Why are Married Men Working So Much? The Macroeconomics of Bargaining Between Spouses*

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Abstract

The rise in per-capita labor over the last 30 years is difficult to explain in a standard macroeconomic model because rising wages of women should have lead to a large rise in husband's leisure. This paper argues that home production and bargaining are both essential for understanding these trends, and develops an equilibrium model of marriage and bargaining. Calibration to US data suggests that the bargaining position of husbands has deteriorated with the closing of the gender gap in wages, that the decline of home-equipment prices plays a role in the rise in per-capita hours, and that the labor trends are consistent with stationarity along a balanced-growth path.

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1 Introduction

The observation that there is no trend in average working hours is very prominent on the short list of 'stylized facts' that economists have traditionally relied upon to justify the assumption that economies tend to a balanced growth path. Stationarity of hours plays a key role not only in growth theory but also in real business cycle models. Over the last 30 years however it has become apparent that in fact average hours of paid work are increasing. Figure 1 shows annual observations of weekly hours worked since 1962 based on the March CPS for the civilian non-farm population aged 18-65. Until 1972, average weekly paid working time remained below 23 hours; since that time the trend was clearly positive until the peak above 27 hours in 2001. Other papers that remark on the recent rise in per capita working hours include Prescott (2004), who sees the effect of tax reform in the 1980s, and Galí (2005), who sees a challenge to the view that technology shocks cause business cycles. [1]

Figure 2 shows that the trend in hours is entirely due to an increase in women's hours, from an average of 12 hours per week in 1965 to about 23 by the year 2000. Men's hours actually decline slightly over the first half of the period, and then remain stationary. Is it possible that the rise in hours is explained by changes in composition of the population? Since married women tend to work less than single women, the fact that the share of the population that is currently married has fallen significantly over the same time period could account for the rise in hours. Tabulation of the data by year and marital status shows that the declining share of married couples explains only 9% of the per-capita trend, and that 80% of the remainder is explained by a rise in average work hours of married women. An understanding of the trend in per

[1] McGrattan and Rogerson (2004) also remark on this trend, but, taking a longer view, argue that per capita hours were nearly as high in 1950 as they were in 1990. Their statement is based on the population aged 15 and older. This wider range of ages brings in people, such as school-age children, and extremely old people, who may not be able to choose working hours freely. The population I consider is the same as that of Prescott.

capita hours requires therefore an understanding of the change in behavior of married couples. The problem is that in the typical macro model there are no married couples, indeed there are no people, only households.

The logical response to this problem is to write down a model of married-couple households with preferences given by a weighted sum of the utility of the spouses. Almost all macro models that allow for the existence of married people, as opposed to a married household, follow this "unitary" approach, meaning that the household is assumed to behave as a rational entity with a stable utility function. The main alternative to this approach are models based on bargaining between spouses. However macro papers based on this latter approach tend to address questions less closely related to the mainstream of macroeconomics, such as the determination of fertility or marriage or divorce rates. As a result the rich literature on bargaining within married couples that has grown up since McElroy and Horney (1981) and Manser and Brown (1980) has been largely ignored by macroeconomists. Until it can be demonstrated that the more complicated bargaining model can make quantitatively significant contributions to macroeconomics, this situation seems likely to continue.

Jones, Manuelli, and McGrattan (2003) show that the unitary household model can explain the rise in women's labor supply since 1950 in response to the trend in the female-male wage ratio. The trend in this ratio can be seen in Figure 3, which shows that for people working 10 hours or more weekly, the ratio of men's median wage to women's fell from 1.7 to 1.2. While it is possible in principle that much of the closing of the gender gap in wages can be explained by a rise in the productivity of working women, previous research seems to imply there has indeed been a significant rise in women's wages. Blau and Kahn (2000) for instance find that even in the late 1980s, human capital differences explained about a third of the gender gap. They find that the unexplained gender gap declined in the 1980s, and argue this could have been due either to a rise in unmeasured factors in women's productivity, such as improved k-12 education, as indicated by higher SAT scores, or to a decline in discrimination. For

our purposes, there is no need to distinguish between these theories of the decline of the gender gap; the important point is that married women can potentially have much higher earnings than they did in the past. However Jones, Manuelli, and McGrattan (2003) find that calibration of their unitary model, which includes home production and wage dynamics, to US data leads to the prediction that married men's labor supply should have fallen, by somewhere between 5-8 hours weekly. Figure 4 shows that working hours of married men remained absolutely stationary over the 1962-2006 period.

In this paper, I argue that bargaining is essential to understanding the rise in per capita hours. I show that while it is indeed possible to match this trend in a unitary model, by introducing a home-production technology with inputs that can be substituted for women's time, such as husband's time and home equipment, such a model implies a large decline in husband's market labor, and this we did not see in the CPS data over the period in question. In a simple extension of the standard model to allow for bargaining between spouses, the failure of husband's paid labor to fall over time is explained by a negative trend in the bargaining position of married men relative to that of their wives. This paper shows that such a model can be both tractable and consistent with the trends in aggregate labor, even for log preferences, a typical example of the CRRA class usually employed so that hours remain constant along the balanced growth path. The essential assumptions are Pareto-optimality of the married-couples allocation, separability of preferences between consumption and leisure, and bargaining positions of spouses that are increasing in their own wages.

With bargaining, the main theoretical result is that for married men's relative leisure not to rise when their relative wage falls requires that single life be sufficiently attractive to women, be it because they have high wages or because there is a large enough non-pecuniary benefit of single life. Thus the reason married men's leisure failed to increase in response to the closing of the gender gap in wages is that higher wages have made it relatively easy for their wives to walk away from the marriage,

and thus enhanced the wive's bargaining position. A calibrated version of the model generates about 60% of the observed rise in per capita hours, and yet per-capita hours in the model barely budge in response to a rise in TFP comparable to that observed in manufacturing since the 1970s. We conclude therefore that the trend in per capita hours is perfectly consistent with the stationarity implied by the balanced-growth path in the standard growth and business cycle models.

The individual-level labor-supply analysis developed here is in the spirit of the household bargaining literature deriving from Manser and Brown (1980) and McElroy and Horney (1981), which is surveyed in Lundberg and Pollak (1996) and Bourguignon and Chiappori (1994). An extension to include home production is described in Chiappori (1997). However, the current paper is the first to derive labor supply when the outside options are endogenously determined through equilibrium in the marriage market. In this sense, the paper is closely related to Greenwood, Guner, and Knowles (2003), who compute labor supply and equilibrium marriage rates when allocations are given by the Nash bargaining solution. Other papers on the equilibrium analysis of marriage and female labor supply also appear to be limited to computational results, as in Caucutt, Guner, and Knowles (2002) and Regalia and Ríos-Rull (1999).. On the other hand, analytical results are obtained by Chiappori and Weiss (2000) and Chade and Ventura (2002), who develop simple equilibrium-marriage models comparable to that of the current paper. Their concerns are very different however; the former focuses on optimal divorce contracts, the latter on the effect of taxes on search behavior. Neither model allows for labor-supply decisions, and assumes instead that the gains from marriage are exogenous.

The implications for household bargaining of the relative-leisure trend in the US data is also the subject of a simultaneous paper, Bech-Moen (2006) , who shows that a similar trend also holds in Norwegian data. That paper relies on a Nash-bargaining solution concept, and hence relies more on numerical analysis, and does not consider the possibility of corner solutions or the implications of trends in home technology.

The current paper by contrast makes the point that while the trend in wages *could* explain labor supply trends, in fact other trends, such as in home technology, are also important. In this sense the current paper is also related to Greenwood, Seshadri, and Yorukoglu (2005), who argue that improvements in home technology were critical for women's labor supply trends through the first half of the 20th century.

The rest of the paper is divided into seven parts: an empirical analysis in Section 2, followed by an analysis of the unitary model in section 3, then an analysis of the allocation of leisure in the bargaining model. Section 5 presents the quantitative implications when the model is calibrated to US data. The conclusion contains a summary of the results.

2 Trends in Time Allocation

This section documents the trends in aggregate labor supply alluded to in the introduction. We begin by documenting the trends in aggregate labor supply, using data from the March CPS. The theoretical analysis in the next section will focus on the allocation of leisure; when unpaid working time is variable, this requires the empirical analysis to account for trends in unpaid work time. Gershuny and Robinson (1988) document that women do much less housework than they used to in the 1960s, while men do somewhat more than they used to. Therefore this component may be critical for understanding labor supply trends.

Since unpaid work time is not documented in the CPS, we begin by looking at a sequence of time-use surveys for the US carried out intermittently between 1965 and 2003. These reveal that the major categories of unpaid work time are work at home, including child care, and job-related activities, such as commuting between work and home. With respect to computing time trends, these surveys suffer from several major problems: neither the sampling frame nor the variable definitions are consistent over time, and there is almost no information about the spouses of the respondents. More

to the point, the trends in market hours of married people according to these surveys is significantly different from the hours trend in the CPS. Fortunately, we can appeal to a third data set, the PSID, which has data on both market and housework hours, though the latter are much less comprehensive than those of the time use surveys. It turns out that the trends in market hours according to the PSID are similar to those of the CPS. It seems reasonable therefore to combine the two sources of information by using the time use surveys to impute unpaid work from the housework and other variables available in the PSID.

We then analyze the trends in non-working time for married couples. We define this as the total time endowment of 168 hours per week, less 50 hours for the non-discretionary portion of personal-care activities like sleep, less total working time. The main finding is that there is a significant positive trend in non-working time of wives relative to husbands, due to a small decline in married-women's total working hours, and a slight increase in those of married men. We also discuss how these findings relate to previous research on leisure.

2.1 Market Labor Supply Trends: CPS

The data consists of the March Supplement of the CPS, from 1962 to 2006. The population is restricted to civilians age 18 to 65 who are not employed in the farm sector. These restrictions make the sample similar to that reported in the Employment and Earnings publication of the U.S. Department of Labor, Bureau of Labor Statistics. Younger people are likely to be constrained by compulsory schooling, and older people by mandatory retirement, social security rules, and disabilities. The weekly hours variable is computed as the product of hours worked last week and number of weeks worked last year. [2] The average weekly hours worked in 1970-75 was 22.0. For the

[2]Before 1967, weeks worked is reported in intervals only. The intervals variable is available in all years. Therefore for each analysis group, we replace these intervals with the mean computed over the period 1967-1976 for similar workers who reported the same interval in the later period.

period 1995-2000, this had risen to 26.6 weekly hours. Figures 1 to 4 were drawn from this sample, and were discussed in the introduction.

Table 1 shows weekly paid hours by sex and marital status. For married women it is clear that average weekly hours of paid labor increased steadily, from an average of 9.1 in the 1962-65 period to 11.6 in the 1969-74 period, 17.8 in the 1984-90 to 21.2 in 1994-2001. For single women, there is also a constant trend, but it is much smaller: from 17.4 hours in 1962-75 to 22.32 hours in the 1990s. For single men, the trend is similar, from 20 hours to 25.3. For married men, there is no trend at all; hours remained in the 35-37.1 range throughout. The numbers in the table imply that only 9% of the change in hours can be attributed to changes in demographic composition; of the remaining 91%, almost all (93%) is due to changes in women's labor supply, and mostly (80%) due to that of married women.

Figure 5 shows age-hours profiles for 10-year birth cohorts of married men and women. Those for women rise significantly with each successive cohort; by 3 hours at age 30 when we move from the 1930s to the 1940s cohorts, by an additional 7 hours to the 1950s cohort, and by another 3 hours from the 1950s to the 1960s cohort. In contrast, the age-hours profiles of married men are essentially identical over all cohorts. This also means that there is no question here of substitution of labor time across the lifecycle in response to changes in married women's roles: the shape of the men's profiles do not change systematically as we move across cohorts.

The essential point is that there is no negative trend in husband's hours to accompany the positive trend in the wife's hours. Of course it is possible that trends in paid hours do not accurately reflect trends in working time because there may be a negative trend in time spent in unpaid work. Therefore we must consider trends in how time is allocated outside of paid work. Since the CPS has no information on unpaid work, this requires a new source of data.

2.2 Non-Working time: The PSID and Time-Use Surveys

There are two sources of data on unpaid time use in the US that cover the period of interest; the Panel Study of Income Dynamics and the collection of dedicated time-use surveys that eventually evolved into the 2003 American Time-Use Survey. Neither of these datasets are ideal for the purpose of measuring trends in relative home hours of married people but because they differ in their strengths and weakness, they turn out to be highly complementary. One data set is consistent over time and with the CPS but lacks sufficient detail on unpaid work, while the other has comprehensive data on unpaid work, but does not seem to be consistent over time or with the CPS. The purpose of this section is to describe trends in unpaid work and non-working time using measures that rely on combined information from both sources of data. The details of the motivation and creation of these measures are described in the appendix.

There are five major time use surveys: 1965-1966 Americas' Use of Time; 1975-1976 Time Use in Economics and Social Accounts; 1985 Americans' Use of Time; 1992-1994 National Human Activity Pattern Survey; and the 2003 American Time Use Survey. We will use these surveys to impute unpaid work, excluding the 1992-1994 survey because it does not include marital status. Because of inconsistent design over the years, comparison of variables from the time-use surveys requires standardization of activities into consistent categories. Results for this type of exercise are reported by Robinson and Godbey (1997) and Aguiar and Hurst (2007); the analysis draws on the variables constructed by the latter. These surveys are the only source of information on home production time apart from cooking and cleaning, notably child care and shopping time. This is important because it is well-known (see Gershuny and Robinson (1988)) that married-couple's allocation of home-production time has shifted radically since the 1960s. The appendix includes a more detailed analysis of the time trends in these surveys.

If one variable should be consistent over time in these surveys, it is paid work

hours. Table 2 however reveals wide disparities between this variable and the trends documented by the CPS. The time-use surveys overstated paid work of married women by about 20% in 1965 and again in 1975, finally getting it right in 2003, when the methodology was overhauled. Husband's hours are overstated by nearly 5 hours in 1965, and by 3 hours in 1975. Relative to the trends with which this paper is concerned, these disparities are significant. The raw data is therefore unsuitable for explaining aggregate trends in the CPS. The trick therefore is to find a way to exploit the richness of the time data in these surveys such that the employment series is consistent with the CPS. While the analysis of work time at home is an obvious reason to do this, another is that the time-use surveys show that unpaid job-related activities are significant; this is reflected in the Total Job Hours' column of Table 2. Total time spent in job-related activities is about 20% higher than time spent in paid labor.[3]

The appeal of the PSID is that it is consistent over time, in the sense that the same questions are asked every year, it has information on spouses, and it has measures of both market work and housework. The drawbacks are that these measures are quite crude, consisting of one question for each category of work per spouse, and there is no way to be certain what types of activities the responses include. With respect to market work, the annual averages in the PSID correspond very well with those of the CPS, as is shown in Figure 6, where the trend lines for the two surveys are virtually identical.

The housework variable in the PSID is the response to the question: "About how much time does your (wife/"WIFE") spend on housework in an average week? I mean time spent cooking, cleaning, and doing other work around the house." A similar question is asked for husbands. This is not an ideal instrument in many ways, particularly as the interpretation of housework may vary across sexes, and over time. Furthermore, while cooking and cleaning are important categories of unpaid labor,

[3]This type of activity includes commuting and unpaid meal times.

other important categories, such as time spent in childcare, shopping or commuting are not explicitly included.

