

Why are Married Men Working So Much? An Aggregate Analysis of Intra-Household Bargaining and Labor Supply.

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August 2012

Abstract

Are macro-economists mistaken in ignoring bargaining between spouses? This paper argues that models of intra-household allocation could be useful for understanding aggregate labor supply trends in the US since the 1970s. A simple calculation suggests that the standard model without bargaining predicts a 19% decline in married-male labor supply in response to the narrowing of the gender gap in wages since the 1970s. However married-men's paid labor remained stationary over the period from the mid 1970s to the recession of 2001. This paper develops and calibrates to US time-use survey data a model of marital bargaining in which time allocations are determined jointly with equilibrium marriage and divorce rates. The results suggest that bargaining effects raised married men's labor supply by about 2.1 weekly hours over the period, and reduced that of married women by 2.7 hours. Bargaining therefore has a relatively small impact on aggregate labor supply, but is critical for trends in female labor supply. Also, the narrowing of the gender wage gap is found to account for a weekly 1.5 hour increase in aggregate labor supply.

JEL Codes: E130, J120, J160, J200, J220

JEL Keywords: General Aggregative Models: Neoclassical; Time Allocation and Labor Supply; Economics of Gender; Marriage; Marital Dissolution;



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[‡]I am grateful to Jeremy Greenwood, Nezih Guner, Iouri Manovskii, Guido Menzio, Andrew Postlewaite, Victor Rios-Rull, Larry Samuelson, Raul Santaella-Llopis and Gustavo Ventura for helpful discussions.

1 Introduction

The economic position of women appears to have improved significantly relative to that of men over the last forty years, as reflected in higher wages and stronger career prospects. Figure 1(a), for instance, shows that the mean wages for workers with more than 10 average weekly hours converged strongly over the period 1975-2001. To the extent that such changes improve the bargaining position of women relative to men, they provide an opportunity to contrast the aggregate implications of the “unitary” view of the household that dominates macro-economic analysis with the “collective” view increasingly favored by micro-economists.

The potential impacts of wage convergence have not been extensively studied at the aggregate level, largely because macro models of the household tend to ignore questions of intra-household allocation.¹ This paper asks whether extending a standard macro model to include bargaining between spouses can enrich our understanding of the rise in married-women’s labor supply observed in the US over the period 1975-2003. The implications for aggregate labor supply and the decline of marriage are also examined. The analysis relies on a simple model of equilibrium bargaining between spouses that is both tractable and compatible with the highly aggregated models used in macroeconomics.

While the evidence for reallocations in response to improved outside options is quite strong at the micro level, macroeconomic models with households usually abstract from such effects by assuming that the household acts as an economic agent with a stable utility function. At the level of the micro data on labor supply, this “unitary” assumption has been shown repeatedly to be inferior to an approach that allows allocations within the marriage to depend on the economic position outside the marriage. For instance, Chiappori, Fortin, and Lacroix (2002) find that the data rejects the unitary model in favor of the “collective model with distribution factors”, which is essentially an empirical implementation of bargaining between spouses, in the tradition of McElroy and Horney (1981). Empirical support for inter-temporal implications of this model was provided by Mazzocco (2007). The comparative neglect of inter-spouse bargaining by macro-economists is all the more surprising considering the central role of bargaining in the labor-search literature, and the obvious parallels between employment and marriage relationships, as discussed in Burdett and Coles (1999).

From the point of view of empirical analysis, an important advantage of employment relationships is that wages and output are in principle observable, while the utility allocation between spouses in a marriage is not. The standard practice in the collective-model literature has been to study paid labor time as a proxy for intra-household allocations; the implicit assumption has been that paid labor is negatively related to leisure, and that an improvement in the outside option of the wife will result in an increase in her leisure, and hence a decline in her paid labor. A well-recognized problem with this approach is that it is only valid if the relative prices faced by the married household, as well as its wealth, are invariant to the forces underlying the changes in the outside options. Hence the collective-model literature is limited to the study of effects that leave these unchanged, such as local variations in divorce laws and in sex ratios of singles. Analysis of changes in relative wages therefore requires a more structural approach which can account for income and substitution effects of wages.²

¹For a recent exception, see Lise and Seitz (2011), who find that accounting for trends in intra-household inequality substantially reduces the apparent increase in consumption inequality over the last 30 years.

²Browning and Gortz (2006) find that variation in wife’s leisure across Danish households is positively correlated with her consumption expenditures, supporting the hypothesis of bargaining over that of preference heterogeneity. This also rationalizes the use of leisure as a proxy for relative welfare in the household.

The assumption that time outside of paid work equals leisure time is also unsuitable for historical comparisons of leisure allocations, because it ignores the time married people spend in household chores. Indeed Greenwood, Seshadri, and Yorukoglu (2005) [GSY hereafter] have argued that rising labor productivity at home accounts for roughly half of the increase in married-women's labor supply since 1945, as the time required to accomplish the chores has diminished, due to the decline in prices of labor-saving home equipment. Over the 1975-2003 period, NIPA deflators show that in 2003 the price of home equipment relative to consumption prices stood at about 25% of the 1975 level. Since the main predictions of bargaining models for labor supply are based on the allocation of leisure, this suggests that it may be misleading to make inferences from labor supply without accounting for home-production time.

A sensible rationalization of the macro-economist's neglect of intra-household bargaining might be that the aggregate effects of reallocation are likely to be small. Jones, Manuelli, and McGrattan (2003) [JMM hereafter] have shown that a standard unitary household model with home production can explain the rise in married women's labor supply since 1950 in response to either the trend in the female-male wage ratio or in response to rising productivity at home, as in GSY. In both cases, they find that calibration to US data implies that married men's labor supply should have fallen, by somewhere between 5-8 hours weekly. However Figure 1(c) shows that married men's weekly paid work hours, after a significant decline in the 1960s, remained essentially stationary over the 1972-2001 period while women's relative wages were rising. This suggests that the shortcomings of the unitary model may be significant at the macro level. This may have direct implications for aggregate labor supply, which increased by roughly 20% over the same period.

In this paper I show, using American surveys of household time use, that the problem of relative leisure is robust to accounting for home production. While total working time of married people, both men and women has increased since 1975, the ratio of husband's non-working time to that of the wife is roughly constant over the period. This is supported by similar findings by Bech-Moen (2006) for the US and Norway. Composition effects do not appear to be the main explanation: slicing the data more finely to account for heterogeneity in education, age or female labor force participation only exacerbates the problem: the relative leisure of wives actually increased in most of the sub-categories, declining only among couples over age 50. Indeed, Burda, Hamermesh, and Weil (2007), noting that the leisure ratio is independent of relative wages across a wide range of countries, call this the "iso-leisure" pattern, which they explain on the basis of social norms.

The argument developed here proceeds in two stages; first a model of marriage and allocations is developed; the model is equipped with a standard CES home-production technology, CRRA preferences, and a stochastic process for marriage quality. The marriage-equilibrium concept is similar to that of Chade and Ventura (2005) but allows for intra-household bargaining, as in McElroy and Horney (1981). Without bargaining, the model predicts a 12% decline in the leisure ratio, in response to the shrinking of the gender gap in wages. Given a level of married leisure of roughly 61 weekly hours per capita in 1975, that translates into a 7 hour weekly decrease in married-men's working time.

From the point of view of matching the iso-leisure fact, the key feature of the model is that the bargaining position of the spouses depends on the marriage-matching equilibrium, which depends in turn on the relative wage. The model shows that the stationary leisure ratio can be easily explained by the impact of relative wages on bargaining position, and hence without reference to social norms. While the model is very stylized, this basic insight is clearly characteristic of the broad class of models used in macro-economics; the most important assumption being that household utility is within the CES class and separable across goods.

