_d is a small positive number but statistically insignificant.

Now we focus on the head workers of married households, results for whom are reported in columns (3) and (4) of table 3. Unlike the single households, more than 25 percent of married heads had zero housework hours. Consequently, as we see, the OLS and Tobit regressions yield rather different results, with the latter showing more pronounced and statistically significant effects of market hours constraints. Even the Tobit results show that the housework hours of the constrained married head are only 26 hours higher than the unconstrained married head, a difference of only half the size for unmarried heads. However, given the fact that married heads on average spend far less time on housework, the 26-hour difference can account for a more than 10 percent gap. Another distinction between the results of married and unmarried heads is that the former has a negative, though insignificant, estimate for β_d, which is consistent with the model prediction.

Given the different reactions to market hours constraints demonstrated by married and unmarried workers, it is natural to ask how the housework hours of the wife in a married household react to the market hours constraint of the head. Accordingly, we estimate equation (17), replacing head housework hours with wife housework hours. The results are shown in columns (5) and (6) of table 3. Again, the OLS and Tobit results are similar because the distribution of wife housework hours have only a small mass at the zero lower bound. We find that wives of upside-constrained husbands do not on average work more hours on housework. Nevertheless, and probably somewhat surprisingly, wives of downside constrained husbands work nearly 50 more hours than wives of unconstrained husbands, suggesting that households with a lot of necessary housework are more likely to desire a reduction in head market work hours.

5.1.2 Panel Analysis

We now exploit the longitudinal structure of the PSID data and estimate the models using panel techniques. We should keep in mind that the sample panel is unbalanced because of the PSID sample attrition and our sample construction procedures. As in the cross-section analysis, we estimate the model using both linear and Tobit techniques, which in the panel regression context corresponds to

[17]The mean housework hours of unmarried and unconstrained head is 591.

a linear fixed-effects regression and a random-effects Tobit regression.[18] Because we estimate the models for single and married households separately, in our panel regressions we restrict the sample to households that have not changed marital status. As the household-specific effects (either fixed or random) have been accounted for, the results of longitudinal regressions, which are reported in table 4 in the same order as in table 3, can be interpreted as how much the market hours constraints would make workers change their housework hours.[19] Comparing with the results in table 3, the estimated effects of upside constraints on unmarried households are visibly smaller but remain both statistically and economically significant. The attenuations suggest that the ever-upside-constrained workers are likely to have also spent more time on housework during years when they were not constrained. Meanwhile, the difference between the linear and Tobit estimators become more pronounced, with the latter showing that upside constraints lead unmarried heads to increase housework hours by nearly 30 hours. The estimated effect of downside constraints remain contradictary to the model predictions but statistically insignificant.

In the next two columns of table 4 we see that the results of married heads were not attenuated much relative to the cross-section results. The estimated β_u suggests that married heads spend 25 more hours, which is statistically significant, on housework when their market hours are upside constrained. In contrast, a downside-constrained head would cut housework time by 16 hours, though the estimate is not statistically significant. As in the previous analysis, the differences between the Tobit and linear estimators are substantial. What about wives' housework hours? The answer is that the wives' housework hours do not react strongly to the constraints of the husbands. As shown in columns (5) and (6), wives' hours do not respond much to the upside constraints of heads at all, and are somewhat, but insignificantly, higher when heads are downside constrained.

To summarize, in contrast to our model predictions, we find strong asymmetry and heterogeneity in how housework hours respond to market hours constraints. Workers, especially the unmarried, tend to increase housework hours when they cannot work as many hours as they want to in the labor markets. However, workers do not appear to significantly reduce housework hours when they are working more than their desired hours in labor market.

[18] We do not estimate the fixed-effects Tobit model because there are no sufficient statistics to use to condition out the fixed effects in Tobit regressions, whereas the unconditional fixed-effects Tobit estimators are biased. See Bo (1993) for a discussion of some nonparametric fixed-effects Tobit estimators.

[19] Coefficients of control variables are not shown in the table. They are similar to the cross-section results and are available from the author upon request.

5.1.3 Extension – More Quantitative Analysis

We want to further characterize the relationship between the increase in housework time and the gap by which workers are constrained on market work hours. Put differently, in the notation of our model, we want to compute $\frac{H^U - H^*}{N^* - \overline{N}}$. The numerator is the increase of housework hours relative to the unconstrained optima and the denominator is the margin by which market work hours are limited by the upside constraints. The primary challenge of doing this is that we do not observe directly the counterfactual unconstrained optimal hours of the constrained workers, i.e., how many hours they would like to work in the home and in labor the market should they not be constrained. We cannot simply take the first-order difference of market and housework hours because hours changes between year t and $t+1$ reflect both market hours constraints and workers' preference changes. We take multiple steps to circumvent this data deficiency. We first project the desired market work hours of the constrained households. Our assumption is that the unconstrained households always work up to their desired hours in labor markets. Specifically, we estimate a market work hours equation similar to the specification in Altonji and Paxson (1992) using the unconstrained sample and project the counterfactual unconstrained optimal market work hours of the constrained workers. Similarly, we estimate a housework projection equation using the unconstrained household sample. The projection uses all control variables of equation (16) and (17), plus lagged housework hours and current market work hours. Recall that we mindfully excluded current market hours when estimating equation (16) and (17) because market and housework hours are likely jointly determined by households. We include these potentially endogenous variables here because we view this relationship purely as a projection equation and do not interpret the coefficients in any causal or structural way. Subsequently, we plug the projected counterfactual unconstrained optimal market work hours of constrained households into the housework equation and project the counterfactual first-best housework hours of the constrained households.