The procedure by which the measures of unpaid time analyzed in this section are generated consists of estimating in the time-use survey data a regression model of unpaid work as a function of the variables that are also present in the PSID, including housework. The estimated coefficients are then used to project time use in the PSID sample. Although crude, the reliability of the procedure stems from the availability of the hours variables in the PSID, which turn out to be excellent predictors of unpaid work. Furthermore, the analysis in this section is purely in terms of aggregates; as there is no analysis at the level of the individual household, we are unconcerned about how well the measures reflect idiosyncratic variation.

The sample is drawn from the household heads and spouses in the representative cross-section sample of the PSID. To be included in the sample, respondents must be aged 18-65 for the years 1969-2001, excluding two years in which home hours were not recorded, 1975 and 1982, as well as two years in which the survey was not carried out, 1998 and 2000. . To be included in the sample for a given year, there must be no missing or implausible responses regarding market and home hours for that year.[4] There are no cross-year restrictions. The analysis in this section is based on two time intervals, 1969-74 and 1994-2001. The sample consists of 80840 observations over these two period, where an observation consists of a household-year.

The measures of unpaid work that the analysis is based on include paid market hours, which is a PSID variable, and two variables that are projections, using the time-use surveys, based on the method described in the appendix: unpaid market hours, and home hours. Unpaid market hours are not reported in the PSID, but in the time-use surveys consist mainly of time spent commuting and unpaid meal times on the job. Home hours include in addition to time spent cooking and cleaning, time spent

[4]To eliminate implausible responses, we drop all observations where the predicted home hours are in either the top or the bottom percentiles for the sample by sex.

in child care, shopping, and home or vehicle repair. As explained in the appendix, we construct time series for total housework (including child-care and shopping time) and job-related activities by estimating regression models of these variables in the time-use surveys. The explanatory variables are restricted to those also available in the PSID. Fortunately, the type of housework that the PSID housework variable seems to reflect is a very good predictor of total housework including childcare, and time in job- related activities is well predicted by time spent in paid work. We then use these estimated coefficients to predict non-paid working time for married couples. Combined with the hours spent in paid labor according to the CPS, these variables sum to total working time.

The sample statistics for time use and family composition by sex, marital status and time period are reported in Table 3. Between 1969-74 and 1994-2001, total time in market work fell by nearly two hours for husbands, from 49.7 to 48.0 hours and rose by slightly more than 12 hours for wives, from 16.8 to 29.4. The decline for husbands was due to unpaid hours, which fell from 10.7 to 8.0 weekly hours, while the increase for wives was nearly all paid hours, which rose from 14 to 25. For single men total market time, rose from about 42 hours weekly to 43, and for single women an increase of about 5 hours, from 32 to 37 hours. The importance of non-paid market hours indicates that the rise in per capita hours in the CPS is somewhat overstated.

House work for husbands rose by about six hours, from 12.7 to 18.7 weekly hours. [5] For wives, home hours fell 13 hours, from 45.4 to 32.6. For single men home hours increased by 1.5 hours, and for single women they fell by 2.5 hours, from 23.1 to 20.7 weekly hours. Thus the large changes in home hours (about -33% for wives, +50% for husbands) appear to be confined to married couples.

What do these trends imply for non-working time? We define total discretionary

[5] One weakness of the method is that husband's home hours are likely to be quite responsive to the wife's market work status, but this variable is not available in all years of the time-use surveys. Thus the trend in husband's home hours is likely to be underestimated.

time as 168 hours minus a minimum maintenance time of 50 hours weekly. This is somewhat arbitrary, but we know that there is some minimum that is required to function, and in the time-use surveys, only 1% of the sample report spending less than the equivalent of 50 hours weekly on sleep and other personal care. Combined home hours and market hours, according to the table, imply that married people in the 1970s had equal non-working hours, about 55.5 hours. The numbers for the 1990s indicate a decline of about 4 hours in husbands non-working time, while that of wives appears to have stayed constant.. The rise in the ratio of wife's to husbands non-working time is therefore on the order of 7%, though one should bear in mind that this is sensitive to the assumption regarding non-discretionary maintenance time.

In Figure 7, we can see a plot of the wife-husband leisure ratio by year for the entire 1969-2003 period. For our purposes, the important point is that the ratio appears to show no sign of a negative trend over this period. While it is reasonable to expect the exact numbers to vary according to the method used to construct non-working time, the lack of trend in relative leisure is robust; Table A1 in the appendix shows that in the time-use surveys, the ratio of wife's to husband's non-working time is stationary around 1.07. The failure of husband's leisure to rise relative to the wife's is therefore robust to accounting for unpaid hours.

3 A Simple Unitary Model

We begin by asking under what conditions the ratio of husband's to wife's leisure does not increase when women's relative wage increases. The first step is to develop a unitary model, in which the weights of each spouse in the household utility function are fixed. Preferences should be restricted to the CRRA class in order to generate constant average hours along a balanced growth path; the model assumes log preferences as a simple example of this class. To reflect the fact that spending on home goods falls relative to income when productivity rises, the model imposes that home

goods appear as a minimum-consumption constraint, and do not enter the utility function..

Suppose that preferences of individuals are represented by the following utility function:

$$\widetilde{u}\left(c^h, c_i, l_i\right) = \phi \ln c^h + (1-\phi) \ln c_i + \delta \ln l_i$$

where c^h is household consumption (a public good), c_i is the private consumption of person i, l_i is her leisure and ϕ is a constant.[6]

The unitary household is assumed to maximize a household utility function consisting of a weighted sum of the utility of each spouse. We represent this by assigning to the husband a Pareto-weight μ_i in the household utility function.

There is also a home good that is produced using inputs of housework time (h_i, h_j), as well as a flow of appliances, k, according to a production function G. Married couples are constrained to produce a minimum level of the home good. Since home goods do not enter the utility function, this constraint always binds:

$$\underline{g}^m = G\left(k, h_i, h_j\right)$$

Each person i has a time endowment of one unit of time, which is allocated across three competing uses: leisure l_i, market work, n_i and housework h_i. There is a fixed cost of working that is proportional to the wage; we express this as a fraction τ_i^e of the time endowment. Let's assume that the optimum has both spouses working. The time constraint for each spouse i is:

$$l_i + n_i + h_i + \tau_i^e = 1$$

A person of sex i gets wage w_i per unit of market labor The household buys home appliances k at price p per unit, so the budget constraint of the household is given by

$$c^h + c_i + c_j + w_i l_i + w_j l_j = I\left(h_i, h_j, k | w_i, w_j, p\right)$$

[6]The distinction between the two types of consumption plays no role in the current section, but will be relevant later in the paper.

where

$$I\left(h_i, h_j, k | w_i, w_j, p\right) = \left(w_i + w_j\right)\left(1 - \tau_i^e\right) - w_i h_i - w_j h_j - pk$$

Suppose that the household's optimal allocation is on the interior of the choice set. Then we can represent this as the solution to a two-stage problem; first maximize full income through the choice of h_i, h_j, k, and then maximize the household utility function via the allocation of leisure and consumption.

Define full income as the solution to the income maximization problem:

$$Y^m\left(w, p\right) = \max_{h_i, h_j, k} \left\{I\left(h_i, h_j, k | w_i, w_j\right)\right\}$$

subject to the above constraints.

Let $\left(h_i^*, h_j^*, k^*\right)$ represent the solution to this problem, so that

$$Y^m\left(w, p\right) = I\left(h_i^*, h_j^*, k^* | w_i, w_j\right)$$

. Now the optimal leisure choice solves this sub-problem:

$$\max_{l_i, l_j} \left\{\phi \ln c^h + \left(1 - \phi\right)\left[\mu_i \ln c_i + \left(1 - \mu_i\right) \ln c_j\right] + \delta\left[\mu_i \ln l_i + \left(1 - \mu_i\right) \ln l_j\right]\right\} \tag{1}$$

subject to:

$$c^h + c_i + c_j + w_i l_i + w_j l_j < Y^m\left(w, p\right)$$

Since the solution is interior by assumption, the optimal decisions are:

$$\begin{aligned} c^h &= \frac{\phi}{1+\delta} Y^m\left(w, p\right) \\ c_i &= \mu_i \frac{1-\phi}{1+\delta} Y^m\left(w, p\right) \\ l_i &= \frac{\mu_i}{w_i} \frac{\delta}{1+\delta} Y^m\left(w, p\right) \end{aligned} \tag{2}$$

This is an instance of the well-known result that expenditure shares are constant with Cobb-Douglas preferences.[7]

[7] In the appendix we deal with the corner-solution case where wives do not work outside the home. The solution requires that we consider the technology for home production, which we defer until later in the paper.

3.1 Leisure in the Unitary Household

The model says that the leisure of the spouses is related by

$$l_j/l_i = \frac{1}{\widetilde{w}} \frac{1-\mu_i(\widetilde{w})}{\mu_i(\widetilde{w})} = \widetilde{l}(\widetilde{w}) \tag{3}$$

Blau and Kahn (1997) report that the average wages of women working full time rose, as a fraction of men's, from 0.60 to 0.76 over the period 1975 to 1995. If the weight μ_i remained constant, then wife's relative leisure $\widetilde{l}$ should have decreased by 20%:

$$\frac{\widetilde{l}(0.76)}{\widetilde{l}(0.6)} = \frac{1/0.76}{1/0.6} = 0.80$$

We saw that working and non-working time are roughly equal at 60 hours each. Given that married women's working time stayed more or less constant over the period, the model implies we should have seen a decline of men's working time on the order of 12 hours per week. Instead, men's working time also remained constant. This predicted decline is so large relative to any observed trend in the data that it seems unlikely that tweaking the preferences or the home production technology are going to solve the problem.

The results of Jones, Manuelli, and McGrattan (2003) not only corroborates this conjecture for wage-based explanations of the rise in women's market hours, but also shows that if improvements in home productivity are to explain the rise in women's labor supply, then the implied fall in married men's working hours is even larger. Their model has all the standard features that are missing from the model in this section: CES preferences, home goods in the utility function, and human capital accumulation. They calibrate the model to US data and still they end up with predicted declines in married men's labor supply on the order of 5-8 hours weekly.

One of the benefits of the simple model presented here is that it is easy to solve for the Pareto weight given the observed leisure and relative wages. We observed in Table 3 that husband's leisure was roughly equal to that of working wives in the 1970s, so relative leisure is $\widetilde{l}_{1970} = 1$. Setting $\widetilde{w} = 0.60$, and inverting the optimality

condition for leisure gives us

$$\mu_i^{1970} = \frac{1}{1 + \widetilde{w}_{1970}\widetilde{l}_{1970}} = \frac{1}{1 + 0.60 \times 1.01} = 0.62$$

, implying that husbands are getting a larger share of the utility in the marriage.

How do the results change for the 1990s when we plug in the changes in wages and relative leisure? Table 3 showed wife's relative non-working time increased to 1.07, while the relative wage of wives increased to 0.76. Solving for the implied Pareto weight:

$$\mu_i^{1990} = \frac{1}{1 + \widetilde{w}_{1990}\widetilde{l}_{1990}} = \frac{1}{1 + 0.76 \times 1.07} = 0.55$$

. The Pareto weight of the husband would have to fall more than 10% to explain the lack of trend in relative leisure for the married population. To understand the role of relative wages in the observed aggregate trends in household labor supply therefore requires a theory of these weights. Since the motivation for considering such a theory involves the observation that husband's leisure is not increasing, it is essential to consider the conditions under which an increase in the wife's wage causes men's leisure to fall.

Proposition 1 *If the following condition is satisfied, then for wife's relative leisure to rise when the wife's wage increases requires that*

$$\frac{d}{d\widetilde{w}} \ln \widetilde{l}\,(\widetilde{w}) > 0 \Leftrightarrow -\frac{d\mu_i}{d\widetilde{w}} \frac{1}{(1-\mu_i)\,\mu_i} > \frac{1}{\widetilde{w}} \tag{4}$$

The more responsive is the wife's share to her wage, the more likely it is that husband's leisure declines when her wage rises. To see under what conditions this might happen, we now consider a simple theory of the Pareto weight μ_j.[8]

[8]Note that if this condition is satisfied, then the spouses's leisure will be increasing in her own wage, because of the symmetry of the problem.

4 The Allocation of the Marital Surplus

In this section, we consider Pareto-optimal allocations of the marriage surplus. We also assume that all Pareto-optimal allocations are interior; later in the paper we will relax this assumption to consider wife's labor-force participation. Under these conditions, the allocation can be represented as a Pareto weight μ_i for, say, the husband. This is because the solution of the household problem in the unitary model is a point on the frontier, and any point on the Pareto frontier can be generated as the solution to the household problem for some weight μ_i.

In a recent literature review, Pollak (2005) says that cooperative bargaining models of the married couple "have become the standard tool for analyzing intrafamily allocation". In this section, we apply such a model to analyzing how the Pareto weights might evolve over time. We restrict attention to solution concepts that map the gains from marriage of each spouse onto a point on the Pareto frontier. This is the key assumption of the paper. There is a long tradition of models using this approach in the literature on intra-household allocations, beginning with Manser and Brown (1980) and McElroy and Horney (1981). More recent applications that rely on the assumption that allocations are determined by the gains from marriage include models based on 'distribution factors', such as Browning, Bourguignon, Chiappori, and Lechene (1994). [9]

Despite such a long tradition, the microfoundations of this approach to marriage decisions are not clear; we don't know the details of plausible non-cooperative games that give rise to the cooperative bargaining solutions that are the basis of the literature. We therefore consider this topic to be outside the bounds of the current paper. Nevertheless, it may be instructive to consider two possible interpretations of the assumption that the allocation is a mapping from the gains from marriage

[9] In contrast, the "separate spheres" model of Lundberg and Pollak[1993] assumes marriage allocations depend on the gains to co-operation within marriage; this model would also be consistent with the analysis below, provided that an increase in one's wage reduces the gains to co-operation.

onto the Pareto frontier. Lets start by taking the assumption literally. Consider a sequential-offer bargaining game. If the bargaining procedure allowed people to make take-it-or-leave-it offers, then the proposer's dominant strategy would be to offer the potential spouse an allocation that gave her only slightly more utility than she would get outside the marriage. It would be rational for the spouse to accept. If the proposer were selected by a coin flip, then the law of large numbers would lead to equal sharing of the marital surplus on average.

This suggests an "egalitarian" solution concept, in which the marital surplus is split equally between the spouses. When utility is perfectly transferable, which is not the case here, this is equivalent to the Nash solution, which maximizes the product of the gains from marriage. The advantage of the egalitarian solution is that it is analytically tractable, as well as simple and plausible. More generally, we might consider the possibility that the marriage allocation depends on a process of repeated rounds of alternating offers that may result in agreement, in perpetual disagreement or in an exogenous termination that results in both partners becoming single. When negotiations are subject to some risk of this breakdown, then the equilibrium allocation depends on the utility of being single. In this case, the allocations will respond to forces that shift the values of being single, although the exact form of the dependence will be sensitive to variations of the bargaining process and to the solution concept employed..Therefore it is reasonable to expect at least qualitatively, that allocations will depend on the gains from marriage in the way outlined below.

This egalitarian solution is illustrated in Figure 8. The diagram plots the attainable allocations in the space of the indirect utilities of husband and wife. The curved line represents the Pareto frontier, the tangent line the indifference curve of a household planner who puts weight μ_h on the husband's utility. The origin represents the reservation utilities of the spouses. The fact that tangency occurs along the 45 degree ray from the origin indicates that the planner views the egalitarian solution

as optimal.[10] Obviously we can trace out the entire Pareto frontier by varying μ_h.