In the second stage, the paper proposes answers to the essentially quantitative questions raised above: how much does intra-household bargaining change the model's responses of labor supply and

home production time to relative wages, taxes, equipment prices or other shocks to the economic environment? How much do each of these shocks contribute to the rise in aggregate labor supply?

The model is first calibrated to match time allocations for 1975 and 2003, so as to permit an accounting decomposition of the changes over time. Values for wages, non-labor income and tax rates are fed in from survey data. We allow preferences and technology to be specific to each household type/year; the paper shows how the parameters are identified explicitly from the moments of the data, so the model matches the time-allocation statistics and identifies shifts in technology and preferences. We then calibrate the marriage-matching process to observed marriage and divorce rates, allowing the value of single life to shift over time so as to match the marriage rates.

This benchmark version of the model is then compared with the "unitary" version, in which the Pareto weights on the spouses are held constant, to make it comparable to the standard macro approach. Finally, the model is subjected to a series of computational experiments in which all variables but one are kept at their 1975 levels; these experiments are carried out in both the unitary and bargaining versions of the model.

With regards to explaining the rise in wife's paid labor, the results suggest that the most important force is the closing of the gender gap in wages, as in JMM. This is more than simply a reallocation between husband and wife; the average labor supply of married couples increases by more than 6 weekly hours. However bargaining turns out to have little effect on per-capita hours, justifying the neglect of bargaining in models at the highest level of aggregation. With the Pareto weights constant, the error in the predicted per-capita hours is 0.8 hours, about 12% of the increase observed since the 1970s.

In contrast to GSY, improvements in the home-production technology or the decline of home-equipment prices seem to have little impact on female labor supply. This is because accounting for the cost of husband's time in home production reduces the measured equipment share in the home production technology to the point that diminishing marginal returns preclude any major impact of labor-saving equipment on time allocation. In the benchmark model, the declining equipment price frees up 1.2 hours of the wife's time from home production, but most of this is absorbed into higher leisure. These two features, absent in GSY, plus the fact that the current paper is focused on a later period in time, would appear to explain the divergence from their results.

Relative to the large literature on female labor supply and intra-household allocation, the main theoretical contributions of this paper are 1) to put the model into an equilibrium context, where the outside options are determined endogenously, and 2) to develop a simple version of the model that relates directly to the models used in macroeconomics. These features mean that allocations between married couples can be related, through the model, to data on marriage and on the time-use decisions of single-person households; this disciplines the values of the outside options in the calibration.

The model in the current paper can be seen as extending the two-period marriage-market models of Greenwood, Guner, and Knowles (2000) and Greenwood, Guner, and Knowles (2003), where the analysis is limited by wage heterogeneity to one or two marriage opportunities per lifetime. A recent paper in which marriage and intra-household outcomes are modeled as jointly determined is Choo, Seitz, and Siow (2008); they analyze female labor supply but, in the absence of a bargaining model are limited to the consideration of distribution factors, like the sex ratio. Similar concerns are also addressed in a recent paper on paid labor supply and marriage by Jacquemet and Robin (2011).

It is important to stress that the extreme simplicity of my approach precludes direct comparison with life-cycle models of the trends in female labor supply. Attanasio, Low, and Sanchez-Marcos (2008) (ALS hereafter), for instance, use a lifecycle model to consider the role of returns to experience and the costs of child-raising; they abstract however from intra-household allocation and marriage decisions. My model on the other hand abstracts from important features in the ALS model, such

as age and the intensive/extensive margin distinction; the results of this paper suggest that it would be useful to extend the lifecycle approach to allow for marriage decisions and bargaining between spouses.

2 Trends in Time Allocation

The data sets usually used in the analysis of labor supply lack systematic information on unpaid work; this turns out to be critical for distinguishing different versions of the household model, which hinges on the response of total work time, including unpaid work, to changes in relative prices. The goal of this section is to document patterns in non-working time by studying these changes. The strategy is to use the March CPS, the standard source of macro labor-time data, to document the trends in paid labor and relative wages and show that the trends are driven by the behavior of married people. Since unpaid work time is not documented in the CPS, we then turn to time-use surveys and show that the relative leisure ratio has been stationary over the 1975-2003 period. In the Appendix, we propose a reconciliation of the discrepancies between the two data sources.

2.1 Paid-Labor Supply Trends: CPS

Figure 1(c), which shows the labor-supply trend by sex and marital status, the trend in relative wages, and the per-capita hours trend, is based on the March Supplement of the CPS, from 1962 to 2006. To filter out the role of cyclical fluctuations, Table 1 averages the data over several years. The population is restricted to civilians age 18 to 65, a standard definition of working-age adulthood. 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 the reported hours worked last week.³

For married women it is clear that average weekly hours of paid labor increased steadily, from an average of 11.8 in the 1962-66 period to 22.97 in 1994-2001. For single women, there is no trend, hours fluctuate between 22 and 26 over these periods. For single men, the pattern is similar, a stationary series that fluctuates between 24 and 28 weekly hours. For married men, hours are essentially constant at 36 from 1976-2003.

The wage trend shown in Figure 1(a) is computed by dividing annual earnings by annualized hours worked, as given by the hours worked last week response. To avoid noise from people with low hours, the sample for this calculation is restricted to people who worked at least 10 hours.

Average hours worked per person in 1971 was 24.7, slightly lower than in 1962. Figure 1(b) shows that, over the next 28 years, average hours rose steadily to 29.3 in 2000, an increase of nearly 18%.

To compare the lifecycle and cohort effects, Figure A1 (appendix) 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.

It may be interesting to explore the possibility that the lack of trend in husband's hours is driven by conflicting trends between households where the wife works and those where she doesn't, or by

³Similar results obtain if instead we multiply usual weekly hours by number of weeks worked.

a rise in household where the wife works. Figure A1 shows that for wives aged less than 50 years, husband's hours are stationary after 1974 for both household types. In all cases, husbands work more in households where the wife is also working. For households where the wife is older than 50, there is decline in husband's hours until 1984 for households where the wife is not working, and stationarity thereafter. The stationarity of husband's paid working hours therefore holds even when age and labor force status are accounted for, except that, for the oldest group, the stationary period starts somewhat later.

Another possibility is that paid work hours are fixed by custom at a rigid number, such as 40 hours per week. We measure average weekly hours in the March CPS in the 1990s by age, sex and occupation type (managerial/professional versus other). As Figure A3(a) in the appendix shows, the median, at all age groups in the 1990s is indeed 40. Furthermore, for men older than 25, the 25th percentile is also close to 40. However in all cases, a significant fraction of working people work 30 hours or less, or 60 hours or more, per week, even conditional on age and occupation type. This analysis suggests that there is no lack of options for adjusting paid-working time. In any case, the model implies that if this constraint is binding, the household can respond by adjusting home work hours, which are presumably free from the institutional rigidities that operate in the work place.

2.2 Non-Working time: The Time-Use Surveys

To track trends in unpaid work and hence non-working time, we follow the existing literature in relying on a collection of cross-sectional time-use surveys beginning in 1965 and culminating in the first wave of the American Time Use Survey in 2003. These appear to be the only source of representative data on home production time apart from cooking and cleaning, notably child care and shopping time, as well as unpaid work time and leisure activities. This is important because it is well-known (see Gershuny and Robinson (1988)) that married-couple's allocation of home-production time has shifted since the 1960s, with husbands apparently bearing a larger share of house work than in the past.