As shown in table 5, on average, the upside-constrained married workers want to work one hundred more hours, whereas the downside-constrained workers prefer to reduce working time by 66 hours. Both market hour gaps are statistically significant in the sense that they have standard errors much smaller than mean statistics, though we acknowledge that their sizes are smaller than what constrained workers reported in the HRS data. Meanwhile, our results indicate that the upside-constrained married (household head) workers on average spend 18 more hours on housework than the projected unconstrained counterfactual housework hours, a difference that is also statistically

significant. Hence our estimates suggest that for each extra market work hour limited by the upside constraint, the married workers will increase housework time by nearly 0.2 hours. Furthermore the correlation coefficient between the market and housework hours gaps is negative as expected but not statistically significant. In contrast the observed housework hours of downside-constrained workers are essentially the same as the predicted counterfactual number, reassuring the asymmetric response patterns exhibited in table 3 and 4.

Like the previous regression results, as shown in the second row of table 5, the counterfactual analysis reassures that single workers react to market hours constraints in a way that is both statistically and economically more significant than married workers. The average market hours gap among single upside constrained workers is 79, much smaller than the 102-hour gap among married workers. However, these workers increase their housework hours by 36 hours, doubling the magnitude of the response by married workers. Moreover, unlike the married sample, the correlation coefficient between market and housework hours gaps among single households is statistically significant. Conversely, the downside constraints gap is 78 hours among single workers, somewhat bigger than among married workers. The implied reduction of housework is more than 5 hours, larger than that of married workers, but neither the mean nor the correlation coefficient (which bears the expected sign) is significant.

To summarize, the above analysis yields results consistent with the theory predictions in terms of how workers react to upside constraints. So constrained workers will increase their housework hours, but by fewer hours than the margin that they are constrained by. Consequently, their net leisure time rises due to binding upside constraints. In contrast, we did not find any concrete evidence that downside-constrained workers reduce their housework hours.

5.2 Food-out Ratios

Now we repeat the estimation of equation (16) and (17) using the same cross-section and longitudinal techniques, with the dependent variable being replaced with food-out ratio. Because food-out ratio is associated with the household instead of the head or wife, we only run the regression for households without differentiating head from wife. Because the food-out ratio is distributed over $[0, 1]$, we continue to estimate Tobit models in addition to linear models. The results are reported in table 6. Focusing on the estimates of β_u and β_d, we find three noteworthy features. First, the results demonstrate strong asymmetry as we documented in the housework hours analysis. The upside-constrained households at large reduce their eating out shares of food expenditure by a margin that

is statistically and economically significant. For example, unmarried households appear to reduce their food-out ratio by 1.4 percentage points, nearly 10 percent, when upside constrained (column 6). In contrast, the downside-constrained households do not appear to alter their food-out ratio significantly (if at all). In some specifications, the estimated β_d is even negative, contradicting the model prediction. Second, we continue to find strong asymmetry between married and single households. Comparing the β_u and β_d coefficients estimated using the same econometric technique, the single households' results are uniformly larger in coefficients' size and more consistent with model predictions than the married households' results. For example, comparing column (6) and (8), the results show that single households reduce their food-out ratios by 1.4 percentage points, 0.9 percentage point more than married households. In addition, the single workers increase food-out ratios when downside constrained, though the margin is not statistically significant; whereas the food-out ratio declines slightly for downside-constrained married workers. Third, the patterns of our results are qualitatively robust to the different econometric techniques used to estimate the models. Nevertheless, the Tobit regression typically yields more pronounced estimates, while the longitudinal specifications tend to attenuate the cross-section results.

Looking at the coefficients of the control variables, we notice that most of them can be rather tightly estimated with signs consistent with our prior beliefs. Specifically, we find white and better-educated households eat out more often, while families with more kids and adults eat out less. In addition, female single heads tend to eat out less than male. Finally, food-out ratio increases with income deciles and there was a very pronounced upward trend in this ratio during 1969-1986 (not shown in the table).

It is rather challenging to infer the increase in housework hours, mostly for food preparation, grocery shopping and cleaning, due to the decline in the food-out ratio. When households alter their food-out ratios, they presumably also alter the quality of food used both in and out of home, which in turn may affect the relative price of food-in and food-out and total food expenditure. Moreover, if households' home production technology implies complementarity among various home production activities, when they increase hours of cooking, they will also increase hours on other housework activities. For example, if the home production takes a homothetic technology over different housework activities, hours spent on other housework will increase proportionally with cooking time. Conversely, if the technology implies substitutability among home production activities, hours on other activities should decline as cooking time rises. Nevertheless, the author's calculation under strong assumptions suggests that the estimated β_u in table 6 should call for an increase of housework hours that are at

large in the same ball park as the results reported in table 3 and 4.