The response of the unitary model to an increase in women's wages is shown in Figure 9a. The unitary solution constrains the slope of the tangent to be constant, so the husband's utility increases, and that of the wife falls, because wife's leisure has become more expensive. In contrast, Figure 9b shows that the bargaining model implies wife's utility increases when her wage increases, due to the increase in her outside option. This requires the magnitude of the slope of the tangent to increase, which is inconsistent with the unitary model. In what follows, we propose a theory of movements of μ_h over time based on this requirement that the Egalitarian solution solve the planner's problem indexed by μ_h.

4.1 A Model of Marriage

We begin by outlining a simple equilibrium marriage model. We proceed by first working out the equilibrium leisure allocations, taking the marriage rate as given; in the appendix we work out how the equilibrium marriage rates depend on full income by marital status.

We assume there is a very large marriage population with equal number of both sexes, that people live forever and that time is divided into discrete periods. People of a given sex are identical. At the beginning of each period, people are either married or single. Married people learn their realization of a match-quality shock ε, and then choose whether to stay together or to divorce. If they divorce, they must then wait until the next period to meet a new potential spouse. All people who entered the period as singles are then randomly paired with a single of the opposite sex. The new pairs then learn their match quality and decide whether to marry. After the marriage decisions, all married couples choose their time allocations over market and house work, and get utility from leisure, match quality and consumption of household

[10] To preserve tractability, it is critical that each spouse get exactly half of the surplus; this causes any utility term that is equal for both spouses to drop out of the problem.

earnings.

We assume that divorce and marriage are costless, and that the process for match quality is independent of marital status. Finally, we require that wages and the quality of single life do not change over time.

4.1.1 Single People

Suppose that when people are single they get some additional utility q_i which is sex-specific; the preferences of individuals are given by:

$$\widetilde{u}(c_i, l_i, q_i) = \ln c_i + \delta \ln l_i + \delta \ln q_i$$

, where l_i is the fraction of time devoted to leisure and $\delta \ln q_i$ is the joy from being single. The total time endowment, is again normalized to one. A single person of sex i faces budget and home-production constraints given by:

$$\begin{aligned} c + w_i l_i &\leq w_i (1 - h_i) - pk = I^S (h_i, k | w_i) \\ G(k, h_i) &\geq \underline{g}^s \end{aligned}$$

Define full income as the solution to the income maximization problem:

$$Y^s (p, w_i) = \max_{h_i, k_i} I^S (h_i, k | p, w_i)$$

subject to

$$G(k, h_i) \geq \underline{g}^s$$

Optimal decisions for single people are given by

$$\begin{aligned} c_i &= \frac{1}{1+\delta} Y^s (p, w_i) \\ l_i &= \frac{\delta}{1+\delta} \frac{Y^s (p, w_i)}{w_i} \end{aligned}$$

The flow utility from being single is given by the indirect utility function:

$$U_i^s (p, w_i, q_i) = K_S + (1 + \delta) \ln Y^s (p, w_i) - \delta \ln w_i + \delta \ln q_i$$

where $K_S = \delta \ln \delta - (1 + \delta) \ln (1 + \delta)$.

4.2 Equilibrium Marriage

Suppose that married couples are optimally at some interior solution. Let $\widetilde{U}_i^M(\mu_i)$ represent the indirect utility function of person i being married. It's easy to show that this is given by:

$$\widetilde{U}_i^M(\mu_i, \varepsilon) = K_M + (1+\delta)\ln Y^m(w,p) - \delta \ln w_i + (1-\phi+\delta)\ln \mu_i + \delta \ln \varepsilon$$

, where K_M is given by

$$K_M = \phi \ln \phi + (1-\phi)\ln(1-\phi) + K_S$$

It is convenient to break out the Pareto weight from the flow utility:

$$\widetilde{U}_i^M(\mu_i, \varepsilon) = U_i^M + (1-\phi+\delta)\ln \mu_i + \delta \ln \varepsilon$$

where

$$U_i^M = K_M + (1+\delta)\ln Y^m(w,p) - \delta \ln w_i$$

The difference in flow utilities, excluding the marital share and the match quality, is

$$\begin{aligned}\Delta_i(p, w_i, q_i) &= U_i^M - U_i^s \\ &= K_{MS} + (1+\delta)\ln \frac{Y^m(w,p)}{Y^s(p,w_i)} - \delta \ln q_i\end{aligned}$$

where

$$K_{MS} = K_M - K_S = \phi \ln \phi + (1-\phi)\ln(1-\phi)$$

We show in the appendix that there is a unique equilibrium marriage rate equal to the probability that the match quality exceeds ε^M, where this marriage threshold is given by:

$$\varepsilon^M = K\left[\left(\frac{Y_i^s}{Y^m}\right)^{p_1} q_i^{p_0} + \left(\frac{Y_j^s}{Y^m}\right)^{p_1} q_j^{p_0}\right]^{1/p_0} \tag{5}$$

. In this expression, K, $p_{0,}$ and p_1 are positive constants whose values depend on ϕ and δ. What matters for marriage rates, according to this expression, is a weighted average

of the income of singles relative to the income of married couples. The income-ratio of sex j is more important than that of sex i to the extent that $q_j > q_i$. This means that if sex j needs marriage less, then the marriage rate is more dependent on her income than on that of sex i. In terms of the gender gap, a trend towards equality could cause marriage rates to rise or fall, depending on the extent to which the low-wage sex enjoys single life more than the high-wage sex.

4.3 The Egalitarian solution

Suppose that spouses agree to split the gains from marriage evenly. This implies that the Pareto weight μ_i solves

$$W_i\left(w,q,\varepsilon|\mu_i\right) = W_j\left(w,q,\varepsilon|1-\mu_i\right)$$

, where $W_i\left(w,q,\varepsilon|\mu_i\right)$ is the gain from marriage for a person of sex i given that he has Pareto weight μ_i in the household utility function..

We show in the appendix that this Egalitarian solution equates the gains in flow utility from marriage. If the household is at an interior solution, then this implies:

$$\Delta_i\left(p,w_i,q_i\right) + \left(1-\phi+\delta\right)\ln\mu_i = \Delta_j\left(p,w_i,q_i\right) + \left(1-\phi+\delta\right)\ln\left(1-\mu_i\right)$$

. Solving this condition yields the equilibrium allocation, which we represent, in accordance with Figure 1, by the husband's Pareto weight:

$$\mu_i\left(\widetilde{y},\widetilde{q},\varepsilon\right) = \frac{1}{1+\widetilde{q}^a\widetilde{y}^b}$$

, where $\widetilde{y} = \frac{Y_j^s(p,w_j)}{Y_i^s(p,w_i)}$, $\widetilde{q} = \frac{q_j}{q_i}$ and $a = \frac{\delta}{1-\phi+\delta}$ and $b = \frac{1+\delta}{1-\phi+\delta}$.

. This says that the bargaining position of spouse j is summarized by the product of her relative taste for single life and her relative full income as a single. Notice that ε does not enter; this is because with the egalitarian solution, factors that are common to both spouses drop out of the determination of μ_i.

The Pareto weight depends on the relative wage through the ratio of full incomes when single. Therefore the leisure of spouse i will fall in response to a rise in $\widetilde{y}$ when the following condition is satisfied:

$$\frac{d}{d\widetilde{w}} \ln \widetilde{l} = \frac{d}{d\widetilde{w}} \left[\ln \left(\frac{\mu_j}{1-\mu_j} \right) - \ln \widetilde{w} \right] = b - 1 > 0$$

$$b = \frac{1+\delta}{1-\phi+\delta} > 1 \text{ if } \phi > 0 \tag{6}$$

This implies literally that relative leisure falls whenever there is some public good aspect to consumption that prevents all of the response to changing wages being made through consumption. In general therefore the model predicts that in response to an increase in women's wages, relative to men's, wive's leisure will increase, relative to that of husbands, consistent with what we saw in the empirical section.

4.4 Numerical Example

We have extended the unitary model of household labor supply by incorporating a theory of the intra-household allocation that depends on two additional parameters, ϕ and $\widetilde{q}$, that are inherently unobservable. In this section we show that these parameter values can be inferred, together with δ, from a few simple leisure statistics: leisure's expenditure share of full income, the relative leisure of spouses at a given time, and the elasticity of relative leisure with respect to the relative full income. To keep the results simple, we assume that $\widetilde{y}$ equals $\widetilde{w}$; this implies the role of equipment in home production is minimal.

According to Table 3, singles in the 1970s devoted 62% of their discretionary time to leisure. This implies $\delta = 1.64$.For married couples, we can write the ratio of wife's to husband's leisure as

$$\widetilde{l} = l_j/l_i = \frac{\mu_j/\mu_i}{w_j/w_i} = \frac{1}{\widetilde{w}} \widetilde{q}^a \left[\widetilde{y}\left(\widetilde{w}\right) \right]^b$$

Taking derivatives of the log of this expression yields the elasticity of relative leisure

with respect to wage:

$$\xi \equiv \frac{\partial \ln \widetilde{l}}{\partial \ln \widetilde{w}} = b\frac{\partial \ln \widetilde{y}}{\partial \ln \widetilde{w}} - 1$$

. If $\widetilde{y}$ equals $\widetilde{w}$, then the elasticity is given by $b-1$. First, we can recover μ from the relative leisure, as in the previous section; this implied the husband's share was $\mu_i = 0.62$. According to the bargaining model, μ is a non-linear function of ϕ and $\widetilde{q}$. With δ fixed by the levels of leisure, ϕ is identified by the change in relative leisure in response to the change in $\widetilde{w}$. From the 70s to the 90s, the relative leisure of husbands fell by 7%, while their relative wages fell 20%, so the elasticity ξ is 35%. Maintaining the assumption that $\widetilde{w} = \widetilde{y}$, this allows us to solve for ϕ :

$$b = 1 + \xi = 1.35 = \frac{1+\delta}{1-\phi+\delta} \Rightarrow \phi = 0.68$$

This says that more than 2/3 of consumption in marriage is public.

We now have $a = \frac{\delta}{1-\phi+\delta} = 0.84$.Setting $\widetilde{w}_{1970} = 0.61$ implies $\widetilde{y}^b_{1970} = \widetilde{w}^b_{1970} = 0.5$.We can now return to our first result, that $\mu = 0.62$ in the 1970s, to pin down $\widetilde{q}$.

$$\begin{aligned} \mu_i^{70s} &= 0.62 = \frac{1}{1+\widetilde{q}^a \widetilde{y}^b_{70}} \\ 0.62 &= \frac{1}{1+q^{0.84}/2} \\ &\Rightarrow \widetilde{q} = 1.27 \end{aligned}$$

This implies that, holding income constant, women gain less from marriage than men do.[11] Note also, from equation (5), that $\widetilde{q} \geq 1$ implies that convergence of women's wages may cause marriage rates to fall.

Since this solution is for the special case where $\widetilde{w} = \widetilde{y}$, the quantitative results are meant to be merely suggestive. The more important point is that all of the apparently

[11] Regalia and Ríos-Rull (1999) reports that, as in this paper, one can infer from US data that women have a higher intrinsic enjoyment of single life. They infer this from the fact that women tend to marry men higher in the wage distribution, and that higher wages are associated among women with lower marriage rates, but among men with higher rates. Along with the current paper, this suggests that both cross-sectional and time-series support this view that women need marriage less than men do.

free parameters in the model are in fact pinned down by the data, once the home technology is given.

5 The Decline in Home Hours

So far the results have been in terms of leisure. We know that if women's wages rise then husband's relative leisure can actually fall, contrary to the standard model. This does not tell us however whether market labor rises or falls, because home production time of the husband will also respond. So we first specify a home technology that is consistent with the above argument, derive the response of home hours to relative wages and then compute the response of market hours.

Over the period in question, we saw married women's time working at home decline by about 25%, from 46 hours to 34 hours weekly. While it is undoubtedly the case, as argued by Greenwood and Guner (2004) that improvements in home technology played a large role, as evidenced by a dramatic fall in the price of home equipment, we also observe an increase in the husband's time input, from 11 hours weekly to 17 hours by 1995. These facts suggest substitution of inputs is indeed significant over this period. In this section we therefore present a home technology that allows for purchased inputs (home equipment) to substitute for time, as in the theoretical section earlier.

Let the home technology for household type $s \in \{i, j, m\}$ be given by a function that is Cobb-Douglas in market goods k and total labor input H_s :

$$g_s = k^{1-\alpha} H_s^{\alpha}$$

For singles of sex i, labor input is $H_i = z_i h_i$, where z_i gives the productivity of sex i at home, and h_i the time input.

For singles this implies a home labor time given by:

$$h_i = h_i^0 \frac{\overline{g}_i}{z_i} \left(\frac{p}{w_i} \right)^{\alpha}$$

where $h_i^0 = \left[\frac{1-\alpha}{\alpha}\right]^{\alpha}$.

Note that if $\alpha = 1$, the ratio of full incomes of singles is proportional to the wage,.as was assumed for the numerical example:

$$\widetilde{y}(\widetilde{w}) = \widetilde{w}\frac{1-\left(\overline{g}_j/z_j\right)^{\rho}}{1-\left(\overline{g}_i/z_i\right)^{\rho}} = \widetilde{w}\widetilde{g}$$

For married couples, the effective labor input is the CES function:

$$H_m(h_i, h_j) = \left[z_i h_i^{1-\rho} + z_j h_j^{1-\rho}\right]^{1/(1-\rho)}$$

, where ρ is the elasticity of substitution between the labor inputs of the wife and the husband. If $\rho > 0$ then rising spouse wage increases own share of home time:

$$\frac{h_i}{h_j} = \left(\frac{w_i/z_i}{w_j/z_j}\right)^{-\rho}$$

, so this fits with the rise in husband's home hours. Note that the price p has no impact on the ratio of home hours. This means the role of trend in p for explaining relative leisure will be limited, as it will also have a similar effect on singles, thus leaving the bargaining positions unchanged.

5.1 Calibration

We calibrate the technology and the home-goods requirement to match home hours in the 1970s and the 1990s according to the data in Table 3 by sex and marital status. The calibration involves parametrizing two objects: the home goods constraint $\underline{g}^m(n_k)$ as a function of household type and the home-production technology $G(k, h_i, h_j)$. We have already seen that once we know the full income of the households, the model is fully identified, and we can then infer the role of bargaining in the household from the data on relative leisure.

The exogenous variables that change between the two periods are relative wages, the price of home equipment, and family size. The wages in 1970 are set to $[0.61, 1.0]$ for women and men, respectively, and to $[0.76, 1.0]$ to match the observations on full-time full-year men and women aged 35-44 in the CPS. These numbers are drawn

from Blau and Kahn (2000), who note that the changes in the gender gap are roughly comparable for the 18-55 age groups.

The relative price p of home equipment falls by 50% between the two periods, as in the NIPA furniture and household equipment price index shown in Figure **??**. For married couples in the model, this could affect both the attractiveness of single life and hence the bargaining positions of the spouses, as well as the opportunity cost of market labor.[12]

Family size fell quite significantly; Table 3 shows that, in the PSID sample, the average number of children in married couple households fell from 1.41 to 0.97. For single women, the average stayed constant around 0.68 and for single men the average was 0.21. Family size also varies due to adults present of course, but this does not seem to have resulted in any additional change between the periods. The home-goods requirement is parameterized as the following function of number of adults n_a and kids n_k :

$$\underline{g}^m(n_k) = g_0(m) \times (n_a + \omega_0 n_k)^{\omega_1}$$

In order to identify the role of a falling price of home equipment, we need to use data from both periods. To distinguish between changes in home hours due to the wage trend and changes due to the price trend, the change in home hours of single women will play an important role. One anomaly in the table is that single men's housework time actually increased slightly; this is difficult to reconcile with the model, so instead we'll allow single men's requirement for home goods to be higher in the 1990s.