Because of inconsistent design over the years, comparison of variables from the time-use surveys requires standardization of activities into broader categories. Results for this type of exercise are reported by Robinson and Godbey (1997) and Aguiar and Hurst (2007); from the regression methods of the latter, for instance, we learn that, over the period 1965-2003, leisure for men increased by roughly 6 to 9 hours per week (driven by a decline in market work hours) and for women by roughly 4 to 8 hours per week. Robinson and Godbey (1997) also finds that women's total work declined over the 1965-1985 period.

For the purposes of the current paper, however, a closer look at the data is warranted for three reasons. First, while the existing results concern the population as a whole, we need to examine the time allocation of married people. Second, the results reported in previous papers concern trends since 1965, with little information on the period that is critical for the analysis here, 1975 to the end of the 1990s. The 1965 survey is not in fact representative, as the representative component consists of a small ($n=1200$) sample that restricts attention to people living in cities of population 30,000 to 280,000. Finally, while the labor literature analyses trends in leisure, defined as time in specified non-work activities such as attending social functions or watching TV, in the macro literature it is standard to divide discretionary time into paid work, home-production and non-working time.

Of the 168 hours available each week, it is assumed that the minimum time required for sleep and personal care is 50 hours, which turns out to be the first percentile in the pooled data for 1965, 1975, 1985 and 2003. The exact number assigned to this minimum time is without consequence for the analysis. The important point is that time spent in sleep and personal care includes a discretionary component, as documented by Biddle and Hamermesh (1990). This paper assumes discretionary

time is allocated between paid work and unpaid work; the residual is taken to be non-working time. The variables making up each of these categories are taken from the definitions of Aguiar and Hurst (2007).

Table 2(a) reports the time allocation of married people aged 18-65 according to these surveys. The table shows that working time did decline over the longer period since 1965, but all of this decline was before the period of interest begins in 1975. Since then the working time of both married men and women has increased, due to a rise in unpaid work for men and in paid work for women. The main point however is that while non-working time has declined slightly for both husbands and wives since 1975, the ratio of married women's non-working time to that of married men has remained stable; 1.073 in 1975, 1.073 in 2003. Even after accounting for unpaid working time therefore, married women's non-working time is not responding relative wages in the way predicted by the unitary model.

Part (b) of the table shows that unpaid working time is composed largely of time spent cooking and cleaning in the case of the women; while this component has increased 50% for men, it was still only 3.33 hours weekly on average in 2003, compared to 14.9 hours for wives. Commuting and Job-related time declined for both men and women, even though time in paid work did not. The 2.5 hour decline for men in time spent in Job-related was largely offset by small increases in other categories. One category that increased for both men and women was child care (excluding time spent playing with children); the effect is small however relative to the other changes, so it does not appear worth worrying how time spent in this category might be mis-measured. Overall, men in 2003 were spending two more hours in "Other home production" per week, and one more in "Cooking and Other Indoor Chores" than in 1975. The lack of trend in relative non-working time therefore is robust to how we treat child-care time.

Table 3 shows that conditioning on observables such as age, education and labor force status does not explain the stationarity of relative non-working time. The relative wages of the sub-samples are shown in Table 3(a), which gives the female/male wage ratios for people working 10 hours more per week. For the 25-54 age group, the ratio of mean wages rises from 0.6 in the 1967-74 period to 0.76 in the 1995-2000 period. For the 55-65 age group, the wage ratio is the same in both periods. For those with less than a bachelor's degree (BA), the ratio evolves from 0.6 to 0.76; for those with a BA or more, the trend is weaker, from 0.66 to 0.72, falling back to 0.69 in the 2000-2006 period. Table 3(b) shows that, over the 1975-2003 period, only one group of husbands gets an increase in relative non-working time; those with educational attainment equal to 12 years, the equivalent to a high-school diploma. The wife's relative non-working time falls in this case from 1.14 to 1.06. For all other groups, wife's relative non-working time increases or stays constant. Most significantly, when the sample is restricted to spouses who are working, the wife's relative non-working time increases from 0.97 to 1.04. The effect appears to be strongest among younger couples; the increase for married people aged 25-55 is from 0.94 to 1.04. Among the 55-70 age group the rise in wife's relative non-working time is much weaker, from 1.01 to 1.06, which may be due to the fact that the wage change is much smaller for this group as shown in Table 3, from 0.66 to 0.69. Far from accounting for the failure of husband's non-working time to rise, the observables seem to exacerbate the issue by revealing that in fact it is the wife's relative non-working time that is increasing within most groups.

Could it be that there is a rigidity, perhaps due to social norms, that restricts married couples from freely adjusting leisure time? It is generally difficult to examine this in the time-use surveys because they sample individuals, rather than households. However in 1985, the sample included 531 married couples. Figure A3(b) in the appendix shows, the husband-wife ratios of nonworking time for this sample. While it is clear that the distribution is centered around one, considerable dispersion exists. A similar result for Australia, Germany and the US is obtained by Burda, Hamermesh, and

Weil (2007). While analyzing the source of this dispersion is outside the scope of the current paper, it seems to indicate that there is no lack of flexibility in the allocation of non-working time.

3 A Model of Marriage and Labor Supply

This section describes a simple equilibrium marriage model. We first work out the efficient allocations, taking as given the Pareto weight the household puts on each spouse. Holding these weights fixed corresponds to the standard unitary model used in macroeconomics. We then extend the model by nesting a bargaining theory in which the Pareto weights depend on the value of leaving the marriage. Finally, we work out how the equilibrium weights depend on full income by marital status for all household types. A simple example of the model is then fully worked out to show how the main features determine labor supply.

3.1 Household Structure

There is a large population comprised of two sexes $i \in \{H, W\}$ in equal numbers, who are otherwise *ex ante* identical and live through an infinite succession of discrete periods. At the beginning of each period, people are either married or single. Married people learn their realization of a match-quality shock ε , choose allocations, 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. This shock has an unconditional distribution Φ ; realizations are independent across pairings, but may be persistent within. Let the conditional distribution be $F(\varepsilon', \varepsilon)$. The cost of divorce is $d_c \geq 0$.

All people who enter the period as singles are randomly paired with a single of the opposite sex. The new pairs then learn their match quality ε , choose allocations 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 market goods.

Each agent i has a one-unit time endowment, which is allocated across three competing uses: leisure l_i , work outside the household, n_i and home work h_i . There is a time cost t_n per unit of outside work. The time constraint for each agent i is:

$$l_i + n_i (1 + t_n) + h_i = 1$$

. Agents derive utility from leisure l_i , as well as the consumption of a market good c and a home good g . We assume a CES utility function:

$$u(c, l, g) = \frac{\sigma_c}{1 - \sigma_1} c^{1 - \sigma_1} + \frac{\sigma_l}{1 - \sigma_1} l^{1 - \sigma_1} + \frac{\sigma_g}{1 - \sigma_1} g^{1 - \sigma_1}$$

. Preferences of individuals over infinite streams of utility are represented by the discounted sum:

$$E_0 \left(\sum_{t=0}^{\infty} \beta^j [u(c_t, l_t, g_t) + J_{i,t}^M \varepsilon_{i,t}] \right)$$

where m indicates marital status and $J_{i,t}^M$ is an indicator equal to one if the agent is in a married household at the end of period t .