Finally, for the constrained households, as with the housework hours, we contrast the gaps of market work hours and food-out ratios among married and single households between the counterfactual unconstrained and the observed scenarios, respectively. The results are reported in the lower panel of table 5. We notice that the imputed market work hours gaps are similar to what are shown in the upper panel, with the slight difference due to variations in the samples used for housework hours and food-out ratio analysis. The observed food-out ratio for upside-constrained married households is on average 0.6 percentage point lower than the unconstrained counterfactual, whereas the downside constrained gap is essentially zero. For upside-constrained unmarried households, we find a larger gap between the observed and unconstrained counterfactual food-out ratios (1.23 percentage points); while for the downside-constrained unmarried households, we estimate that the observed food-out ratio is 1.16 percentage points higher than the unconstrained counterfactual scenario. These results are broadly consistent with the findings in table 6. However, unlike the housework hours counterfactual analysis, the correlation coefficients between market hours gaps and food-out ratio gaps are not statistically significant.

Redoing the above analysis using the HRS data from 1992 to 2006, we find even more pronounced effects of the upside constraints and no significant effects of the downside constraints (if any, they are in the direction inconsistent with model predictions). The HRS results, reported in table 7, are qualitatively very similar to the PSID results in the following aspects. First, the asymmetry between the effects of upside and downside constraints is preserved. Second, similar differentials between the married and unmarried households are preserved. Third, the variations between linear and Tobit regression results and between cross-section and longitudinal regression results are similar to those demonstrated in the PSID analysis. The only substantial distinction between the PSID and the HRS analysis is that the β_u coefficient estimated using the HRS sample is larger than that estimated using the PSID sample, more so for the cross-section analysis and for the married households.[20] Being able to largely reach the same conclusion using two independent nationwide household surveys that were collected from different cohorts of population and in different time strongly reassure the accuracy and robustness of the food-out ratio results. It also suggests that other empirical results acquired using the PSID sample enjoy strong applicability with respect to the more recent and contemporaneous

[20]Comparing the estimates of control variables coefficients, we notice that the age quadratic was not precisely estimated for the HRS sample, potentially due to the quite limited variations of age in the sample. Otherwise, race, education, single head gender and family sizes have similar effects on food-out ratios as estimated using the PSID sample

time period.

5.3 Effects on Vacation Time

As we illustrate in table 5, net leisure time tends to be higher for upside-constrained workers as the increase of housework time is typically less than the reduction of market work hours. We now focus on an alternative and more direct metric of leisure consumption—weeks of vacation taken in a year.[21] We estimate equation (16) and (17), replacing the dependent variable with weeks of vacation. Vacation time, both as a labor contract component and as a household time allocation decision, has attracted increased attention recently. Altonji and Usui (2005) offer a comprehensive study of vacation leave and its relationship with hours worked, wages rates and, most directly related to the analysis in the current paper, with hours constraints. However, Altonji and Usui focus on how vacation time affects the probability of being constrained instead of how hours constraints affect the usage of vacation time, which is what we are going to address here.

As in the previous subsection, we estimate the models using four specifications – cross-section OLS, cross-section Tobit, linear fixed-effects, and random-effects Tobit. We employ the Tobit model because the dependent variable is also censored at zero.[22] The results are mixed and are reported in table 8. On the one hand, unlike the previous analysis, the estimated effects of upside constraints are sensitive to model specifications. The cross-section analysis implies that the upside-constrained married households on average took 0.2 weeks, or 8 percent, less vacation time than the unconstrained married households. However, there are no significant effects detected among unmarried households. While in the longitudinal analysis, the upside constraints reduce vacation time for married households but increase vacation time for unmarried households by a statistically significant amount. On the other hand, we find rather significant and robust effects of downside constraints consistent with the model prediction for both married and unmarried households in longitudinal analysis, which we have not detected in housework hours and food-out ratio analysis. Specifically, the random-effects Tobit regressions show that the married and unmarried households take more vacation time by 5 and 8 percent responding to downside constraints, respectively.

[21]The vacation data collected by the PSID reflect the time taken off from work. They do not have to be vacations out of town.

[22]In principle, if the opportunity costs can be extrapolated in either direction, some workers may want to take negative vacation time, which is equivalent to increasing work hours.

5.4 Persistence of the Market Work Hours Constraints

To the best of our knowledge, little work has been done assessing the reoccurrence and persistence of market work hours constraints, which can be an important element to further understanding of the nature and dynamics of these constraints. In this subsection we present some simple statistics describing these characteristics. We also present some preliminary analysis on to what extent the level of persistence of the constraints change their effects on home production activities.

As shown in the upper panel of table 9, the number of households that were upside constrained for $n+1$ consecutive years is about half the number of households that were upside constrained for n consecutive years. Put differently, conditional on being constrained for n years already, the probability of being constrained in the next year is about 50 percent. The conditional likelihood is remarkably stable over different values of n. Meanwhile, among all households that have been upside constrained, more than half were constrained for only one year, whereas the likelihood of experiencing another episode of upside constraints is between one third and one half, depending on how many episodes of constraint the worker has already gone through. In contrast, downside constraints (shown in the lower panel) are less persistent and less likely to reoccur. The vast majority of the households ever facing binding downside constraints were constrained for only one year during the entire sample period of more than twenty years.

We then interact the upside and downside constraint dummy with two persistence dummies. The first dummy is equal to one if the constraint lasts only one year and zero otherwise; the second dummy is equal to one if the constraint lasts more than one year and zero otherwise. The results are mixed and are reported in table 10. Basically, our results do not always show a significant difference between the effects of transitory constraints, which last only one year, and the effects of persistent constraints, which last several years. However, for some specifications, such difference can be detected. For example, we find that unmarried households that are upside constrained for only one year essentially do not alter housework hours, whereas the more persistent constraints imply nearly 66 more hours in housework. Moreover, although the results discussed so far at large suggest that downside constraints do not have many significant effects on housework hours, one exception is that for married households, persistent downside constraints tend to effectively lower housework hours. Finally, the food-out ratio of married households subject to persistent upside constraints is on average significantly lower than it is for those subject to transitory constraints. Indeed, those constrained for only one year do not appear to have eaten out less than the comparable unconstrained households.