To identify the role of family composition, we also exploit cross-sectional variation in family size by household type in the PSID. We estimate a regression model of total housework hours on family size, controlling for marital status and year effects. The

[12]The prices series are drawn from NIPA data on the BLS web page: http://www.bea.gov/beahome.html. The price of home durables is taken as the ratio of the price index for home durables and furniture to the GDP deflator.

estimates, which appear in Table A3, imply that parent households spend 16% more home hours, with an additional 10% per additional child. The model is required to match the coefficients on being a parent and on number of children.

The remaining statistic used to calibrate the home technology is the expenditure share of home equipment. We set the expenditure share in the model for the 1970s equal to 4.0% As shown in Figure 10, this also corresponds well to the NIPA series for equipment and furniture spending, which appears to fluctuate between 4 and 5 per cent of total consumption. However the implicit assumption of full annual depreciation may understate the importance of home equipment.

The calibration targets are shown in Table 4, along with the corresponding results from the benchmark model. Once the parameters implied by the home-production targets have been found, the leisure targets are matched by the simple math outlined in the numerical example. As one might expect, the model generates a fairly precise fit to the targets. The parameters required to do this, shown in Table 5, seem quite plausible. In terms of required home good, a married couple without kids is equivalent to two single women. Single men have a slightly lower requirement for home goods than do single women; this was higher by about 15% in the 1990s. Equipment's share of home output is quite low, about 10%. The elasticity of substitution between husband and wife's time in the home technology is about 1.5, implying a high degree of substitutability.[13] Perhaps less plausible is the result that men are slightly more productive than women in the home technology; this is due to the apparent ability of men's hours to substitute for a fall in women's hours; the small size of the decline in single women's home hours limits the role of technology in explaining why the replacement rate is less than one for one. These parameters imply that $\widetilde{q} = 1.25$; as in the numerical example, holding income constant, women are more attracted to single life than men are.

[13]Rupert, Rogerson, and Wright (1995) also estimate a home-production function on the PSID, but they assume the elasticity of substitution between home hours of the spouses is equal to one.

5.2 Calibration Results

The non-targeted statistics of the model are the leisure of singles and of married couples in the 1990s, shown in Table 7. In the data, the leisure of married people declined, by four hours for husbands, and, for wives, by less than an hour. The model gets close to the correct levels; for the 1990s, the disparities between leisure in the data and model are on the order of 3% for married couples. In terms of trends, the disparities are bigger: the model generates about 60% of the decline in husband's leisure, but actually predicts a 5% rise in wife's leisure. This translates into a 14% under-prediction of wive's market labor, from 16.38 hours weekly in the 1970s to 25.62 instead of 29.91 in the 1990s.

For single people, the model is very close, within 1%, of the leisure of single men, but fails to explain why single women worked so little in the 1970s; 32 hours in the data, 37.85 hours in the model. This translates into a leisure prediction for the 1970s that is 9% lower than that in the data.

For the 1990s however the model does much better with respect to singles, with disparities on the order of 3%, as shown in Table 8. Leisure hours for women are within 1.5 hours of the observations for 1990, those for men are higher than in the data, by two hours for singles and by three hours for married men. Thus married men are working somewhat harder in the data than even the model implies; in general the results suggest a small decline in leisure's share of spending, which log preferences cannot match.

For per-capita market hours, the table reports two results: the top row holds the marriage rate constant at 70%, the fraction married in the 1969-74 CPS sample. The lower row shows the per-capita market hours for the 1990s population, where the marred fraction was 56%. The model predicts per-capita market hours would rise to 37 hours holding the marriage rate at 1970s levels, an increase of about 2.5 hours, compared to 4.5 in the data. The model therefore explains 55% of the trend in per capita hours.

More to the point, how do these results compare to those of a standard macro model without bargaining? Let's consider a computational experiment. The benchmark model implies that in the 1970s the husband's weight in the married utility function was 0.62, and that during the 1990s it had fallen to 0.54. What would have happened to leisure and labor supply if the utility weight instead had remained constant, as in a unitary model? Experiment 1 in Table 7 shows that the leisure of married men would have risen nine hours, while that of their wives would have declined by six, relative to what we see in the benchmark model. This implies a bigger increase in per-capita hours, but still falls three hours short of the total change. The prediction for relative leisure however is strongly at odds with the data, even more than in the simple example discussed in an earlier section. By construction, the bargaining model is entirely successful in reconciling this lack of negative trend in wife's relative leisure to the data on relative wages.

Experiments 2 and 3 show that the trend in per-capita hours in the model is entirely due to the trends in the relative wage trend and the equipment price. When the relative wage is fixed in Experiment 2, the constant-population change is 0.8 hours is per week, a reduction equal to about 3/4 of the trend, while Experiment 3 , where the equipment price is held constant generates a trend that is smaller by 0.9 hours weekly than in the benchmark model. These numbers suggest the wage trend accounts for 3/4 of the trend in per capita hours, and the price trend about 1/4.

Is it likely that the relatively humble role of equipment is due to mismeasurement of the price trend? It is well-known that it is difficult to measure price changes when technological progress results in new goods. The microwave ovens and dishwashers of the 1970s for instance are unlikely to be marketable today, and Bils (2004) argues that the NIPA price series seriously underestimates the fall in prices of durable goods when older models become obsolete. In Experiment 4, we reduce the equipment price by an additional 50%, but the additional increase in per capita hours is only about 12 minutes weekly, holding the marriage rate at the 70s level, and about 10 minutes for

the 1990s marriage rate. The trend in equipment price therefore plays a significant role, but clearly secondary to that of the wage trend.

The only other experiment to generate an impact similar to that of holding wages constant is Experiment 5 where hours spent in housework are held constant at the 1970s level. When the marriage rate is held at the 1970s level, this yields zero change in market hours per capita. The ability to substitute out of home production is therefore essential for understanding how hours respond to changes in relative wages. Experiment 6 shows that the impact of the fall in average family size is minimal according to the model, accounting for an increase of about 20 minutes of paid labor per week at 1990s marriage rates: weekly hours falls from 37.41 to 37.19 when family size is held constant at the 1970s levels.

Where does this leave the balanced-growth-path hypothesis? According to the BLS, multifactor productivity in manufacturing was 30% higher in the 1990s than in the 1970s. In the standard model with balanced growth, if this increase were all permanent, this would have resulted in no change in hours worked. How closely does the current model conform to this? In other words, according to the model, could a rise in the general level of wages cause a significant rise in hours of market work? The results of Experiment 7, where the only change between the 1970s and the 1990s is that wages rise by 30 %, show that per capita hours in the model would rise by 0.1 weekly hours from 34.9 to 35.1, about 7/10 of one per cent. This is easy to understand; the utility function implies constant expenditure share of leisure. The cost of satisfying the home-production constraint represents negative non-labor income, but this turns out to be small relative to wage income. From the point of view of modelling growth and business cycles, the model implies therefore that the implication of constant hours along the balanced growth path is consistent with the rise in per capita hours observed since the 1970s.

5.3 Discussion

What prevents the model from making predictions that are closer to the empirical statistics? It is essential to see that the failings of the model are quantitative; while the model generates trends that are qualitatively similar to those in the data, the quantitative shortcomings arise from the limitations imposed to make the model easier to understand. These include the log-preference assumption and the lack of non-labor income. Relaxing these restrictions would help the model match the trend in hours without undermining the basic mechanism implied by the bargaining model. Since this would make the model intractable analytically, and hence obscure the mechanisms, we leave this to future research.

First, consider singles. The model imposes the same utility-for-leisure parameter δ on men and women. Since single men and women chose roughly the same leisure level in the 1970s, despite very different wages, the decision rule would imply that the ratio of wages to full income is the same for both. But this would require a linear production technology with no role for input substitution, which is critical for understanding the home hours of married couples. A more plausible way to resolve this issue would be to extend the model to allow for non-labor income; assuming this was more important for single women than for single men in the 1970s, perhaps due to government transfers, then the lower labor of women in the 1970s could be reconciled to the model.

Second, to match the decline in average leisure levels for married couples requires that the leisure share of spending decline; in the model this is fixed. [14] To discipline the exercise, it was assumed that δ did not change over time. The married couple's expenditure share of leisure in the 1970s fixes δ and their relative leisure in the 1970s fixes $\widetilde{q}$. The parameter ϕ was chosen to match the increase in the leisure of wives relative to husbands; however it has no impact on the expenditure share of leisure.

[14] Alternatively, the ratio of full income to wages could have declined, but this seems implausible as this ratio is increasing in the wage and declining in the price of home equipment.

The most standard way to accommodate the observed decline in married-couple's leisure share would be to allow for more flexible CES preferences. [15]Since the model statistics are qualitatively close to those of the data, it is therefore easy in principle to extend the model to match those statistics that exhibit the larger disparities between model and data.

The reason the price of equipment has so little effect is that this effect is identified from the change in home hours of single women. In relation to the decline in married women's home hours, this was quite modest, a decline from 23 hours to 21, as seen in Table 3. Furthermore, the model is constrained so that the equipment has the same effect on the productivity of each sex. That means that wages are entirely responsible for the increase in husband's time spent in home production. If instead the equipment share in the home technology were higher for men than for women, this would allow the price trend to explain a greater share of the trends in market and home hours.[16] This is another topic we leave to future research.

The implications of the trend in family size were dealt with quite summarily here, as a change in a parameter. This is driven in part by the fact that time spent looking after children, at least for married people, did not fall over this period, according to the time-use surveys reported in Table A1, and the effect of an additional child on home work time was quite modest, according to Table A4, about 10%. Hence a more sophisticated treatment of child care does not seem warranted by this data.

With regards to marriage, the results are not reported here, but the model as calibrated implies virtually no change in marriage rates. While single women are

[15]Another possibility is that part of the increase in market hours in the 1990s is due to cyclical factors; perhaps the model should instead be set to match detrended hours. Its not clear that this will have a major impact on the current exercise however, as the period 1969-1973 was also part of an economic expansion.

[16]Calibration with a more flexible production function in an earlier version of this paper indicated that home equipment was as important as the wage trend for explaining trends along the intensive margin in married women's market work hours.

less attracted to marriage in the 1990s, single men are more attracted to marriage, and these effects cancel out. Greenwood and Guner (2004) argue that the change in price of home equipment could explain the decline in marriage rates over time. That doesn't happen in the benchmark model here because the role of equipment in home production is much smaller than in their paper. Therefore another effect of allowing for a more flexible technology, and hence a larger role for equipment, would be that the model would likely account for some of the decline in marriage rates.

6 Conclusion

The goal of this paper was to determine whether macroeconomists had anything important to learn from bargaining models of the household. We started with some well-established facts: per-capita hours have been rising over time, married-women's labor supply has been increasing, and the gender gap in wages appears to be narrowing. We then established that the leisure of married men is not increasing over time; in fact relative to that of their wives, it has declined slightly since the 1970s.

We developed a simple bargaining model of the household where the outside options were determined by the equilibrium in the marriage market, and established the condition required for husband's leisure to be non-increasing in the wife's wage, as in the data. unlike the unitary model, this model could match the trend in relative leisure exactly. The essential condition for husband's leisure to fall relative to that of their wives was that women find single life sufficiently attractive relative to marriage; if this condition is met, then the wife's weight in the household utility function increases when her wage increases, causing a reduction in the leisure allocated to husbands.

We calibrated the model with home technology to match the data on home hours and leisure of married couples in the 1970s. We found that the model could explain half of the trend in per capita hours. Furthermore, rising TFP had virtually no

effect on per capita hours. We conclude from this that the recent rise in per capita hours is perfectly consistent with the stationary hours hypothesis of the standard macro models. Our results imply that it is possible to generate this effect from a unitary macro model with home production, such as the model of Jones, Manuelli, and McGrattan (2003). However such a model would fail to explain why the leisure of married men has not increased over time. Since the discrepancy appears to be quite large, the fact that the bargaining model developed here can match the trend in relative leisure of the spouses while generating a trend in per capita market work suggests a compelling reason for macroeconomists to take a more serious look at the literature on this type of model.

References

Aguiar, M., and E. Hurst (2007): "Measuring Trends in Leisure: Evidence from Five Decades of Time Use Surveys," *Quarterly Journal of Economics*, Forthcoming.

Bech-Moen, O. C. (2006): "Gender Differences in Market and Home Hours," Mimeo, University of Oslo.

Bils, M. (2004): "Measuring Growth from Better and Better Goods," NBER Working Papers.

Blau, F. D., and L. M. Kahn (1997): "Swimming Upstream: Trends in the Gender-Wage Differential in the 1980s," *Journal of Labor Economics*, 15(1, pt. 12), 1–42.

Blau, F. D., and L. M. Kahn (2000): "Gender Differences in Pay," *Journal of Economic Perspectives*, 14(4), 75–99.

Bourguignon, F., and P.-A. Chiappori (1994): "The Collective Approach to Household Behavior," in *The Measurement of Household Behavior*, ed. by R. Blundell, I. Preston, and I. Walker, pp. 70–85. Cambridge University Press, Cambridge.

Browning, M., F. Bourguignon, P.-A. Chiappori, and V. Lechene (1994): "Income and Outcomes: A Structural Model of Intrahousehold Allocation," *Journal of Political Economy*, 102(6), 1067–1096.

Caucutt, E. M., N. Guner, and J. Knowles (2002): "Why Do Women Wait? Matching, Wage Inequality, and the Incentives to Fertility Delay," *Review of Economic Dynamics*, 5(4), 815–855.

Chade, H., and G. Ventura (2002): "Taxes and Marriage: A Two-Sided Search Analysis," *International Economic Review*, (3), 955–85.

Chiappori, P., and Y. Weiss (2000): "An Equilibrium Analysis of Divorce," Discussion paper, University of Chicago.

Chiappori, P.-A. (1997): "Introducing Household Production in Collective Models of Labor Supply," *Journal of Political Economy*, 105(1), 191–209.

Galí, J. (2005): "Trends in Hours, Balanced Growth,and the Role of Technology in the Business Cycle," *Federal Reserve Bank of St. Louis Review*, 87.

Gershuny, J., and J. P. Robinson (1988): "Historical Changes in the Household Division of Labor," *Demography*, 25(4).

Greenwood, J., and N. Guner (2004): "Marriage and Divorce Since World War II: Analyzing the Role of Technological Progress on the Formation of Households," Discussion paper, NBER.

Greenwood, J., N. Guner, and J. Knowles (2003): "More on Marriage, Fertility and the Distribution of Income," *International Economic Review*, 44(3), 827–862.

Greenwood, J., A. Seshadri, and M. Yorukoglu (2005): "Engines of Liberation," *Review of Economic Studies*, 72(1), 109–33.

Jones, L. E., R. E. Manuelli, and E. R. McGrattan (2003): "Why Are Married Women Working So Much?," Federal Reserve Bank of Minneapolis, Staff Report: 317.

Lundberg, S., and R. A. Pollak (1996): "Bargaining and Distribution in Marriage," *Journal of Economic Perspectives*, 10(4), 139–58.