The home good is produced using inputs of housework time (h_H, h_W) from each spouse, as well as a flow of home equipment e_q , according to a production function $G(e_q, h_H, h_W)$. In order to allow both singles and married to be modeled as operating the same technology, we assume the effective labor input of married couples is CES in the individual inputs:

$$h(h_W, h_H) = \left[\eta_0 h_W^{1 - \eta_1} + (1 - \eta_0) h_H^{1 - \eta_1} \right]^{1/(1 - \eta_1)}$$

Let the effective time input be h and the goods input be e_q . The home-production function is

$$G(h, e_q) = z \left[e_q^{1-\theta} \right] h^\theta$$

3.2 Markets, Prices and Taxation

A unit of outside labor n_i by a worker of sex i produces w_i units of a consumption good, which is consumed within the period.⁴ Both the wage \tilde{w}_i and the work cost t_n are parameters which evolve exogenously. Households also have some endowed non-labor income, equal to y_M^{nl} for married couples and y_i^{nl} , $i \in \{H, W\}$ for singles. Income is taxed according to a progressive tax schedule that distinguishes between married and single households. The tax bill of a household of type i with gross (taxable) income Y_i is given by a continuously differentiable function $T_i(Y_i)$. The household buys home equipment e_q at price p_q per unit.

3.3 Optimal Allocations

We show in the appendix how to write the decision rules as functions of the average and marginal tax rates, which we denote T^A, T^M , respectively. Of course these expressions only give the optimal decisions when evaluated at the correct tax rates, but this is easily resolved through iteration on the taxable income Y^T , using the tax function $T(Y^T)$ to update the tax rates, given the decision rules.

3.3.1 Singles

The indirect utility flow of a single-person household with wage w is:

$$U_i^S \equiv \max_{c, l, h, e_q} \{u(c, l, G(h, e_q))\}$$

subject to

$$c + w_i l + T(Y^T) = w_i(1 - h) + y_i - p_e e_q$$

where w_i is the wage, p_e the price of equipment and y_i the non-labor income of the household. Taxable income is:

$$Y^T = w_i(1 - l - h) + y_i$$

The reduced-form demand functions, which depend on the budget-constraint multiplier λ , are:

$$[c, l, g] = \left[\left(\frac{\sigma_c}{\lambda} \right)^{1/\sigma_1}, \left(\frac{\sigma_l}{\lambda w^M} \right)^{1/\sigma_1}, \left(\frac{\sigma_g}{\lambda D^M} \right)^{1/\sigma_1} \right]$$

⁴Note that we have ruled out savings, an important feature of standard macroeconomic models. In the current model, the savings margin would affect aggregate labor supply, but, in the absence of divorce, have no impact on relative labor. As our model allows for divorce, the impact on relative labor would depend on how wealth is allocated at divorce, and on the degree of assortment on wealth implied by the marriage-market equilibrium. Including wealth therefore complicates considerably the equilibrium concept and the computation. See Cubeddu and Rios-Rull (1997) for analysis of a marriage-market equilibrium with wealth and divorce.

, where D^M is the effective marginal price of home goods, as derived in the Appendix, and $w^M = w(1 - T^M)$ is the effective marginal wage for the single type. The full income of the household is

$$Y^F = D^A \left(\frac{\sigma_g}{\lambda D^M} \right)^{1/\sigma_1} + \left(\frac{\sigma_c}{\lambda} \right)^{1/\sigma_1} + w^A \left(\frac{\sigma_l}{\lambda w^M} \right)^{1/\sigma_1}$$

, where D^A is the unit cost of home production. The solution for the budget multiplier λ is given in the appendix.

We also find that the equipment share of home-production costs is:

$$\frac{p_e e_q}{w^A h + p_e e_q} = \frac{\tau(1 - \theta)}{\theta + \tau(1 - \theta)}$$

, where $\tau \equiv \frac{1 - T^M}{1 - T^A}$ represents the progressivity of taxes, and $w^A = w(1 - T^A)$ is the effective unit cost of leisure.

3.3.2 Married Households

The married household is assumed to maximize a welfare function consisting of a weighted sum of the welfare of each spouse $i \in \{H, W\}$. The state of a marriage is given by the quality shock ε . There is no commitment, so the decisions made by a new marriage are the same as those of an existing marriage with the same quality ε . Allocations are given by the solution to the household planner's problem where μ_i is the Pareto weight on spouse i in the planner's objective function.

Since we assume utility is separable in the home good, and that spouses each get the same utility from the home good, we can let the total utility flow from the home good be $v(G(H(h_M, h_W), e_q))$.

The couple chooses the husband's allocation (c_M, l_M, h_M) and the wife's allocation (c_W, l_W, h_W) and home equipment e_q to maximize

$$v(G(H(h_M, h_W), e_q)) + \mu_M u^M(c_M, l_M) + \mu_W u^W(c_W, l_W)$$

subject to

$$c_M + w_M l_M + c_W + w_W l_W + T(Y^T) = w_M(1 - h_M) + w_W(1 - h_W) - p_e e_q$$

and the time constraints for each spouse:

$$h_M + l_M \leq 1$$

where Y^T represents taxable income:

$$Y^T = w_M(1 - l_M - h_M) + w_W(1 - l_W - h_W) + y$$

. If we take as given the marginal wages w_M^M, w_W^M of the husband and wife, respectively, and let λ represent the budget-constraint multiplier, we can write the reduced-form demand functions as

$$[c_i, l_i, g] = \left[\left(\frac{\mu_i \sigma_c}{\lambda} \right)^{1/\sigma_1}, \left(\frac{\mu_i \sigma_l}{\lambda w_i^M} \right)^{1/\sigma_1}, \left(\frac{\sigma_g}{\lambda D^M} \right)^{1/\sigma_1} \right]$$

, where D^M is the effective marginal price of home goods for married couples. The home-production inputs end up being all proportional to the demand for home goods:

$$[h_M, h_W, e_q] = \left[\frac{g}{x_g}, \frac{x_w g}{x_g}, \frac{x_e g}{x_g} \right]$$

, so the unit price of the home good is independent of the output level. The expressions for the optimal values of the ratios $x_g \equiv g/h_M$, $x_e \equiv e/h_M$, and $x_w = h_W/h_M$ are given in the appendix. Note the tight relationship of the wage ratio to the ratio of wife's time to that of the husband:

$$x_w = \frac{h_W}{h_M} = \left(\frac{w_M}{w_W} \frac{\eta_0}{1 - \eta_0} \right)^{1/\eta_1} \quad (1)$$

The equipment share of expenditure is given by:

$$\frac{p_e x_e}{w_M^A + w_W^A x_w + p_e x_e} = \frac{\hat{\tau} (1 - \theta)}{\theta + \hat{\tau} (1 - \theta)} \quad (2)$$

, where $\hat{\tau}$, by analogy with the expression for singles, represents the effective progressivity of taxation of married couples (derived in the Appendix). These explicit solutions for all the decisions rules will be very useful for providing a transparent identification scheme in the calibration section.

3.3.3 Implications for relative leisure

The first-order conditions for the spouses' leisure imply that if the Pareto weights are constant, then the ratio of marginal utilities for leisure will be proportional to the relative wage:

$$\frac{u_l^M(c_M, l_M, g)}{u_l^W(c_W, l_W, g)} = \frac{w_M}{w_W} \frac{1 - \mu}{\mu}$$

. Since the wage ratio $\frac{w_M}{w_W}$ has fallen over time, the ratio of marginal utilities must have fallen too; concavity of the utility function leisure implies that husband's leisure should have risen relative to that of the wives. Using the CES specification above, the prediction can be made quantitative. The wife-husband leisure ratio is given by:

$$\frac{l_W}{l_H} = \left[\frac{w_M}{w_W} \frac{\mu_W}{\mu_M} \right]^{1/\sigma}$$

.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 we follow Attanasio, Low, and Sanchez-Marcos (2008) in setting $\sigma = 1.5$, the prediction is that married women's leisure should have declined 12.4% relative of that of their husbands, an effect on the order of 7 hours.