5.5 Additional Robustness Analysis

In addition to the variation of measures of home production, model specifications and econometric techniques, we implement two more robustness tests with respect to sample selections. First, we test if our results are mainly influenced by low-income households, which are oversampled by the PSID, particularly in the earlier waves that we use in the current paper. In the first wave of the survey, the nationwide representative sample has about 3,000 households and the low-income sample has about 2,000 households. We repeat the analysis of housework hours, food-out ratio and vacation time using only the households in the nationwide representative sample and their offsprings. The results are essentially unchanged. Second, we restrict the PSID sample to the workers who explicitly acknowledge that they will get extra pay if they work extra hours and the workers on hourly wage rates while removing the salaried workers. Our results are only slightly changed, and do not alter any of the conclusions.

6 Summary, Discussion and Concluding Remarks

To summarize, we have found significant effects of market work hours constraints on home production activities and leisure consumption. These effects are asymmetric and typically only detected for the upside constraints. Consistent with what a standard model predicts, households not able to work as many hours as they want to increase housework hours. However, the increase is not large enough to offset the gap between the observed and desired number of market work hours, leaving leisure time higher than in an unconstrained environment. In contrast, households not able to reduce market work hours as desired do not appear to reduce home production hours significantly. They do, however, take somewhat more vacation time. On net, they enjoy less leisure time than in an unconstrained environment. Moreover, the response to upside constraints is much more pronounced among unmarried households. These results are robust to variations of measurement metrics, model specifications, econometric techniques and are qualitatively invariant in both the PSID and the HRS data.

Why do the asymmetry and heterogeneity arise? Why do the downside constraints not affect housework hours as significantly as the upside constraints do? Why do unmarried workers react to these constraints to a greater extent? Several factors could have contributed to these puzzling patterns. First, there are fewer workers, and in fewer years, that are downside constrained. This sample scarcity could limit the precision of our estimation. However, this is unlikely to be the primary

factor because the effects of downside constraints often have either small point estimates or sizable point estimates with the wrong sign. Second, it is possible that there is a floor of housework hours, possibly due to habit or even social norms, that prevent households from reducing their housework by much. Such a housework floor may evolve over time but cannot change very rapidly. For example, one used to vacuuming his own house may not jump to use a paid maid service even when he realizes that he cannot reduce his work hours as he wants to, as long as such constraints are not very persistent. It is also possible that the floor lowers as households invest more in durable goods and household appliances. Indeed, we find that persistent downside constraints appear to have an effect more consistent with the theory. Third, because our model is at large a static one, it does not allow for additional margins a worker can react to downside constraints. As Charles and DeCicca (2007) and Paxson and Sicherman (1996) point out, one can choose to retire early or to switch employers. If a worker has planned to take these actions, the reaction of housework can be muted. Finally, there might be behavioral reasons why people resist reducing housework hours or increasing leisure consumption by a large amount.

Formal treatments of the above factors are natural candidates for our research agenda. In addition, a more careful investigation on the transition dynamics with respect to workers' entering and exiting a constrained regime is important in its own right, and will facilitate advancing our understanding of the empirical findings of this paper. With regard to the differentials between married and unmarried households, there is a large unknown area about bargaining and time allocation within a family that is not modelled in this paper but should be the subject of much future research. Moreover, it will be useful to evaluate whether and to what extent the existing equilibrium models of aggregate fluctuations that include a home production component are calibrated in a way that is consistent with the empirical results documented here.

References

[1] Aguiar, Mark and Erik Hurst (2007), "Measuring Trends in Leisure: The Allocation of Time over Five Decades," *The Quarter Journal of Economics* vol. 122 (August), pp. 969-1006.

[2] Altonji, Joseph and Christina Paxson (1988), "Labor Supply Preferences, Hours Constraints, and Hours-Wage Trade-offs," *Journal of Labor Economics* vol. 6 (April) pp. 254-76.

[3] Altonji, Joseph and Christina Paxson (1992), "Labor Supply, Hours Constraints, and Job Mobility," *Journal of Human Resources* vol. 27 (Spring) pp. 256-78.

[4] Altonji, Joseph and Emiko Usui (2005), "Work Hours, Wages and Vacation leaves," *Working Paper.*

[5] Baxter, Marianne and Urban Jermann (1999), "Household Production and the Excess Sensitivity of Consumption to Current Income," *The American Economic Review* vol. 89 (September), pp. 902-20.

[6] Becker, Gary (1965), "A Theory of the Allocation of Time," *The Economic Journal* vol. 75 (September), pp. 493-517.

[7] Benhabib, Jess, Richard Rogerson and Randy Wright (1991), "Homework in Macroeconomics: Household Production and Aggregate Fluctuations," *The Journal of Political Economy* vol. 94 (December), pp. 1166-87.

[8] Charles, Kerwin and Philip DeCicca (2007), "Hours Flexibility and Retirement," *Economic Inquiry* vol. 47 (April), pp. 251-67.