Manser, M., and M. Brown (1980): "Marriage and Household Decision Making: A Bargaining Analysis," *International Economic Review*, 21, 31–44.

McElroy, M., and M.-H. Horney (1981): "Nash-Bargained Household Decisions: Towards a Generalization of the Theory of Demand," *International Economic Review*, 36, 333–349.

McGrattan, E. R., and R. Rogerson (2004): "Changes in Hours Worked, 1950-2000," *Federal Reserve Bank of Minneapolis Quarterly Review*, 28, 14–33.

Pollak, R. A. (2005): "Bargaining Power in Marriage: Earnings, Wage Rates and Household Production," Discussion paper, NBER Working Papers: 11239.

Prescott, E. C. (2004): "Why Do Americans Work So Much More Than Europeans?," *Federal Reserve Bank of Minneapolis Quarterly Review*, 28, 2Ű13.

Regalia, F., and J.-V. Ríos-Rull (1999): "What Accounts for the Increase in Single Households and the Stability in Fertility?," Barcelona, Spain: Universitat Pompeu Fabra, Department of Economics, Working Paper No. 1999.

Robinson, J. P., and G. Godbey (1997): *Time for Life*. The Pennsylvania State University Press, University Park, PA.

Rupert, P., R. Rogerson, and R. Wright (1995): "Estimating Subsitution Elasticities in Household Production Models," *EconTheory*, 6(1), 179–193.

A Appendix

A.1 Equilibrium in the Marriage Market

Under the assumptions that there is no commitment and that match quality is iid both over time and across pairings, there is no dynamic component to the gains from marriage. Marriage is the efficient outcome if and only if the flow gains are positive. Since this condition need hold only at the optimal allocation between spouses, however, we cannot just add up the individual gains at some arbitrary allocation. Instead we define the minimum Pareto weight $\underline{\mu}_i$ that makes marriage acceptable to person i.Marriage is the efficient outcome if and only the minimum weights sum to less than one.

The minimum Pareto weight $\underline{\mu}_i$ is the solution to the following equation:

$$\begin{aligned} 0 &= \Delta_i(p, w_i, q_i) + (1 - \phi + \delta)\ln \underline{\mu}_i + \delta \ln \varepsilon \\ &\Rightarrow \ln \underline{\mu}_i = -\frac{\Delta_i(p, w_i, q_i) + \delta \ln \varepsilon}{1 - \phi + \delta} \\ &\Rightarrow \underline{\mu}_i = K \left(\frac{Y_i^s}{Y^m}\right)^{p_1} q_i^{p_0} \varepsilon^{-p_0} \end{aligned}$$

where

$$K_{MS} = K_M - K_S = \phi \ln \phi + (1 - \phi)\ln(1 - \phi)$$

and

$$\begin{aligned} K &= \exp\left(\frac{K_{MS}}{1 - \phi + \delta}\right) \\ p_0 &= \frac{\delta}{1 - \phi + \delta} \\ p_1 &= \frac{1 + \delta}{1 - \phi + \delta} \end{aligned}$$

Marriage is efficient is and only if:

$$\underline{\mu}_i + \underline{\mu}_j \leq 1$$

Under the assumption that μ is not a function of ε, we can define the threshold marriage quality ε^M as the lowest value of match quality for which marriage is the efficient outcome:

$$\begin{aligned} 1 &= K\left(\frac{Y_i^s}{Y^m}\right)^{p_1} q_i^{p_0}\varepsilon^{-p_0} + K\left(\frac{Y_j^s}{Y^m}\right)^{p_1} q_j^{p_0}\varepsilon^{-p_0} \\ \Rightarrow \quad \varepsilon^M &= K^{\frac{1}{p_0}}\left[\left(\frac{Y_i^s}{Y^m}\right)^{p_1} q_i^{p_0} + \left(\frac{Y_j^s}{Y^m}\right)^{p_1} q_j^{p_0}\right]^{1/p_0} \end{aligned}$$

Therefore the equilibrium marriage rate is given by

$$\Pr\left(\varepsilon > \varepsilon^M\right) = 1 - F\left(\varepsilon^M\right)$$

, where

$$\varepsilon^M = K^{\frac{1}{p_0}}\left[\left(\frac{Y_i^s}{Y^m}\right)^{p_1} q_i^{p_0} + \left(\frac{Y_j^s}{Y^m}\right)^{p_1} q_j^{p_0}\right]^{1/p_0}$$

A.2 Determination of the Pareto Weights

Proposition 2 *Under the egalitarian solution, the Pareto weight of spouse j in the household utility function is given by*

$$\mu_j = \frac{\widetilde{q}\widetilde{y}^{\frac{1+\delta}{\delta}}}{1+\widetilde{q}\widetilde{y}^{\frac{1+\delta}{\delta}}}$$

Proof. The solution equates the gains from marriage:

$$W_i\left(\varepsilon|\mu_i\right) = W_j\left(\varepsilon|\mu_j\right)$$

The gains from marriage are given by

$$W_i\left(\varepsilon|\mu_i\right) = \widetilde{U}_i^M\left(\varepsilon,\mu_i\right) - U_i^S$$

Given the expression (**??**) for $W_i\left(\varepsilon\right)$, this implies

$$\begin{aligned}
& \delta\ln\mu_i - (1+\delta)\ln Y_i^s - \delta\ln q_i \\
= \;& \delta\ln(1-\mu_i) - (1+\delta)\ln Y_j^s - \delta\ln q_j \\
\Rightarrow \;& \delta\ln\frac{\mu_i}{1-\mu_i} = (1+\delta)\ln\frac{Y_i^s}{Y_j^s} - \delta\ln\frac{q_i}{q_j} \\
\Rightarrow \;& \frac{\mu_i}{1-\mu_i} = \left(\frac{q_i}{q_j}\right)\left(\frac{Y_i^s}{Y_j^s}\right)^{\frac{1+\delta}{\delta}} \\
\Rightarrow \;& \mu_i = \frac{\frac{q_i}{q_j}\left(\frac{Y_i^s}{Y_j^s}\right)^{\frac{1+\delta}{\delta}}}{1+\frac{q_i}{q_j}\left(\frac{Y_i^s}{Y_j^s}\right)^{\frac{1+\delta}{\delta}}}
\end{aligned}$$

The result follows by symmetry. ■

A.3 Wage Elasticity of Leisure

Using the fact that leisure depends on the relative wage both directly and via the Pareto weight, we show the response of relative leisure to a change in the relative

$$\widetilde{l}\left(\widetilde{w}\right) = \frac{1-\mu_i\left(\widetilde{w}\right)}{\widetilde{w}\mu_i\left(\widetilde{w}\right)}$$

$$\begin{aligned}
\widetilde{l}'(\widetilde{w}) &> 0 \Leftrightarrow \frac{d}{d\widetilde{w}} \ln \frac{1-\mu_i(\widetilde{w})}{\widetilde{w}\mu_i(\widetilde{w})} > 0 \\
&= \frac{d}{d\widetilde{w}} \left[\ln(1-\mu_i)\right] - \frac{d}{d\widetilde{w}} \ln \mu_i - \frac{d}{d\widetilde{w}} \ln \widetilde{w} \\
&= -\left(\frac{1}{(1-\mu_i)\mu_i}\right) \frac{d\mu_i}{d\widetilde{w}} - \frac{1}{\widetilde{w}}
\end{aligned}$$

A.4 Unpaid-Work Trends: Time-Use Surveys

To examine trends in non-working time requires that we have measures of time spent in unpaid work, which is not recorded in the CPS, so we now turn to a series of time-use surveys carried out in the US between 1965 and 2003. There are five major time use surveys: 1965-1966 Americas' Use of Time; 1975-1976 Time Use in Economics and Social Accounts; 1985 Americans' Use of Time; 1992-1994 National Human Activity Pattern Survey; and the 2003 American Time Use Survey. The sample sizes range from 1862 in 1965 to 15,244 in 2003. Valuable analyses of these data sets include Robinson and Godbey (1997) and Aguiar and Hurst (2007).

While these are the most comprehensive data sources on time use in existence over the period of interest, it is essential recognize two severe limitations of any trend analysis based on this data. These limitations arise because the data sets consist of a sequence of essentially independent studies carried out by different agencies, each with their own objectives and constraints. In contrast to the March CPS or the Panel Study of Income Dynamics for instance, which were designed and implemented as on-going projects where concerns about comparability over the years were paramount, comparison of variables from the time-use surveys is a difficult and time-consuming undertaking, hence the importance of the above studies. One of the prime contributions of each study cited above is to aggregate disparate lists of activities into classifications of time use that are as consistent as possible over time, and to point out instances where it appears that such consistency is not possible.

There are 168 hours in a week, allocated over the hundreds of activities listed in these surveys. In the spirit of Robinson and Godbey (1997), these activities can be

aggregated up into broader categories such as Personal Care, Market Work, Home Work, and Leisure. Of course these concepts are somewhat arbitrary and some activities could be reasonably be placed in different categories. For this reason, we stick close to the traditional classification and add one more category for "Other Activities" that includes some of the more difficult to classify activities, such as civic participation, and time spent teaching children. We define discretionary time as the number of hours in the week in excess of some (arbitrary) minimum requirement for sleep and other personal care. This is important because there is enormous variance in the amount of time people seem to devote to these activities, so presumably a significant portion of the average time spent in these activities is discretionary.

For macroeconomists what matters most is the division of discretionary time (the time endowment in their models) into work and non-work. Macro models typically do not make distinctions between .among different types of non-work activities, and this paper will respect that tradition. We define total working time as the sum of time spent in market work, both paid and unpaid, and time spent in home work. Paid market work is what is measured in the CPS; unpaid market work consists of work-related activities like commuting and meal times at work. Home work includes cooking, cleaning and other indoor work, as well as shopping and vehicle maintenance. For simplicity, child care will be included in home work.

The distinction between leisure and household work can be controversial. The standard distinction was formulated by the economist Margaret Reid in 1934 : "If a third person could be paid to do the unpaid activity of a household member, then it is 'work'. This distinction works well for civic or community activities, or time spent playing with children, which are clearly leisure by this measure, but not so well for time spent teaching children, or, a new category in 2003, time spent undergoing security procedures at airports. Also by this measure, time spent in own education is leisure, while macroeconomists generally allow that this activity could be investment. Rather than classify these as leisure or personal care, we put these uses of non-working

time in "Other Activities". The concept of non-working time used here is essentially the "Leisure 2" concept developed in Aguiar and Hurst (2007), with non-discretionary time subtracted off.

In Table A1, we show the time allocation of married people between the ages of 18 and 65 over the four surveys. Minimum Maintenance refers to the non-discretionary component of personal care. It turns out that only 5% of observations have personal care time less than 50 hours; we therefore set the minimum at 50 hours. To eliminate noise from outliers, we also drop all respondents who are in the top percentile for child-care, market work or housework. With respect to market work, the table shows that married women's market labor supply increased by 7 hours from 14.8 hours weekly in 1975 to 21.8 hours in 2003, and that married men's stayed constant at 38.2 hours. Over the 1975-85 period, married women's market labor rose by 3.2 hours, from 14.8 to 17.6, while that of men fell by 2.6 hours, from 38.2 to 35.6 weekly hours. This implies constant per-capita labor supply of married people in the 1975-85 period, and a per-capita rise in labor supply of 3.5 hours weekly over 1985-2003.

How do these trends compare to those in the CPS? Figure 2 shows the annual series of weekly hours worked by married couples in the March CPS where the wife's age was between 18 and 65. This shows that wive's hours increased continually to 1997, from 10 hours in 1965 to 23 hours by 1997. Husband's hours fell from 38.5 in 1966 to 34.6 in 1975, and rose thereafter until 2000, peaking at 38 hours weekly. In 2003, wive's labor hours stood at 23 per week and that of husbands at 36.. This implies a 6-hour increase in per capita labor supply of married couples, compared to 3.5 in the time-use survey. So while the market labor supply data is not a perfect match for that of the March CPS, both datasets point to a significant increase in per capita hours of married people due to an increase of hours worked by the wives. The time-use surveys however miss the 4-hour increase in husband's market labor hours over from 1975 to 2000.

What is the source of the variation between the two datasets? Comparison with

the CPS results in Table 2 suggested that the 1965 and 1975 time surveys are not sufficiently representative of the married population. For 1985 the statistics of the two surveys are very close, and for 2003 the sample frames are identical, so that the discrepancies that year, slightly more than one hour for women and about two for men, probably indicate a shortcoming of the CPS rather than the other way around. Indeed in 1965 the sample was restricted to people living in cities with populations between 30,000 and 280,000, and so was not representative. The 1975 sample includes spouses of respondents, but re-weights the sample to make it representative.[17] The reason why labor supply in 1975 should be 10% higher in the time use study than in the CPS therefore remains unclear.

Home hours in Table A1 are the sum of time spent in child care, plus cooking and cleaning, shopping and other housework. Exclusive of childcare, housework time for wives declined by nine hours weekly between 1965 and 1975, and by four hours from 1975 to 2003. Time spent on childcare declines by 2 hours over 1965-75, but grows slightly thereafter. This latter trend is so slight that the decline in total housework over the period is the same as for the narrower measure of housework. For husbands total housework increases by 6 hours weekly over the entire period, mainly between 1975 and 1985. It is surprising that so little decline occurred outside this period, given the large change in the time allocation of the wives, but this again suggests non-comparability of the survey samples over time.

Combining market and housework, therefore, the table shows that total working time declined for both husbands and wives, but that all of the decline occurred between 1965 and 1975, and since then working time has increased by 3.5 hours for wives and 2.5 hours for husbands. Non-working time has therefore declined, by one

[17] With reweighting, the 1975 sample has 77% of the respondents married, whereas in the CPS only 68% of the population are married that year. That seems to indicate that oversampling of married people due to inclusion of the spouses in the time-use survey has not been correctly compensated by reweighting. Its not clear that this can explain the divergence with respect to hours of married people however.

hour more for wives than for husbands over the 1975-2003 period, but this difference is so small that the ratio of wife's non-working time to that of husbands has remained roughly constant at 1.07.

Aguiar and Hurst (2007) report that leisure for men increased by roughly 6-9 hours weekly and for women by roughly 4-8 hours weekly over the period 1965-2003. The trend in non-working time reported here is not strictly comparable to their leisure trend for a number of reasons. First the time frame we consider is the period of rising per-capita hours in paid labor. That began in the 1970s. Our measure of non-working time shows a four-hour increase for married men between 1969 and 1972, essentially zero thereafter. Second, the claim in this section is focused on one clearly defined 'demographic': married people between the ages of 18 and 65. They on the other hand are interested in a representative person of each sex, and so adjust their measures to purge the effects of changing demographics. To aid comparison with their findings, consider Leisure 1, their broadest measure of leisure that is wholly contained in non-working time. This measure accounts for about half of non-working time, the balance mostly going to discretionary personal care, and about 10% to other uses of non-working time. With respect to Leisure 1, husbands gained about four hours relative to wives over the period 1975-2003, while they lost about two hours of personal care time and an hour of other activities. However this is based on a measure of paid hours that is inconsistent with the CPS. If we were to substitute the working hours from the CPS for those of the time-use surveys, the result would be a three-hour decline in husband's non-working time relative to that of wives. Regardless of how one treats the discrepancy with the CPS, what we don't see in these numbers is evidence of a strong and consistent trend to higher non-working time for married men. In what follows, we will often refer to non-working time as leisure; this should be understood to include all uses of non-working time, not just leisure narrowly defined.