Note that these implications are independent of the tax function and the home-production technology. With joint taxation, the relative wage of husband and wife is unaffected, so any increase in wife's labor supply induced by changes in the tax schedule should leave the leisure ratio unchanged. Similarly, the allocation of working time between home and paid work affects neither the marginal utility of leisure nor the relative wages, so the leisure ratio is independent of the home technology or relative productivity of the spouses at home. Both of these are special cases of the general point that wealth effects in the model cannot directly affect leisure ratios.

3.4 Determination of the Pareto weights

Our theory of the Pareto weights is that they are functions of the gains from marriage, relative to divorce, as in a wide range of papers from McElroy and Horney (1981) to Chiappori, Fortin, and Lacroix (2002) to Greenwood, Guner, and Knowles (2003). We assume that this mapping can be represented by a bargaining solution. We will consider two types of solution: the standard

Nash bargaining solution, and the Egalitarian bargaining solution. The latter is very useful because for special cases it renders the model tractable, so that we can solve for equilibrium allocations and marriage decisions.⁵ In the case of a linear Pareto frontier, i.e. fully transferable utility, a standard assumption in the labor-matching literature, the Egalitarian solution is equivalent to the Nash bargaining solution with equal bargaining power.

In what follows we consider a stationary environment; relative wages are constant, so the only source of divorce is random variation in match quality; as spouses will agree on the states of the world in which divorce is preferable, commitment is not an issue in this environment.⁶

Let $U_i^M(\mu_i, Y^M) + \varepsilon$ represent the indirect utility flow to agent i from a marriage where μ_i is the Pareto weight on agent i , and ε is the current realization of a random variable representing the quality of the marriage. Let V_i^M indicate the value to a person of sex i of being married and V_i^S that of being single. Let Φ represent the unconditional CDF of ε ; this is the distribution from which the match-quality realization is drawn for new matches. Let $F(\varepsilon'|\varepsilon)$ represent the conditional distribution for on-going matches.

Standard arguments show that there exist thresholds $\varepsilon^M, \varepsilon^D$ such that marriage occurs only if $\varepsilon > \varepsilon^M$ and divorce only if $\varepsilon < \varepsilon^D$, and that with positive divorce costs, $\varepsilon^D < \varepsilon^M$. If we take μ'_i as fixed, the value to spouse i of being in the marriage is

$$V_i^M(\mu_i, \varepsilon) = U_i^M(\mu_i, Y^M) + \varepsilon \dots \\ \dots + \beta [F(\varepsilon^D|\varepsilon)(V_i^S - d_c) + (1 - F(\varepsilon^D|\varepsilon))EV_i^M(\mu'_i, \varepsilon')] \quad (3)$$

Similarly, for singles, let the indirect utility flow be U_i^S , so that we can write the value of being single as:

$$V_i^S = U_i^S + \beta \left[\Phi(\varepsilon^M) V_i^S + \int_{\varepsilon^M} V_i^M(\mu'_i, \varepsilon') d\Phi(\varepsilon) \right] \quad (4)$$

Define the gains from marriage, relative to divorce, as

$$W_i^D(\mu_i, \varepsilon) = V_i^M(\mu_i, \varepsilon) - V_i^S - d_c$$

where the divorce cost $2d_c$ is assumed to be paid equally by each spouse.

Definition 1 A bargaining solution $B(W_H, W_W)$ is a mapping from a pair of functions $W_H^D(), W_W^D()$ to a Pareto weight μ on spouse H . The weight on spouse W is given by $1-\mu$.

Notice that this definition allows B to map on to any Pareto-optimal allocation. The main restriction relative to the set of all possible bargaining solutions, is that solutions depend only on the gains from marriage. This is quite standard in the literature on household labor supply, and is consistent with the result of Chiappori, Fortin, and Lacroix (2002) and others who find that labor supply of married couples responds to variables ("distribution factors") that affect the value of single life, such as divorce rules, or the sex ratio of singles.

It is useful to contrast two common examples. The "Egalitarian" solution μ^E is defined as the value of μ that equalizes the gains from marriage. Hence μ^E solves:

$$\frac{W_M^D(\mu^E, \varepsilon)}{W_W^D(1 - \mu^E, \varepsilon)} = 1$$

⁵The Egalitarian solution, while it lacks the scale invariance of the standard Nash solution, is more intuitive; indeed Kalai (1977) argues that this solution implements a Rawlsian approach to justice.

⁶The computational methods we use can be extended to the case of wage trends with perfect foresight, provided we assume full commitment at the time of marriage, but the solutions are difficult to characterize analytically.

. A nice feature of this concept is that it is easy to solve because the symmetry implies terms that are common to both sides drop out. The Nash solution by contrast takes into account both the gains and the curvature of the Pareto frontier, i.e. the marginal cost of transferring utility. The FOC for the Nash solution μ^N , with equal bargaining power, is

$$\frac{W_M^D(\mu^N, \varepsilon)}{W_W^D(1 - \mu^N, \varepsilon)} = - \frac{\partial W_M^D(\mu^N, \varepsilon) / \partial \mu}{\partial W_W^D(1 - \mu^N, \varepsilon) / \partial \mu}$$

With concave utility, the right-hand side is declining in μ^N ; this reduces the elasticity of the Nash solution with respect to gains from marriage. It turns out that while the Nash solution is insufficiently elastic to fully account for the stability of relative leisure, the Egalitarian solution is too elastic. In the quantitative analysis we will therefore rely on a convex combination of the two solutions to generate Pareto-optimal allocations.

3.5 Matching Equilibrium

The marriage threshold ε^M sets the marriage surplus to zero, relative to single life. Similarly the divorce threshold ε^D sets the marriage surplus to zero, relative to divorce. The wedge between the two is a function of the divorce cost d_c . These two thresholds define the market-clearing conditions in a stationary marriage-market equilibrium.

Definition. A *stationary recursive equilibrium* of the matching market with progressive tax functions $T_i(\cdot)$ and bargaining solution $B(W_H, W_W)$, consists of a pair of thresholds $\{\varepsilon^M, \varepsilon^D\}$, a Pareto weight μ , and for each household type $i \in \{M, S_W, S_H\}$, allocations, tax rates $\{T_i^M, T_i^A\}$ and value functions $\{V_i^M(\mu_i, \varepsilon), V_i^S\}$ such that:

1. The value functions solve the Bellman equations (3,4) for men and women, given the prices $\{w, y, p_q\}$ and thresholds
2. The threshold ε^M sets to zero the gains from marriage, relative to remaining single, while ε^D sets to zero the gains from marriage, relative to divorce .
3. The allocations implied by the Pareto weight μ equal those generated by the bargaining solution: $\mu = B(W_H^D, W_W^D)$, where W_i represents the gain of spouse i from marriage, relative to divorce.
4. The allocations generate, for each household type i , a level of taxable household income Y_i^T such that $T_i'(Y_i^T) = T_i^M$, and $T_i(Y_i^T) / Y_i^T = T_i^A$.

3.6 Computation

The model's solution is computed using a three-step iterative strategy. First we solve the time-allocation problem of married couples, and derive the indirect utility as a function of the Pareto weight, given the continuation values. Second, we solve for the marriage and divorce thresholds, exploiting the fact that with efficient separation rates, these will be the same for any Pareto-optimal sharing rule. Finally we compute the updated Pareto weights and value functions, and repeat the procedure until convergence.

With progressive taxation, the tax rate depends on the labor income of the household, and hence on the leisure allocations. The time-allocation problem is therefore solved by guessing the labor income (and hence the tax rate), solving for the leisure allocation, and updating the guess until we

have guessed the correct labor income, given μ . Thus the static components of the model are easily solved.