[9] Charles, Kerwin, (2008), "New Expenditure Data in the Panel Study of Income Dynamics: Comparisons with the Consumer Expenditure Survey Data," *Working Paper.*

[10] Greenwood, Jeremy, Richard Rogerson and Randy Wright (1995), "Household Production in Real Business Cycle Theory," in Thomas Cooley ed. *Frontiers of Business Cycle Research.* Princeton: Princeton University Press, 1995, pp. 157-74.

[11] Greenwood, Jeremy, Anath Seshadir and Mehmet Yorukoglu (2005), "Engines of Liberation," *Review of Economic Studies* vol. 72 (January), pp. 109-33.

[12] Honoré, Bo (1993), "Orthogonality Conditions for Tobit Models with Fixed Effects and Lagged Dependent Variables," *Journal of Econometrics* vol. 59 (September), pp. 35-61.

[13] House, Christopher, John Laitner and Dmitriy Stolyarov (2008) "Valuing Lost Home Production of Dual-earner Couples," *International Economic Review*, Vol. 49 (May 2008), pp. 701-36.

[14] McGrattan, Ellen, Richard Rogerson and Randy Wright (1997), "An Equilibrium Model of the Business Cycle with Household Production and Fiscal Policy," *The International Economic Review* vol. 35 (May), pp. 267-90.

[15] Paxson, Christina and Nachum Sicherman (1996), "The Dynamics of Dual Job Holding and Job Mobility," *The Journal of Labor Economics* vol. 14 (July), pp. 357-93.

[16] Prescott, Edward, Richard Rogerson and Joanna Wallenium (2009), "Lifetime Aggregate Labor Supply with Endogenous Workweek Length," *Review of Economic Dynamics* vol. 12 (January), pp. 23-36.

[17] Ríos-Rull, José-Víctor (1993) "Working in the Market, Working at Home, and the Acquisition of Skills: A General Equilibrium Approach" *American Economic Review* vol. 83 (September), pp. 893-907.

[18] Roberts, Kristen and Peter Rupert (1995), "The Myth of the Over Worked American," *Economic Commentary Federal Reserve Bank of Cleveland* 1995 (January).

Table 1: Variables definition and availability

Definition	PSID	HRS
Head Upside Constrained — Wanted to work more hours but were not able to (UC)	1967 - 1986	All waves
Head Downside Constrained — Wanted to work fewer hours but were not able to (DC)	1967 - 1986	All waves
Wife Upside Constrained — Same as head	1970 - 1975	All waves
Ideal number of market hours	NA	All waves
Hours spent on housework by head and wife (HWHead, HWWife)	1968 - 1986	NA
Ratio between food consumed out and total food expenditure (Food-out ratio)	1969 - 1986 except 1973	All waves except 1998
Number of vacation weeks taken (Weeks)	1967 - 1986	NA

The PSID data availabilities refer to the waves of 1968 – 1986. The HRS data have eight waves, every other year from 1992 to 2006.

Table 2: Summary Statistics

	Upside Constrained		Downside Constrained		Not Constrained	
	PSID	HRS	PSID	HRS	PSID	HRS
Percentage sample observations	19.3	10.6	5.7	9.0	75.1	80.4
Percentage sample households	46.2	19.4	18.7	15.2	54.3	67.5
By how many hours	NA	454	NA	664	NA	0
	NA	(354)	NA	(393)	NA	(0)
Demographic Characteristics						
White (%)	79.4	82.0	87.9	87.5	88.6	87.3
Below high school (%)	38.1	17.9	25.6	12.8	26.2	14.2
High school graduate (%)	22.3	37.5	19.9	35.2	18.5	30.9
Some college and college (%)	39.6	44.7	54.3	52.0	55.2	54.9
Married (%)	72.7	54.2	70.2	63.8	72.2	65.1
Age	39.4	56.1	42.7	57.0	42.0	57.6
	(10.4)	(4.5)	(11.4)	(4.3)	(11.3)	(4.9)
Family size	3.49	2.47	2.96	2.33	3.11	2.42
	(1.85)	(1.37)	(1.55)	(1.22)	(1.67)	(1.23)
Income and hours worked						
Family income($thousand)	27.4	29.6	36.7	42.6	35.7	42.9
	(15.0)	(24.1)	(18.6)	(31.7)	(20.2)	(35.9)
Head hours worked	1,959	1,972	2,182	2,181	2,115	2,014
	(377)	(431)	(387)	(342)	(399)	(518)
Wife hours worked	651	664	599	808	625	778
	(831)	(937)	(813)	(981)	(828)	(954)
Home production and vacation time						
Unmarried food-out ratio (%)	23.0	21.8	29.3	27.2	29.1	27.0
Married food-out ratio (%)	13.9	22.9	17.4	26.9	17.3	27.0
Unmarried head housework hours	658	NA	580	NA	591	NA
	(494)		(440)		(446)	
Married head housework hours	277	NA	248	NA	251	NA
	(362)		(329)		(316)	
Wife housework hours	1396	NA	1411	NA	1358	NA
	(672)		(677)		(667)	
Unmarried Head Vacation weeks	2.20	NA	2.63	NA	2.95	NA
	(2.76)		(2.66)		(3.55)	
Married Head Vacation weeks	2.00	NA	2.69	NA	2.67	NA
	(2.26)		(2.08)		(2.68)	

All statistics are computed using the PSID and HRS weights. Standard deviations of continuous variables are reported in parenthesis.