To create a measure of non-working time consistent with the hours data in the CPS, we estimate a regression equation relating unpaid-working time y_i in the time-

use surveys to variables in the PSID, including time spent in paid labor n_i and time spent in cooking and cleaning, h_i as well as other variables x_i such as age and household income. For each category j of non-working time, such as home production and unpaid job-related time, this results in a set of estimates $(\widehat{\alpha_{j0}}, \widehat{\alpha_{j1}}, \widehat{\alpha_{j2}}, \widehat{\alpha_{j3}})$ such that

$$y_{ij} = \widehat{\alpha_{j0}} + \widehat{\alpha_{j1}} h_i + \widehat{\alpha_{j2}} n_i + \widehat{\alpha_{j3}} x_i + \upsilon_{ji}$$

where υ_{ji} is the unexplained portion of the variation in non-working time, consisting presumably of idiosyncratic variation and measurement error.

These estimates are then used on the PSID sample to impute non-working time category for individual i in the PSID as a function of her variables (h_i, n_i, x_i) :

$$\widehat{y}_{ij} = \widehat{\alpha_{j0}} + \widehat{\alpha_{j1}} h_i + \widehat{\alpha_{j2}} n_i + \widehat{\alpha_{j3}} x_i$$

This procedure is carried out separately for groups defined by age range, sex and marital status. This results in 24 separate sets of regression results. Rather than report all the statistics from each of these tables, we show in Table A2 the R- squared from all the regressions for the two time-use categories of interest, home production and unpaid job-related time. The table shows that the model is particularly successful with respect to women's home hours, with r-squareds as high as 79%, and less so with those of men, where the r-squared ranges from 27% to 50%. Since the analysis is not at the individual level, the inability of the regression model to account for all of the idiosyncratic variation is not a big concern. The specification, along with estimated coefficients for married peoples home hours, is shown in Table A3.

A.5 Calibration of Family-Size Parameters

Table A4 shows the determination of partial effects by estimation of a regression equation of (log) total home hours on PSID data. These effects are used to calibrate the family-size function in the benchmark version of the model. We attempt to measure the various effects associated with the trend in housework hours by running

an OLS regression in which the dependent variable is the log of the sum of the housework hours of both head and spouse for married couples, and of the housework hours of the head for singles. The table reports the results when the excluded group is married with zero kids. Four specifications are reported, the simplest of which shows that married couples spend about 112% more time on housework than single males do, and 85% more than single females, after controlling for the number of children. Parents of one child spend 25% more time on housework, and for each additional child housework increases 9%. In the paper we set this last statistic to 10% as the effect of family on the results is so slight.

Specification 2 shows that non-linearity in the number of kids is not an issue; the coefficient on number of kids barely changes. Specification 3 shows that single men's housework increased significantly in the 1990s, despite evidence from Table 3 that family size was the same as in the 1970s, and that there was no significant decline in the housework time of single women. Specification 4 shows that working parents spend less time on their kids. The interpretation of the coefficients is ambiguous however, as it may be that parents who have less taste for kids, or those with kids who require less time (i.e. older kids) who choose to spend more time working.

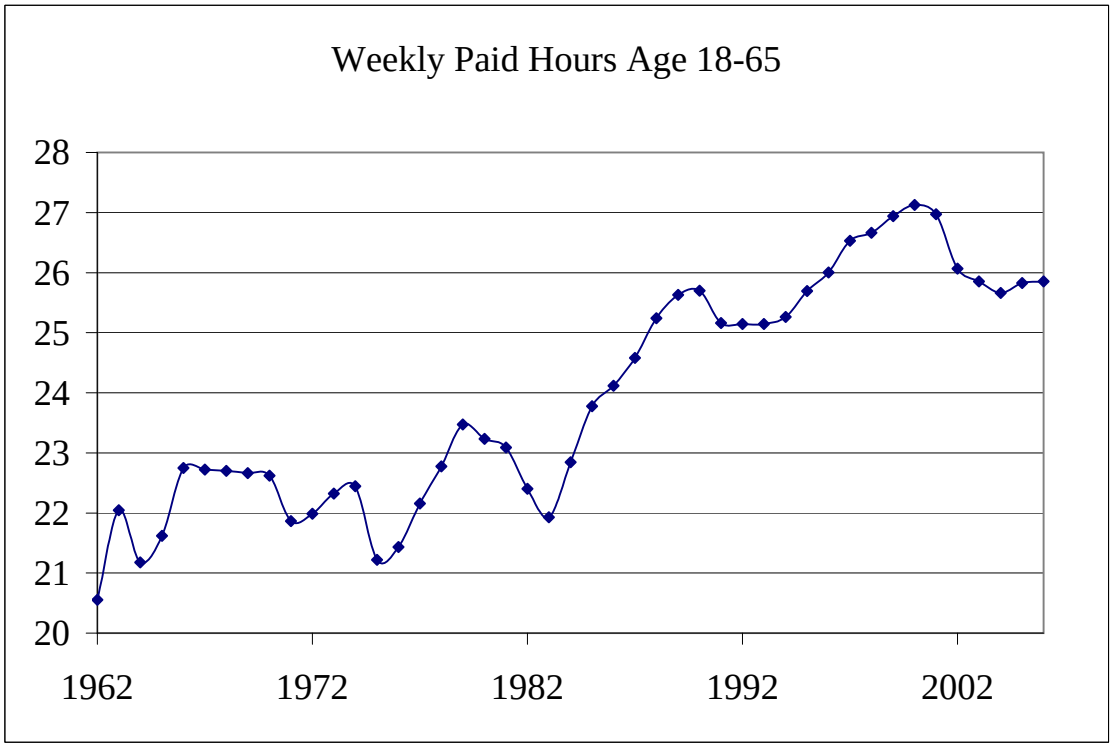

Figure 1: Per-capita hours in the March CPS; based on author's computations, using projections from intervalled data for 1962-67.

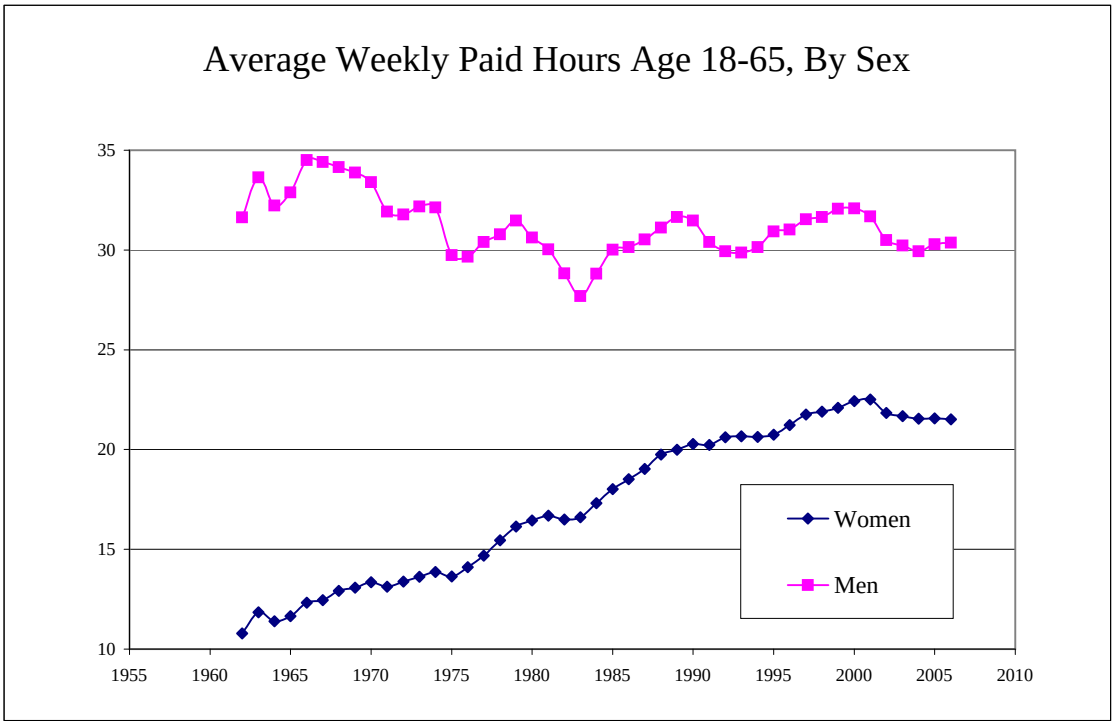

Figure 2: Per-capita hours by sex in the March CPS; based on author's computations, using projections from intervalled data for 1962-67

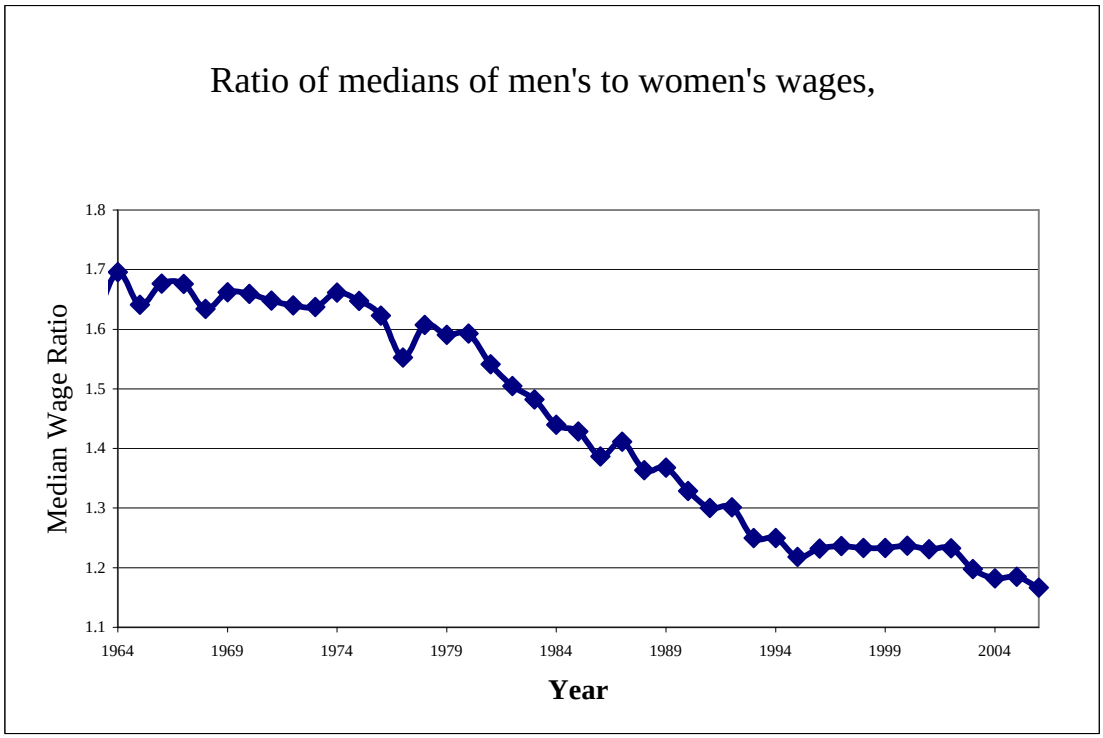

Figure 3: Median Wages by sex in the March CPS,25-50 years old, working 10 hours or more