The solution strategy for the equilibrium $(\varepsilon^M, \varepsilon^D, \mu)$ in the marriage market takes as given a set of approximations for the values V_i^M of being married, as functions of ε . We search over the unit simplex in R^2 to find a pair $(\varepsilon^M, \varepsilon^D)$ of stationary marriage and divorce rates. To compute the marriage/divorce thresholds, we define the minimum weight $\underline{\mu}_i^M(\varepsilon)$ as the Pareto weight that leaves a single agent of sex i indifferent between marriage and single life: $W_i(\underline{\mu}_i^M, \varepsilon) = 0$. Similarly we can define $\underline{\mu}_i^D(\varepsilon)$ as the value that leaves a married agent of sex i indifferent between marriage and divorce. The surplus equals the sum of the gains $W_j(\mu_j, \varepsilon)$, so we can find ε^M by solving $\underline{\mu}_W^M(\varepsilon^M) + \underline{\mu}_H^M(\varepsilon^M) = 1$. The divorce threshold ε^D is computed in a similar way. Of course if ε is iid then $\varepsilon^D = \varepsilon^M - 2d_c$.

Once we know the thresholds, we can use the Bellman equations (3) to compute the bargaining solution for any ϵ in $[\epsilon^D, \epsilon^M]$. The approximations to the value functions are then updated by splining the value of marriage for each spouse on a grid over $[\epsilon^D, \epsilon^M]$. We then repeat the procedure with these solutions replacing the initial guesses.

This procedure converges monotonically in the Euclidean norm to a fixed point for $\varepsilon^M, \varepsilon^D$. At the fixed point, all of the equilibrium conditions hold, by construction.

With the solutions in hand, there is at least one potential reason why it may be important to base statistics from the model on simulations. As discussed earlier, the Nash equilibrium yields a Pareto weight that depends on the marriage quality. If this is persistent then the average marriage quality, and hence the allocations, will be functions of the marriage (and divorce) rates. Even with iid quality, the non-linearity of the decision rules may cause the average of the decisions to differ from the decisions of the average householders of each type. Therefore the statistics reported below are based on simulations of the model at the solution.

4 Calibration

The goal of the calibration is provide an analytic tool to help understand the change in time-allocation patterns since 1970. The strategy is to supply an accounting decomposition of the changes: we find a set of parameter values such that the model matches exactly the time-allocation patterns and marriage rates for each of two years: 1975 and 1995, given measurements on the exogenous parameters such as wages, non-labor income and home technology. This procedure therefore identifies changes in preferences and technology explicitly, using the optimality conditions derived in the appendix.

The time allocation targets are drawn from Table A3 in the appendix, where we reconcile the relevant discrepancies between the March CPS and the time-use survey data summarized in Table 2.

The calibration is in two stages; first we choose parameters for the time allocation problem to match time-use statistics and the NIPA equipment share of consumption, then in the second stage for the marriage-matching problem, we choose parameters to match marriage and the wife-husband leisure ratio for the two years. Given that the model yields explicit solutions for time allocation, we can use the equations in which the equilibrium variables $[\epsilon^M, \epsilon^D, \mu]$ do not enter to infer most of the time-allocation parameter values. Given these, we calibrate the remaining free parameters to match the equilibrium marriage and divorce rates, and the wife/husband leisure ratios.

4.1 Income and Taxes

From the March CPS, we have labor income and total personal income for the whole sample in every year. The wage is computed as the ratio of labor income to hours worked and averaged each year over the population aged 18-65 of each sex. This results in the estimates reported in Table A4 in the appendix and imply a growth of real wages of 19% over the period. Non-wage compensation, which is excluded from the CPS measure, also grew rapidly over the period. According to Meisenheimer (May 2005), analysis of the National Compensation Survey reveals that total compensation per hour in the non-farm business sector actually grew 32% between 1979 and 2003, the excess over reported wage growth being due to a 55% growth in benefits.

We take non-labor income to be the excess of total personal income over reported labor income. The mean estimates, reported in Table A4 in the appendix, in terms of ratios to mean full labor income, i.e. the sum of the observed wages, are on the order of 4% for married and 6% for singles. In terms of realized or observed income, this corresponds to about 12% for married and 18% for singles.⁷

The tax function is taken from Guner, Kaygusuz, and Ventura (2012). This is a three-parameter, continuously-differentiable function:

$$T(y) = \alpha + \alpha_1 \ln(y/\bar{y})$$

, where the average tax rate for the household with average income \bar{y} equals α_0 and the marginal tax rate $\alpha_0 + \alpha_1$. The function is fitted for the years 1970 and 2000 to IRS data on average tax rates, by income of the household and filing type (married or single).⁸ For married couples in 1970 the coefficients are (0.096, 0.0814) and in 2000 (0.1023, 0.0733), while for singles they are (0.1597, 0.0857) in 1970 and (0.1547, 0.0497) in 2000. The tax functions are normalized by average household income in each year. Note that the marginal tax rate for the married household with average income is roughly 0.18 in both 1970 and 2000, reflecting the fact that the decline of marginal tax rates so often discussed in the literature on female labor supply was a short-run phenomenon, at least in regards to married couples. Marginal tax rates for singles did decline, from 0.25 to 0.2 at the average income. The tax functions are shown in Figure A6.

4.2 Technology Parameters

We use equation (1) to set the substitutability parameter η_1 for married-couples' home labor to match the change in the home-production time ratio:

$$\eta_1 = \frac{\log\left(\frac{w_M}{w_W}\right)_{2003} - \log\left(\frac{w_M}{w_W}\right)_{1975}}{\log\left(\frac{h_W}{h_M}\right)_{2003} - \log\left(\frac{h_W}{h_M}\right)_{1975}}$$

⁷In aggregate, macro economists usually find non-labor income to be about a third of GDP. Supposing our population to be representative of the economy as a whole this would lead us to expect non-labor income to average about 10% of full income, so the CPS measurements appear to be quite low. The relatively low capital income in our sample may be explained by measurement error in the CPS, as capital income is quite concentrated in the wealthiest minority of the population, or by exclusion from the sample of the retired population, which is likely to have a particularly high share of non-labor income. This is not a major concern for the current exercise, as we are taking wages as exogenous, and so the capital/income ratio has little role to play.

⁸I am grateful to Remzi Kaygusuz for supplying the 1970 coefficients. The historical data is available for 1916-1999 at the IRS web Statistics on Income web site:

<http://www.irs.gov/taxstats/article/0,,id=223808,00.html>

This yields a value of $\eta_1 = 0.33$, which implies a high elasticity of substitution between the labor of husband and wife.⁹

An important advantage of the Cobb-Douglas production function relative to a more general specification is that it provides a clean way to calibrate the role of equipment, as represented by the parameter θ . From the NIPA we have observations on a related quantity, the share of home equipment in total NIPA consumption expenditure. The NIPA series for equipment and furniture spending, as shown in Figure A4(a), appears to fluctuate between 4 and 6 per cent of total consumption.

We can replicate the observed equipment share X^{EG} of production spending by setting

$$\theta = \frac{(1 - X^{EG}) \hat{\tau}}{(1 - X^{EG}) \hat{\tau} + X^{EG}}$$

, where $\hat{\tau}$ is the effective progressivity of the tax schedule for married couples, as defined in the appendix. A similar procedure is applied to singles.

We assume work costs are proportional to time spent working, and for each year set τ to match the ratio of unpaid work-related time to paid work time, averaged over all household types.

4.3 Preference Parameters

We set the utility curvature parameter σ_1 to 1.5, the same value taken by Attanasio, Low, and Sanchez-Marcos (2008) to represent a happy medium of existing practices. With the technology parameters in place we can infer the amount of consumption of the home good from the data on home hours, as well as the effective prices of the home good. For each household type we set the parameters $\sigma_C, \sigma_l, \sigma_g$ so that the model exactly matches the average hours spent on home production, leisure and paid work. For singles, we can express expenditure on each good as a share of consumption expenditure:

$$X^{HC} \equiv \frac{w^A h + p_e e_q}{c} = \left(\frac{\sigma_g}{D^M \sigma_c} \right)^{1/\sigma_1} \frac{w^A + p_e x_e}{x_g}$$

, where the proportions $x_e = e_q/h_M$ and $x_g = h_M/g$, as well as the effective home production price D^M , are derived in the Appendix.