Table 3: Effects of market work hours constraints on housework hours – Cross-section Analysis

Sample	Unmarried	Unmarried	Married	Married	Married	Married
Model	OLS (1)	Tobit (2)	OLS (Head) (3)	Tobit (Head) (4)	OLS (Wife) (5)	Tobit (Wife) (6)
β_u	52.93***	54.12***	18.34***	26.24***	0.15	0.36
	(9.87)	(10.38)	(4.56)	(6.60)	(8.31)	(8.41)
β_d	7.08	6.46	-1.78	-13.72	46.53***	47.25***
	(18.08)	(19.00)	(8.47)	(12.25)	(15.45)	(15.63)
childage2	198.45***	195.38***	40.75***	53.10***	181.16***	182.41***
	(23.27)	(24.38)	(4.52)	(6.43)	(8.24)	(8.34)
childage6	130.44***	128.64***	19.78***	22.72***	123.80***	124.06***
	(12.46)	(13.07)	(3.20)	(4.68)	(5.84)	(5.92)
childage12	93.04***	91.80***	3.68	-5.76	71.59***	71.05***
	(7.11)	(7.47)	(2.33)	(3.52)	(4.26)	(4.31)
childage18	44.82***	43.70***	-13.57***	-36.13***	36.99***	36.14***
	(6.17)	(6.50)	(2.48)	(3.78)	(4.52)	(4.58)
adults	-2.08	-11.30	-8.68***	-22.92***	31.54***	30.79***
	(6.76)	(7.16)	(3.31)	(5.02)	(6.04)	(6.12)
head age	14.58***	13.00***	-4.66**	-6.30*	0.32	-0.87
	(3.37)	(3.54)	(2.29)	(3.30)	(4.17)	(4.24)
head age^2/100	-12.51***	-10.67***	6.32**	8.58**	0.93	2.27
	(3.92)	(4.13)	(2.67)	(3.88)	(4.86)	(4.94)
white	-35.50***	-37.22***	-36.38***	-39.93***	147.59***	149.30***
	(9.34)	(9.82)	(4.53)	(6.53)	(8.26)	(8.36)
high school	-4.34	-3.85	20.45***	46.38***	26.34***	27.32***
	(11.95)	(12.57)	(5.51)	(8.02)	(10.05)	(10.17)
some college	-19.19*	-16.26	41.39***	77.04***	-11.71	-11.63
	(11.07)	(11.64)	(5.26)	(7.60)	(9.59)	(9.71)
college	-99.36***	-95.80***	41.23***	93.01***	-52.76***	-53.10***
	(14.68)	(15.44)	(6.80)	(9.69)	(12.40)	(12.55)
disability	-5.89*	-6.59*	-2.60	-4.55*	6.27**	6.20**
	(3.26)	(3.43)	(1.66)	(2.43)	(3.03)	(3.06)
real wage	-6.82***	-7.00***	-1.30***	-2.54***	2.36***	2.38***
	(1.52)	(1.60)	(0.44)	(0.67)	(0.81)	(0.82)
head female	237.20***	271.10***				
	(9.66)	(10.22)				
control for wife information?	no	no	yes	yes	yes	yes
control for income deciles?	yes	yes	yes	yes	yes	yes
control for year FE?	yea	yes	yes	yes	yes	yes
R-squared	0.187		0.116		0.233	
N	11801	11801	30530	30530	30530	30530

Data source: PSID. 90% 95% and 99% statistical significance are denoted by *, ** and ***, respectively.

Table 4: Effects of market work hours constraints on housework hours – Longitudinal Analysis

Sample	Unmarried	Unmarried	Married	Married	Married	Married
Model	Linear FE	RE Tobit	Linear FE (Head)	RE Tobit (Head)	Linear FE (Wife)	RE Tobit (Wife)
	(1)	(2)	(3)	(4)	(5)	(6)
β_u	19.81*	28.53***	14.41***	25.15***	-0.27	0.50
	(10.59)	(10.07)	(4.78)	(6.40)	(8.67)	(8.05)
β_d	17.80	19.08	-7.87	-15.80	8.97	22.46
	(18.71)	(18.01)	(8.44)	(11.50)	(15.30)	(14.56)
N	10694	10694	29842	29842	29842	29842

Data source: PSID. 90% 95% and 99% statistical significance are denoted by *, ** and ***, respectively.

Table 5: Predicted gaps of constrained workers

	Upside Constrained		Downside Constrained	
Marital Status	Market work (hours)	Housework (hours)	Market work (hours)	Housework (hours)
Married	-101.6	17.6	65.6	-0.3
Single	-79.0	35.7	77.7	-5.4
Marital Status	Market work (hours)	Food-out ratio (%)	Market work (hours)	Food-out ratio (%)
Married	-103.0	-0.63	63.6	-0.06
Single	-78.3	-1.23	82.6	1.16

Gaps are calculated as the realized hours minus the counterfactual unconstrained optimal hours. The estimated market hour gap vary slightly for housework and food-out ratio analysis mainly due to the minor differences of samples used.