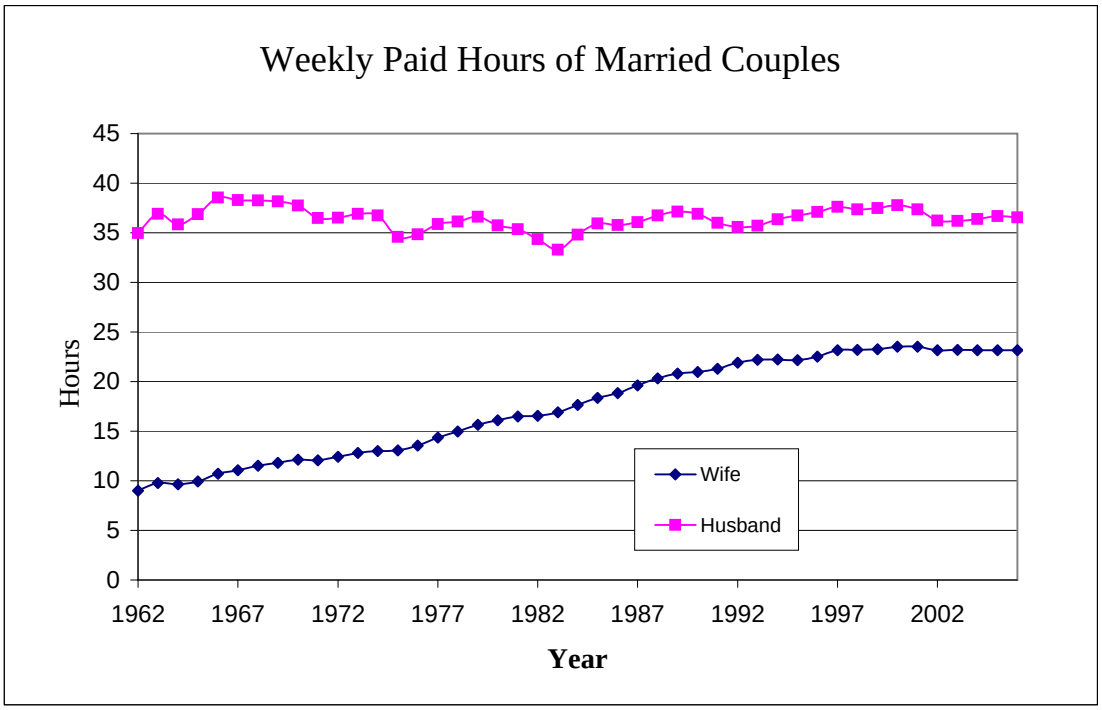

Figure 4: Weekly Paid Hours of Married Couples in the March CPS

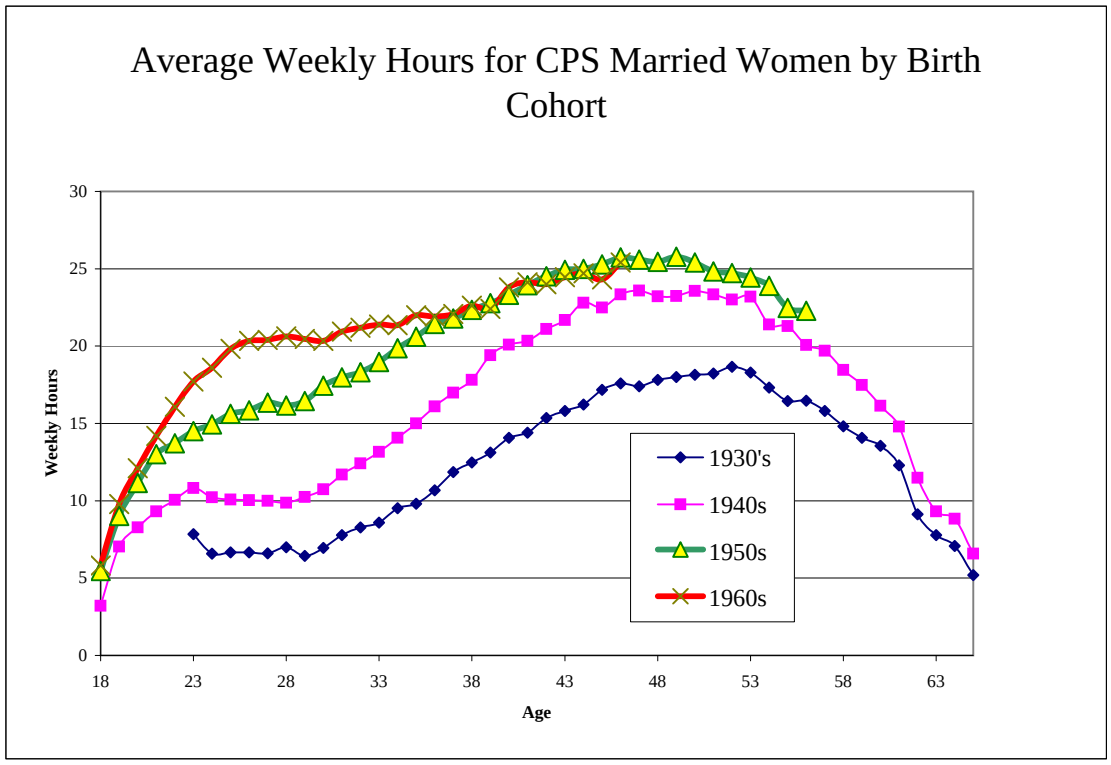

Figure 5a: Weekly Paid Hours of Married Women by Birth Cohort in the March CPS

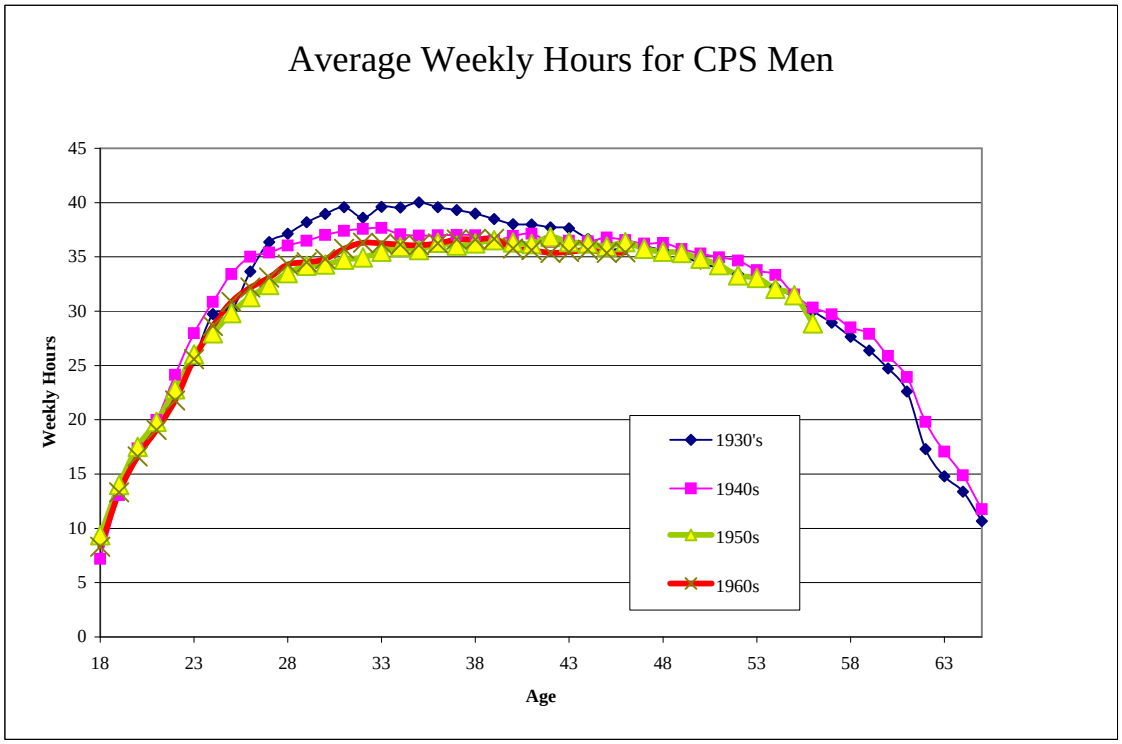

Figure 5b: Weekly Paid Hours of Married Men by Birth Cohort in the March CPS

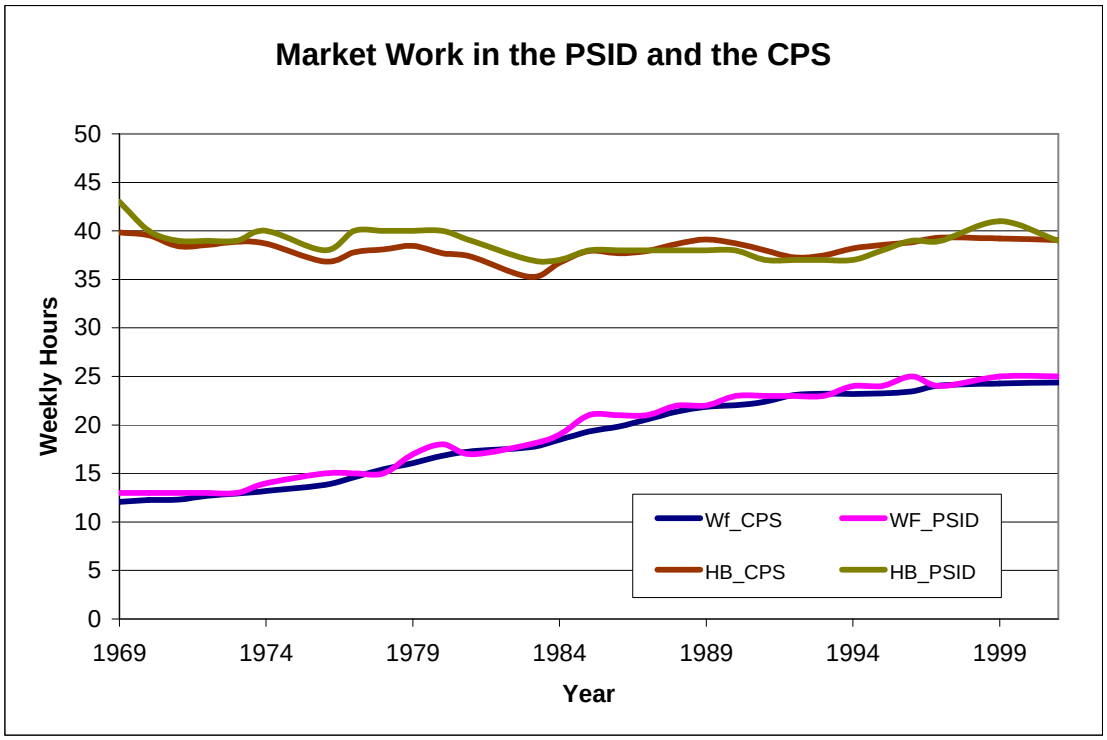

Figure 6: Correspondence of paid market hours in the PSID and the CPS

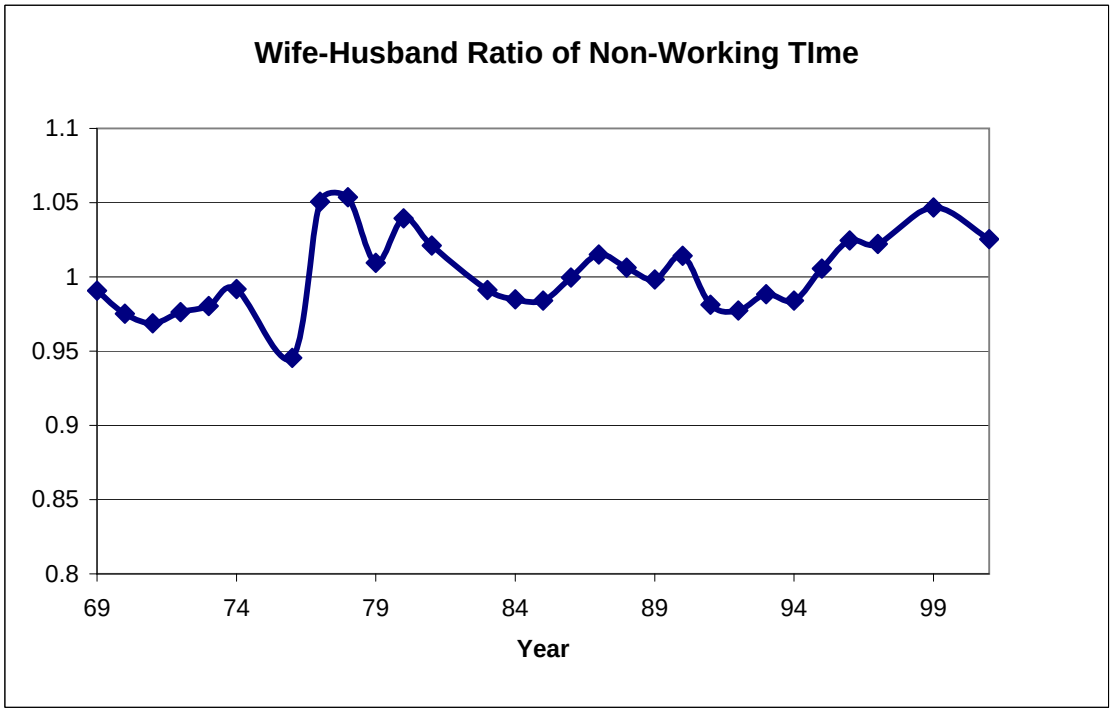

Figure 7: Relative Leisure in the PSID; non-working time imputed from time-use surveys

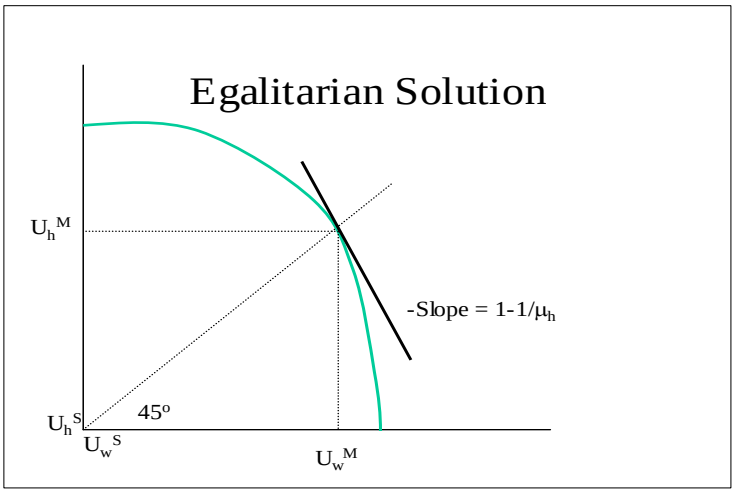

Figure 8: The egalitarian bargaining solution and the Pareto weight.

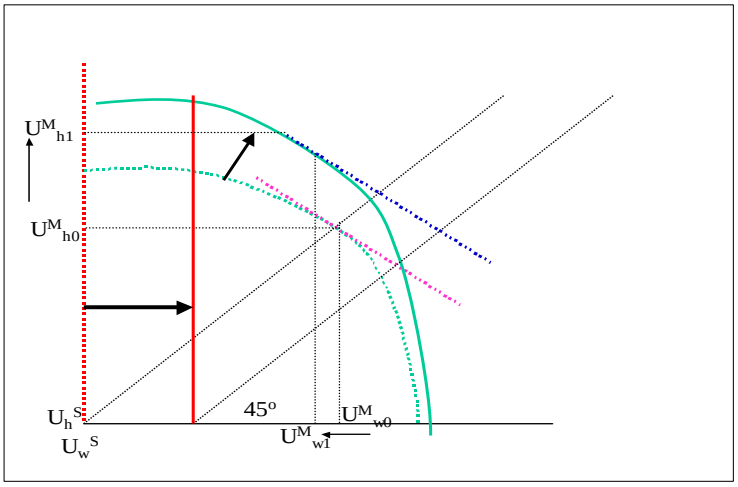

Figure 9 Part (a): The unitary solution responds to a rise in the wife's wage. Husband's utility increases, and that of the wife falls.

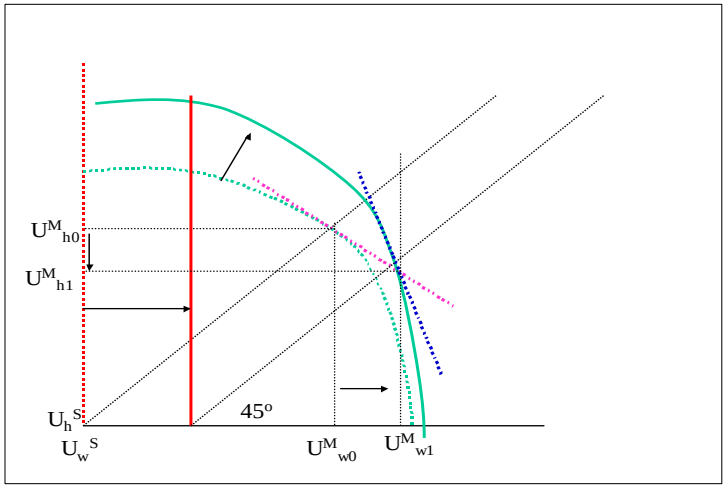

Figure 9 Part(b): The egalitarian solution responds to a rise in the wife's wage. Husband's utility fall, and that of the wife rises.

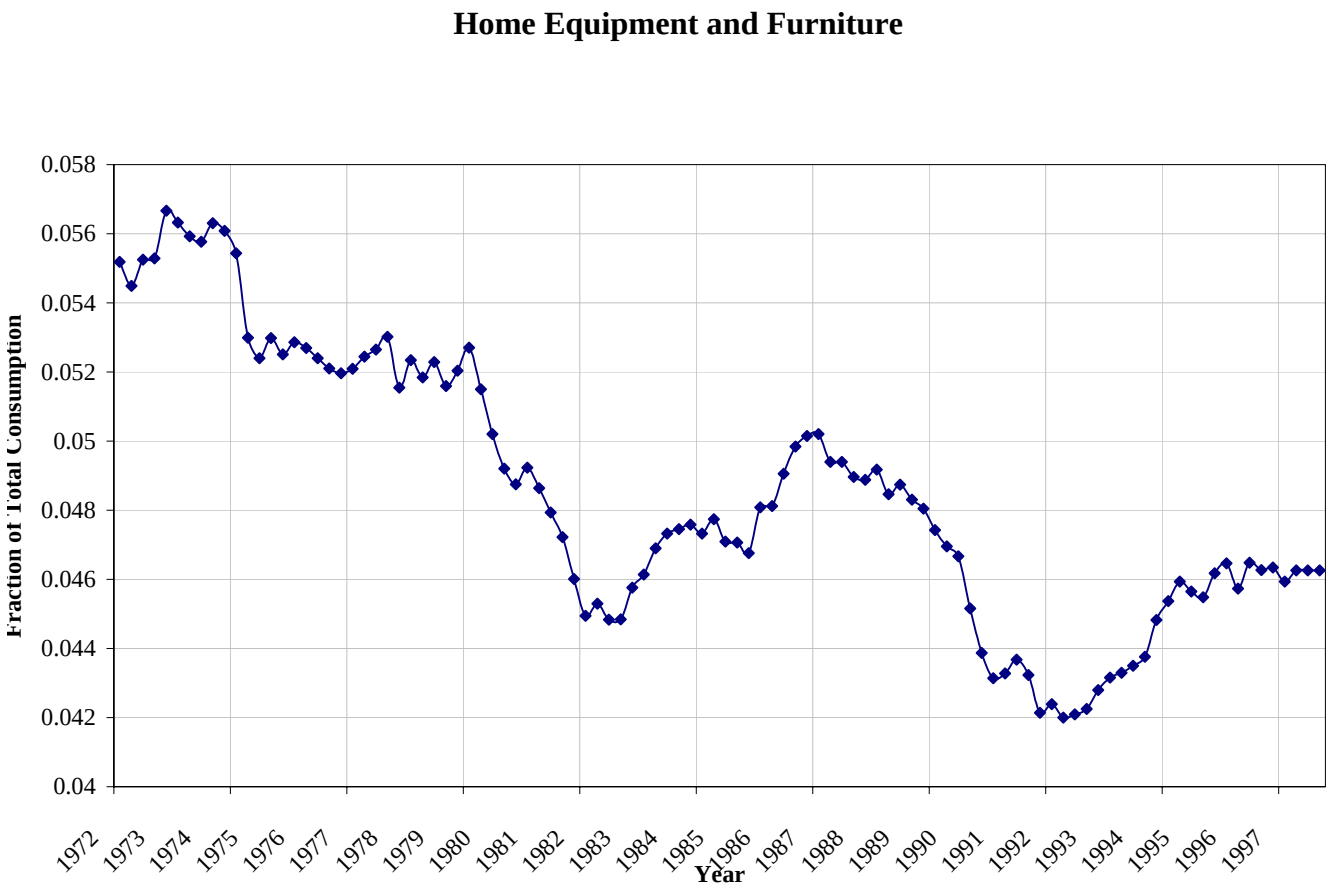

Figure 10: Spending share of Home Equipment in the NIPA, 1972-1997. Data from BLS web site.