Assuming we can observe X^{HC} , then we can infer the ratio of preference weights as:

$$\frac{\sigma_g}{\sigma_c} = \left(X^{HC} \frac{x_g}{w^A + p_e x_e} \right)^{\sigma_1} D^M$$

Of course we can do the same for the leisure-expenditure ratio X^{LC} ,

$$X^{LC} \equiv \frac{w^A l}{c} = \frac{w^A \left(\frac{\sigma_l}{w^M} \right)^{1/\sigma_1}}{(\sigma_c)^{1/\sigma_1}}$$

from which we infer the ratio:

$$\frac{\sigma_l}{\sigma_c} = \left(\frac{X^{LC}}{w^A} \right)^{\sigma_1} w^M$$

Imposing that the weights sum to 1 then results in values for each utility-weight parameter.

⁹An interesting implication of this value is that the fact that wives spend much more time than husbands in home production is entirely explained by the wage differential; the productivity parameter value $\eta_0 = 0.475$, which implies roughly equal productivity of spouses at home, is required in order to generate the observed home-labor ratios. Of course if the model were to be expanded to allow for other factors that might have caused the home hours ratio to fall over time, then the elasticity estimate would be considerably reduced.

4.4 Free Parameters

We impose that μ is given by the weighted sum of two bargaining solutions. Let ω be the weight on the Egalitarian bargaining solution and $(1 - \omega)$ the weight on the Nash solution.¹⁰

The stochastic process for ϵ is arbitrarily fixed to an iid standard normal with mean zero and variance $\sigma = 2$.

There are therefore 5 free parameters. Three parameter values are held constant over the two calibration dates: the relative joy of being single q_W/q_M , the divorce cost d_C , and the weight ω on the Egalitarian bargaining solution. The joy of being single q_W is allowed to vary across the two dates in order to match the change in marriage rates over time.

The statistical targets we use set these parameters consist of the marriage rate π^M , the divorce rate π^D , and the relative leisure l_W/l_H . There are therefore 6 potential targets. Since there are only 5 parameters in the loop, we drop one of the targets, the divorce rate for 2003. Matching this would require higher persistence in ϵ to allow divorce rates to fall when marriage rates rise. Since persistence makes the model more difficult to compute, it is natural to begin by abstracting from this feature. The initial conditions for the simulation consists of the fraction of women married by age 18 and a vector of marriage quality, assumed to be above the threshold, for these women. In practice, the mass of these women is so small that they make little difference for the quantitative results.

Because official estimates of the empirical marriage and divorce hazard rates not available after 1995, these are computed instead from the annual transitions in the distribution marital status in the March CPS according to a simple procedure described in the appendix, starting from the fraction of women already married by age 18. This ensures that the hazard rates are consistent with the population fractions.

4.5 Results

The statistical targets that were used to choose the parameter values are shown in Table 4, and the resulting parameters in Table 5. In addition to the 26 targets shown there, the work-related time from Table A3 was used to set the values of the work costs, for a total of 28 targets. However the procedure described above uses the leisure expenditure shares, not the actual leisure times; leisure times of married couples are therefore not pinned down, leaving 26 targets.

The resulting parameter values are shown in Table 5(a). It is clear that the calibration implies a limited role for equipment: the home-output elasticity with respect to labor input is around 90% for all household types, leaving only 10% for equipment. This means that doubling the amount of home equipment purchased would increase home output by only 7%. Even for single men in the 1970s, who appear to be more reliant on equipment, with an 80% labor share, doubling equipment would result in home output increasing by less than 15%. The reason θ turns out so low is that the cost of the labor inputs is so high; for married couples, accounting for the cost of the husband's time significantly reduces the apparent role of equipment.

In regards to preferences, we see another reason limiting the impact of home technology: the utility weight on home goods is very small, in the 3-7% range. This implies relatively low expenditure shares; wealth effects will be largely absorbed by the other goods, such as leisure, with expenditure shares on the order of 2/3. In Greenwood, Seshadri, and Yorukoglu (2005) for example, technical change increases married women's paid labor by "liberating" women from home production; however

¹⁰Recall that this is to get the required elasticity of relative leisure, holding constant the relative joy of single life q_W/q_M . An alternative strategy would be to go with one bargaining solution and back out the variation in q_W/q_M .

that paper abstracts from both husband's time input and the leisure margin, implying larger effects on paid labor than would obtain in the current paper.

Another interesting implication of the time allocation data is that the utility weight on leisure has decreased over time; this is implied by the observation that expenditure shares on leisure have decreased since 1975. While all 3 household types seem to care less now about leisure, the decline is by far the greatest for married couples. Per-capita leisure however is relatively stable, declining only by 1/2 hour, because the composition of the population has shifted from low-leisure types (married households) to high-leisure types (singles). This of course consistent with leisure having increased over the much longer run, documented in Aguiar and Hurst (2007), who analyze per capita trends since 1965, and Vandenbroucke (2009), who documents the rise in leisure time since the 19th century.

The results imply that women get more direct utility from single life than men do; $q_W/q_M = 1.25$; this is needed to explain why wives get roughly the same leisure as husbands despite having lower wages(and hence higher pecuniary gains from marriage).

The calibrated divorce cost is fairly high; 5.29 is equivalent to four years of full income for married couples in 1975, 2.6 years in 2003. This is related to the dispersion in the marriage shock; less dispersion would imply a lower divorce cost to match the data, since very bad shocks would be less frequent. Higher persistence would also reduce calibrated divorce costs, as married quality would be higher on average than under the unconditional process. This would also help deal with the non-targeted divorce rate, which increases in the model, while it declines in the data, although this could be easily be fixed by indexing the divorce cost to income.

The model puts 40% weight on the Egalitarian and 60% on the Nash solution. This comes from matching the elasticity of the wife/husband leisure ratio, given that we have imposed that there is no shift in the relative utility from single life. The role of the Nash solution is to reduce the elasticity of μ with respect to relative wages. It also turns out that under the Nash solution the Pareto weight is a declining function of ϵ , because men's gains increase with ϵ relative to women's gains from marriage; for low ϵ the main component of gains is the pecuniary gain, which is larger for women, while for large values the main component is marriage quality, which is assumed to be equal. Therefore there is a potential for changes in the marriage rates to affect allocations through μ .

Finally, the model implies that the decline of marriage is unrelated to wages or income; the sum of the utilities (net of q_W, q_M) of a single man and a single woman increases by 0.27, about 4%, from 1975 to 2003, so that singles are indeed better off, but that of married couples increases by 0.36 (about 5%), so marriage rates would have increased slightly if left to these influences alone. Marriage decline is explained in the model entirely by a preference shift, the rise of q_W, q_M . The results is a marriage rate of 8.5% in 1975 for the benchmark model, compared to a target of 9.3%, and 4.4% in 1975, compared to a target of 4.6%. The magnitude of the decline is therefore very similar in the model (48%) and the data (51%).

5 Experiments

How much of a difference does bargaining make in our assessment of labor-supply trends? In other words, does it matter whether we allow for bargaining when assessing the impact on labor supply of the historically-changing variables that we take as exogenous, such as wages, the home equipment price and the effective tax rate of working wives? In this section we describe a set of computational experiments aimed at answering these questions.