Table 6: Effects of market work hours constraints on food-out ratios – PSID Sample

Sample	Unmarried	Unmarried	Married	Married	Unmarried	Unmarried	Married	Married
Model	OLS	Tobit	OLS	Tobit	Linear FE	RE Tobit	Linear FE	RE Tobit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_u	-1.56***	-1.91***	-0.77***	-0.93***	-0.64	-1.37**	-0.27*	-0.51***
	(0.43)	(0.57)	(0.16)	(0.19)	(0.46)	(0.57)	(0.16)	(0.18)
β_d	0.89	1.24	-0.09	-0.04	0.86	0.95	-0.19	-0.13
	(0.80)	(1.04)	(0.31)	(0.36)	(0.83)	(1.00)	(0.29)	(0.33)
childage2	-3.98***	-4.73***	-3.21***	-3.73***	-2.82**	-4.55***	-2.84***	-3.61***
	(1.03)	(1.37)	(0.16)	(0.19)	(1.38)	(1.44)	(0.17)	(0.18)
childage6	-3.49***	-4.06***	-2.03***	-2.41***	-2.04**	-4.25***	-1.67***	-2.38***
	(0.57)	(0.76)	(0.12)	(0.14)	(0.80)	(0.82)	(0.13)	(0.14)
childage12	-3.25***	-4.79***	-1.66***	-2.22***	-1.87***	-4.50***	-1.33***	-2.07***
	(0.31)	(0.43)	(0.09)	(0.11)	(0.43)	(0.48)	(0.11)	(0.11)
childage18	-1.92***	-3.35***	-1.76***	-2.37***	-1.41***	-2.79***	-1.61***	-2.25***
	(0.27)	(0.38)	(0.09)	(0.11)	(0.36)	(0.41)	(0.11)	(0.11)
adults	-3.41***	-5.09***	-1.54***	-2.19***	-1.65***	-3.78***	-1.01***	-1.61***
	(0.30)	(0.41)	(0.12)	(0.15)	(0.40)	(0.46)	(0.14)	(0.15)
head age	-0.74***	-0.85***	-0.31***	-0.23**	0.21	-0.90***	0.00	-0.39***
	(0.15)	(0.19)	(0.08)	(0.10)	(0.39)	(0.24)	(0.19)	(0.13)
head age^2/100	0.45***	0.44**	0.31***	0.18	-0.18	0.47*	0.25	0.40***
	(0.17)	(0.22)	(0.10)	(0.12)	(0.28)	(0.28)	(0.18)	(0.15)
white	5.19***	7.41***	0.79***	1.62***	-0.67	8.37***	1.12	2.66***
	(0.41)	(0.53)	(0.16)	(0.19)	(3.22)	(0.85)	(0.98)	(0.33)
highschool	0.75	2.13***	0.98***	1.74***	0.91	1.23	-0.44	0.75**
	(0.52)	(0.69)	(0.20)	(0.24)	(0.92)	(0.88)	(0.32)	(0.30)
somecollege	0.75	2.33***	1.32***	2.10***	1.13	1.69**	-0.02	1.41***
	(0.48)	(0.63)	(0.19)	(0.22)	(0.86)	(0.82)	(0.30)	(0.28)
college	2.47***	3.43***	1.57***	2.28***	-0.87	1.01	-0.41	1.70***
	(0.64)	(0.82)	(0.25)	(0.28)	(1.17)	(1.06)	(0.41)	(0.37)
disability	0.21	0.45**	0.04	0.08	0.17	0.42**	-0.02	0.03
	(0.14)	(0.19)	(0.06)	(0.07)	(0.18)	(0.21)	(0.07)	(0.07)
real wage	0.20***	0.21**	0.07***	0.08***	0.29***	0.36***	0.00	0.07***
	(0.07)	(0.09)	(0.02)	(0.02)	(0.09)	(0.09)	(0.02)	(0.02)
head female	-11.57***	-13.19***			0.00	-13.57***		
	(0.42)	(0.55)			.	(0.89)		
control for wife information?	no	no	yes	yes	no	no	yes	yes
control for income deciles?	yes	yes	yes	yes	yes	yes	yes	yes
control for year FE?	yea	yes	yes	yes	yes	yes	yes	yes
R-squared	0.269		0.199		0.019		0.072	
N	12971	12971	33330	33330	11809	11809	32573	32573

Data source: PSID. 90%, 95% and 99% statistical significance are denoted by *, ** and ***, respectively.

Table 7: Effects of market work hours constraints on food-out ratios – HRS Sample

Sample	Unmarried	Unmarried	Married	Married	Unmarried	Unmarried	Married	Married
Model	OLS	Tobit	OLS	Tobit	Linear FE	RE Tobit	Linear FE	RE Tobit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_u	-3.25***	-3.97***	-2.48**	-3.60***	-1.17*	-1.34*	-0.62	-1.18*
	(0.71)	(0.87)	(0.80)	(0.80)	(0.54)	(0.59)	(0.57)	(0.53)
β_d	-0.16	-0.00	-1.62	-1.03	-0.55	-0.51	-0.41	-0.53
	(0.86)	(1.04)	(1.00)	(0.97)	(0.55)	(0.61)	(0.60)	(0.55)
N	5450	5450	5450	5450	10081	10081	10081	10081

Data source: PSID. 95%, 99% and 99.9% statistical significance are denoted by *, ** and ***, respectively.