Years	Sample		N	Weekly Hours
1962-65	Women	Single	20655	17.35
		Married	54042	9.14
	Men	Single	14853	20.05
		Married	49786	36.71
1969-74	Women	Single	74269	17.64
		Married	176342	11.61
	Men	Single	56557	21.01
		Married	157027	37.10
1984-90	Women	Single	133433	20.88
		Married	206784	17.75
	Men	Single	115282	23.94
		Married	191768	35.01
1994 - 2001	Women	Single	143061	22.32
		Married	198396	21.19
	Men	Single	126959	25.31
		Married	184141	36.21

Table 1: Trends in Paid Hours, March CPS ages 18-65

Years	Sample	Weekly Paid Hours		Total Job Hours
		CPS	Time_Use	Time_Use
1964-66	Wives	9.50	11.54	13.75
	Husbands	37.54	42.07	51.39
1974-76	Wives	12.15	14.80	17.51
	Husbands	35.00	38.17	44.71
1984-86	Wives	16.51	17.60	20.69
	Husbands	34.24	35.51	41.68
2002-04	Wives	21.66	21.82	23.84
	Husbands	36.18	38.20	42.25

Table 2: Paid Hours of married people: CPS vs Time-Use surveys for 1965, 1975, 1985 and 2003

Sample	Time Interval	Market Hours			Home Hours	Total Working	Non-Working	Number of Kids	Family Size	N
		Paid	Unpaid	Total						
Single Men	1969-1974	34.00	7.52	41.52	13.96	55.48	62.52	0.21	1.41	1138
	1994-2001	37.00	6.29	43.29	15.63	58.92	59.08	0.20	1.40	5031
Single Women	1969-1974	27.00	5.33	32.33	23.09	55.42	62.58	0.67	1.98	2944
	1994-2001	32.00	4.95	36.95	20.71	57.66	60.34	0.69	1.95	8811
Husbands	1969-1974	39.00	10.71	49.71	12.73	62.45	55.55	1.41	3.66	10976
	1994-2001	40.00	8.02	48.02	18.69	66.72	51.28	0.97	3.18	20482
Wives	1969-1974	14.00	2.77	16.77	45.48	62.25	55.75	1.41	3.66	8022
	1994-2001	25.00	4.43	29.43	32.64	62.07	55.93	0.97	3.18	13948

Table 3: Time allocation by sex and marital status . Author's computations from the PSID. Home hours and unpaid working hours are imputed from cross-sectional time-use surveys. Unpaid working time includes commuting and social activities at work. Home hours includes child care and shopping time.

			Data	Model
Home Hours	Married	Men 1970s	12.73	12.85
		Women 1970s	45.48	45.83
		Men 1990s	18.69	18.57
		Women 1990s	32.64	32.86
	Singles	Men 1970s	13.96	13.96
		Women 1970s	23.09	22.89
		Men 1990s	15.63	15.64
		Women 1990s	20.71	20.93
% Extra Hours per Mom			16.0%	16.0%
% Extra Hours per Child			10.0%	10.0%
Expenditure Share of Home Equipment			2.5%	2.5%
Leisure	Husbands 1970s		55.19	55.19
	Wives 1970s		56.14	56.14
	Wife/Hub 1990s		1.075	1.075

Table 5: Calibration Targets for Benchmark Model

Value	Parameter
2.7617	%base size married
1.3711	%base size female
1.1427	%base size single male 1970s
0.1064	%size per additional kid
0.5503	%curvature of family size
1.3224	%base size single male 1990s
0.1179	%equipment share of output
1.1052	%men's tfp 1970s
1.4491	%substitutabilty
1.0417	%men's tfp 1990s
0.9449	%women's tfp 1990s
1.5777	leisure utility
1.2325	women's relative taste for single life
0.0241	utility for public goods

Table 6: Parameters for Benchmark Model

			Data	Model
Single's Leisure		Men	62.52	63.47
		Women	62.58	57.29
Market Labor	Married	Men	49.71	49.96
		Women	16.77	16.00
	Singles	Men	41.52	40.60
		Women	32.33	37.85
Full Income Ratio of Singles to Married		Men		0.71
		Women		0.39
Women/Men Singles Income Ratio				0.55
Per-Capita Hours			34.35	34.86

Table 7: Non-Targetted Statistics for 1970s

						Experiments						
			Data 1970s	Data 1990s	Benchmark Model 1990s	1 Mu Fixed	2 Wage Fixed	3 P Fixed	4 Bils Price Correction	5 Home Time Fixed	6 Fam Fixed	7 TFP Increase
Leisure	Married	Men	55.55	51.28	54.22	60.88	55.37	52.12	54.29	53.64	53.69	55.59
		Women	55.75	55.93	57.30	49.57	46.94	57.80	61.03	55.92	57.27	56.75
	Singles	Men	62.52	59.08	62.41	62.41	62.41	61.37	63.90	63.07	62.37	63.73
		Women	62.58	60.34	58.67	58.67	58.28	57.38	60.22	59.12	58.21	57.71
Market Labor	Married	Men	49.71	48.02	45.21	38.59	50.57	45.82	46.48	51.52	44.95	49.91
		Women	16.77	29.43	26.86	35.60	27.66	24.61	26.46	16.21	26.48	16.64
	Singles	Men	41.52	43.29	39.95	39.95	39.95	39.67	39.55	39.27	39.94	40.72
		Women	32.33	36.95	38.40	38.40	38.40	37.90	38.29	37.91	38.21	38.04
Per Capita Labor		1970s Dist.	34.35	39.15	36.97	37.72	39.13	36.29	37.20	35.28	36.72	35.11
		1990s Dist.	34.86	39.34	37.41	38.01	39.14	36.79	37.55	35.95	37.19	35.96
Home Hours	Married	Men	12.73	18.69	18.57	No Effect	12.05	20.07	17.24	13.92	19.33	12.50
		Women	45.48	32.64	32.86		43.41	35.58	30.51	45.85	34.21	44.60
	Singles	Men	13.96	15.63	15.64		15.64	16.96	14.55	13.92	15.69	12.84
		Women	23.09	20.71	20.93		21.49	22.72	30.51	22.87	21.62	63.73
Full Income Ratio of Singles to Married		Men	N/A	N/A	0.63	No Effect	0.69	0.64	0.63	0.66	0.64	0.71
		Women			0.45		0.39	0.45	0.45	0.46	0.45	0.39
Women/Men Singles Income Ratio					0.71		0.57	0.71	0.72	0.69	0.71	0.55

Table 8: Empirical and Model Results For 1990s

Variables	1965		1975		1985		2003	
	Wives	Husbands	Wives	Husbands	Wives	Husbands	Wives	Husbands
Total Hours Per Week	168	168	168	168	168	168	168	168
Minimum Maintenance	50	50	50	50	50	50	50	50
Discretionary Time	118	118	118	118	118	118	118	118
Market Work	11.54	42.07	14.8	38.17	17.6	35.51	21.82	38.2
Commute+Work-Related	2.21	9.32	2.71	6.54	3.09	6.17	2.02	4.06
Total Market	13.75	51.39	17.51	44.71	20.69	41.68	23.84	42.25
Cooking and Indoor Chores	26.99	1.66	21.31	1.98	17.99	3.81	14.86	3.33
Shopping	7.28	4.68	6.18	3.8	7.25	4.69	6.55	4.24
Other Home Production	2.79	2.92	2.36	4.53	2.72	5.62	4.06	7.01
Subtotal Home Non-Child	37.06	9.26	29.85	10.31	27.96	14.12	25.48	14.57
Child Care	6.01	0.82	4.23	1.06	4.55	1.03	4.83	1.65
Total HouseWork	43.08	10.08	34.07	11.37	32.52	15.16	30.31	16.23
Total Working Time	56.82	61.47	51.58	56.09	53.21	56.83	54.14	58.48
Non-Working Time	61.18	56.53	66.42	61.91	64.79	61.17	63.86	59.52
Net Personal Care	23.95	21.14	25.4	23.31	25.37	23.05	24.44	20.12
Leisure 1	32.23	31.17	34.5	33.07	33.91	34.67	32.43	35.51
Other Non-Working Time	5	4.21	6.52	5.53	5.51	3.44	7.45	5.39
Sample Size	739	696	697	655	1122	966	4116	3774

Table A1. Author's computations from married people aged 18-65 in time-use surveys. Sample excludes top percentile in child care, market work and home production, and bottom percentile in Personal Care. Observations with more than 4 weekly hours unaccounted for were dropped from the sample.

		Married		Single	
	Age	Home Hours	Unpaid Work	Home Hours	Unpaid Work
Women	18-24	0.735	0.793	0.500	0.485
	25-55	0.651	0.449	0.616	0.432
	56-65	0.676	0.523	0.666	0.620
Men	18-24	0.341	0.479	0.274	0.401
	25-55	0.406	0.381	0.382	0.331
	56-65	0.371	0.434	0.498	0.507

Table A2: R-squared from imputation regressions in time-use surveys

Variable	Women			Men		
	18-24	**25-55**	**56-65**	**18-24**	**25-55**	**56-65**
Age	190.780	1.875	29.411	-351.740	1.171	92.420
Intercept	-1350.470	5.460	-554.951	2517.430	-1.907	-1778.410
Number of Kids	1.880	1.403	-16.531	5.620	0.798	-10.570
Working	-2.780	0.544	0.547	-4.090	0.566	-1.950
Age Squared	-888.970	-6.583	-50.450	1639.840	-2.597	-157.780
Age Cubed	137.710	0.661	2.885	-253.650	0.188	8.940
College Degree	1.080	-0.548	-2.848	-6.660	-0.966	-2.050
Attended College	-0.160	1.441	3.079	2.370	0.552	0.730
Income in Second Quartile	-0.480	1.158	-0.671	-1.700	0.374	1.380
Income in Middle Quartile	1.390	0.127	0.656	57.630	1.604	1.380
Income in Top Quartile	0.730	1.668	1.153	0.170	0.635	0.950
High School Diploma	-0.770	0.590	-2.206	7.270	1.026	-1.340
Number of Kids Squared	1.370	0.140	15.597	-2.560	-0.073	6.030
Number of Kids Cubed	-0.220	-0.017	-2.325	0.240	-0.002	0.320
Cooking and Cleaning Hours	1.490	1.040	1.013	-0.730	1.166	0.650
Zero time Cooking and Cleaning	-2.380	-0.994	-2.465	-2.780	-0.177	-0.850
Cooking and Cleaning Hours Squared	-0.010	-0.008	-0.005	0.230	-0.017	0.000
Cooking and Cleaning Hours Cubed	0.000	0.000	0.000	-0.010	0.000	0.000
Trend x Cooking/Cleaning Time	-1.390	0.400	0.111	-2.290	-0.027	1.440
Trend Squared x Cooking/Cleaning Tii	0.040	-0.017	-0.011	1.070	0.004	-0.080
Trend	0.580	-0.295	-0.299	0.700	0.089	-0.280
Trend Squared	-1.380	0.466	0.616	-0.670	-0.160	0.590
Trend x College Degree	-0.020	0.101	0.104	0.150	0.058	0.020
Trend x Attended College	0.000	-0.045	-0.118	-0.100	-0.015	-0.060
trend_hi_skool	0.110	0.071	0.129	-0.540	0.028	0.180
Trend x Number of Kids	0.200	0.045	0.175	-0.010	0.022	0.520
Trend x Number of Kids Squared	-0.060	-0.010	-0.109	-0.010	-0.001	-0.260
Hours of Paid Work	-0.280	-0.087	0.098	-0.030	-0.352	0.010
Hours of Paid Work Squared	0.000	-0.006	-0.010	0.000	0.004	-0.010
Hours of Paid Work Cubed	0.000	0.000	0.000	0.000	0.000	0.000

Table A3: Regression Model Coefficient Estimates for Home Hours of Married People in the Time-use surveys

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	4.2435	4.2519	4.2797	4.1538
	(0.026)	(0.026)	(0.027)	(0.026)
1980s	0.0527	0.0498	0.0558	0.0665
	(0.005)	(0.005)	(0.005)	(0.005)
1990s	-0.025	-0.041	-0.064	-0.007
	(0.005)	(0.005)	(0.006)	(0.006)
Single Male	-1.123	-1.122	-1.238	-1.152
	(0.006)	(0.006)	(0.009)	(0.009)
Single Female	-0.855	-0.855	-0.843	-0.774
	(0.004)	(0.004)	(0.007)	(0.007)
Parent	0.162	0.1547	0.1494	0.1351
	(0.006)	(0.006)	(0.006)	(0.006)
Number of Kids	0.0894	0.0855	0.0823	0.0637
	(0.002)	(0.002)	(0.002)	(0.002)
Number of kids, 1990s	.	0.0145	0.024	0.0233
	.	(0.003)	(0.003)	(0.003)
Single Male, 1990s	.	.	0.1697	0.1131
	.	.	(0.011)	(0.011)
Single Female, 1990s	.	.	-0.016	-0.056
	.	.	(0.009)	(0.008)
Head works Full Time	.	.	.	-0.209
	.	.	.	0.004
Head does no Paid Work	.	.	.	0.0714
	.	.	.	(0.005)
Age	-0.032	-0.032	-0.032	-0.021
	(0.001)	(0.001)	(0.001)	(0.001)
Age Squared	0.0004	0.0004	0.0004	0.0003
	(0.000)	(0.000)	(0.000)	(0.000)
R-Squared	0.6318	0.6319	0.6334	0.6599
N	65900	65900	65900	65900

Table A4: Estimation of child effects on hours of home labor; data from PSID, ages 18-65. Dependent variable is home hours as imputed from time-use surveys. Standard errors in parentheses.