Table 8: Effects of market work hours constraints on vacation weeks – PSID Sample

Sample	Unmarried	Unmarried	Married	Married	Unmarried	Unmarried	Married	Married
Model	OLS	Tobit	OLS	Tobit	Linear FE	RE Tobit	Linear FE	RE Tobit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β_u	-0.03	0.03	-0.19***	-0.26***	0.12**	0.14**	-0.04	-0.09***
	(0.06)	(0.08)	(0.03)	(0.04)	(0.06)	(0.07)	(0.03)	(0.03)
β_d	-0.15	-0.00	0.01	0.10	0.14	0.24*	0.07	0.13**
	(0.11)	(0.14)	(0.06)	(0.07)	(0.11)	(0.13)	(0.05)	(0.06)
childage2	-0.13	-0.30*	-0.01	-0.02	-0.10	-0.33*	-0.07**	-0.09***
	(0.14)	(0.18)	(0.03)	(0.04)	(0.17)	(0.19)	(0.03)	(0.03)
childage6	-0.10	-0.12	-0.01	-0.03	-0.14	-0.25**	-0.03	-0.06**
	(0.07)	(0.10)	(0.02)	(0.03)	(0.10)	(0.10)	(0.02)	(0.02)
childage12	-0.09**	-0.12**	-0.06***	-0.09***	-0.02	-0.11**	-0.07***	-0.10***
	(0.04)	(0.05)	(0.01)	(0.02)	(0.05)	(0.06)	(0.02)	(0.02)
childage18	-0.09**	-0.15***	-0.07***	-0.12***	-0.00	-0.09*	-0.08***	-0.14***
	(0.04)	(0.05)	(0.02)	(0.02)	(0.05)	(0.05)	(0.02)	(0.02)
adults	0.15***	0.12**	0.01	-0.03	-0.05	-0.10*	-0.00	-0.06**
	(0.04)	(0.05)	(0.02)	(0.03)	(0.05)	(0.06)	(0.02)	(0.03)
head age	0.04**	0.08***	0.02*	0.03*	-0.00	0.06*	0.03	0.05**
	(0.02)	(0.03)	(0.01)	(0.02)	(0.05)	(0.03)	(0.03)	(0.02)
head age^2/100	-0.03	-0.06**	-0.02	-0.03	-0.04	-0.04	-0.09***	-0.07**
	(0.02)	(0.03)	(0.02)	(0.02)	(0.04)	(0.04)	(0.03)	(0.03)
white	0.12**	0.21***	0.14***	0.19***	0.04	0.45***	-0.07	0.33***
	(0.05)	(0.07)	(0.03)	(0.04)	(0.43)	(0.12)	(0.16)	(0.07)
highschool	0.20***	0.34***	0.17***	0.30***	-0.10	0.15	0.01	0.19***
	(0.07)	(0.09)	(0.04)	(0.04)	(0.12)	(0.12)	(0.06)	(0.06)
somecollege	0.28***	0.37***	0.22***	0.35***	0.06	0.26**	0.03	0.21***
	(0.06)	(0.08)	(0.03)	(0.04)	(0.11)	(0.11)	(0.05)	(0.05)
college	1.95***	2.18***	1.06***	1.25***	-0.09	1.20***	0.01	0.66***
	(0.08)	(0.11)	(0.04)	(0.05)	(0.16)	(0.14)	(0.07)	(0.07)
disability	0.10***	0.16***	0.01	0.03**	0.03	0.09***	0.00	0.02
	(0.02)	(0.03)	(0.01)	(0.01)	(0.02)	(0.03)	(0.01)	(0.01)
real wage	0.22***	0.26***	0.06***	0.07***	0.12***	0.20***	0.05***	0.07***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)
female head	0.93***	1.47***			0.00	1.37***		
	(0.06)	(0.07)			.	(0.12)		
control for wife information?	no	no	yes	yes	no	no	yes	yes
control for income deciles?	yes	yes	yes	yes	yes	yes	yes	yes
control for year FE?	yea	yes	yes	yes	yes	yes	yes	yes
N	14595	14595	38518	38518	13075	37358	37353	37353

Data source: PSID. 90%, 95% and 99% statistical significance are denoted by *, ** and ***, respectively.

Table 9: Persistence of hour restrictions

Number of consecutive constrained years	Fraction of Households	Number of periods of being constrained	Fraction of Households
	Upside Constrained		
1	24.63%	1	24.40%
2	10.50%	2	11.86%
3	5.01%	3	5.56%
4	2.77%	4	2.86%
5	1.44%	5	1.07%
6	0.80%	6	0.36%
	Downside Constrained		
1	12.96%	1	13.38%
2	2.69%	2	3.81%
3	0.99%	3	0.98%
4	0.21%	4	0.40%
5	0.15%	5	0.09%
6	0.06%	6	0.00%

Table 10: Effects of Constraints by Persistency

	Upside Constrained			Downside Constrained		
	persist	not persist	F-test	persist	not persist	F-test
Housework hours (married)	17.4	23.4	0.36	-25.7	5.5	3.36*
	(4.9)	(9.4)	p = 0.55	(12.2)	(12.1)	p = 0.07
Housework hours (unmarried)	65.6	0.66	10.7***	4.3	-33.5	1.03
	(10.7)	(18.1)	p < 0.01	(28.3)	(24.9)	p = 0.31
Food-out ratio (married)	-0.91	-0.06	5.17**	-0.01	0.16	0.07
	(0.18)	(0.35)	p = 0.02	(0.46)	(0.46)	p = 0.79
Food-out ratio (unmarried)	-1.76	-1.19	0.40	0.57	2.25	1.00
	(0.50)	(0.83)	p = 0.53	(1.26)	(1.14)	p = 0.32

Data source: PSID. 90%, 95% and 99% statistical significance of the F-test are denoted by *, ** and ***, respectively. Standard errors of the estimated coefficients are reported in the parenthesis.