The idea is that for each experiment, all parameters are fixed at the benchmark calibration

values for 1975, except for the parameter that the particular experiment is concerned with, which is set to its 2003 value. The main results are reported in Table 6, which explicitly explores the role of bargaining in generating responses to changes in relative wages and to changes in preferences, which turn out to be the two main forces at work in the model. Columns (1) and (7) show the benchmark outcomes for 2003 and 1975, respectively; the other columns correspond to experiments. Columns (2) and (5) for instance show the results for the case where the utility-function parameters $(\sigma_c, \sigma_l, \sigma_g)$ alone are allowed to adjust to their 2003 values; in Column (2) with bargaining, and in Column (5) without. The same applies to Columns (3) and (6), except that now it is the relative wage that is allowed to adjust. Those experiments where bargaining turns out not to play an important role are shown in Table A5 in the appendix.

5.1 Paid Hours

It is clear from Table 6 that relative wages can, on their own, account for the entire increase in paid work of wives. Indeed in Column (6) we see an excessive increase, to 26 paid hours, compared to the observed 2003 level of 22.94 hours in Column (1). This implies a significant decline in the wife-husband leisure ratio, from 1.04 to 0.93, a typical result for the unitary model. In Column (3) however, we see that the response of the Pareto weight, through bargaining, brings the ratio back up to 1.02, and married women’s paid work returns to a realistic 23.2 weekly hours. Bargaining, therefore, is playing the critical role in maintaining the leisure ratio; the improved economic position of single women causes the married allocation to shift in favor of wives, offsetting the direct impact of relative wages on the leisure ratio.

Column (2) shows that the shifting utility parameters $(\sigma_c, \sigma_l, \sigma_g)$ play virtually no role in accounting for the rise in married women’s paid hours. This is surprising, as we saw earlier that the weight married couples put on leisure appears to have declined considerably. In fact, we see in Column (5) that under the unitary model the effect of the preference shift on the wife’s paid hours appears much larger, about 1.7 hours weekly. However the preference shift also makes single women better off relative to single men, and so increases the relative leisure of married women offsetting the direct impact on paid hours.

The stability of men’s hours on the other hand appears to be due to the conflicting effects of preferences and relative wages. Column (6) shows that, with rigid Pareto weights, the rise in the wife’s relative wages would have driven husband’s working hours down from 37.63 to 30.61, very much as we predicted from the back-of-the-envelope computation in the theoretical section. Allowing for bargaining, Column (3) shows that the effect of the relative wage is much less severe, and results in the husband’s working 32.70 hours weekly. The static part of the calibration told us that in the preferences of married couples consumption had gained in importance at the expense of leisure. Column (2) shows that on its own this would have increased husband’s working hours by more than 4 hours, to 42.32. However Table 8 shows that this effect is largely offset in turn by wage and income growth, which on its own results in a 3-hour decline. Finally, recall that preferences shifting on its own would also have increased with wife-husband leisure ratio; this effect, due to single women being made better off relative to single men, would have added 1.1 hours to men’s work hours. Bargaining is therefore an important component of the story, raising husband’s labor supply by about 3.2 hours relative to the unitary model, but there are also large effects that do not operate through bargaining.

In Column (2) of Table A5 in the Appendix, we see that income and wage growth on their own cause labor supply to fall, as the preferences deviate from the balanced-growth (log) preference specification. Married men’s labor supply falls from 37.63 hours to 34.3 and that of married women from 15 hours to 11.6. The effect is similar for singles: men’s paid hours fall 1.8 hours, from 25.5

to 23.7 hours, and that of women by 0.35 hours. This makes the observed rise in per-capita hours all the more remarkable. It's clear from Table 4 that the main forces driving the rise in per-capita labor supply are the shifting utility parameters ($\sigma_c, \sigma_l, \sigma_g$), which account for a 3.5 hour increase of married couple's labor supply, and the relative wage, which account for a 1.5 hour increase. Declining work costs (Column 6 in table A5) and equipment prices (Column 1 in table A5) are seen to account for an additional 1.6 hour increase in married couple's labor supply. The effect of shifting taxes (Column 3 in Table A5) is negligible for married couples, but does generate a 0.7 hour increase in paid work per single person. This is not because labor supply is unresponsive to taxes, but rather because the net variation in marginal tax rates over the period turns out to be quite small, particularly for married couples.

5.2 Home Production

The main home-hours fact is that wife's time has declined relative to that of husbands; comparing the empirical targets in Columns (1) and (7) of Table 6 we see an increase of roughly 6 hours for husbands, compared to a 5 hour decline for wives. Column (3) in Table 6 indicates that 3 hours of the husband's increase can be attributed to the shift in the relative wage; Column (2) shows that two hours were due to the preference shift away from leisure. Columns (5) and (6) show that these effects are independent of bargaining, which is to be expected, as the theoretical model showed that the home production decisions are independent of the Pareto weights. For wives' home hours, Column (3) shows that the relative-wage shift would, on its own, have caused a much larger decline, on the order of 10 hours, but this is offset in part by the effects of the preference shift (+6 hours), shown in Column (2). The results therefore show that the direct effect of the relative-wage shift is reinforced, for men, by the preference shift, while for women the two effects partly offset each other.

In Table A5, we see income and wage growth also have a significant effect but smaller effect (-1.8 hours) on married women's home-production time, and the much smaller effects of equipment price on home-work hours of married women (-1.3 hours) and men (+0.5 hours). Even this minor impact however barely shows up in paid hours, being mostly soaked up by leisure time, as one might have guessed from the dominance of σ_l in the preference estimates. The net effect consists of a gain in wife's paid work of about a half hour. It is worth stressing however that the model abstracts from the accumulation of home equipment over time; allowing for accumulation would increase the estimated share of home goods in the production function, making price shifts more important.

A related concern might be the elasticity of substitution of the spouses time in the home production function. Recall that this was calibrated by matching the decline in the wife's home-work relative to that of the husbands. A more sophisticated approach might consider the possibility of technical change that made husband's time more productive at home. An example of this early in the 20th century would be the invention of substitutes for mother's milk in nursing infants, as in Albanesi and Olivetti (2006). The impact of other examples, such as the advent of home-laundry machines, as in Greenwood, Seshadri, and Yorukoglu (2005) are probably still too early to explain the transition since the 1970s. Such forces, if found to be quantitatively significant in the 1970s, would reduce the calibrated wage-elasticity of labor supply, and thus weaken the impact of the relative wage on the home allocations.

5.3 Marriage

Marriage rates in the US declined at a time of unprecedented prosperity and while women's wages were increasing relative to men's. It is tempting therefore to link the increased attractiveness of single life implied by these developments to the decline of marriage. However the main message

regarding the decline of marriage is that it appears not be directly driven by changes in wages or technology.

In Table 6 we see that in the Benchmark model, the marriage rate declines from 9% in 1975 to 4%. Column 3 shows that if the only change had been in relative wages, this decline would not have occurred; indeed the marriage rate increases, to 10%; Column (6) shows that this is independent of the bargaining model. The best explanation that Table 6 has to offer, as shown in Columns (2) and (5), is that the shift in utility parameters ($\sigma_c, \sigma_l, \sigma_g$) reduced the gains from marriage. Bargaining amplifies this effect by about 1/3: we see marriage rates decline to about 0.07 in the Unitary model, and to 0.64 in the Bargaining model.

Turning to Table A5, Column(5) shows that on its own the increasing preferences for single life (the rise in (q_W, q_H)) can on its own reduce the marriage rate to 0.03, by far the largest force behind the marriage-rate decline.

Of course these two preference shifts were identified as residuals; the former from the time allocation part of the calibration, the latter from the decline on marriage rates. The only significant measurable influence on marriage rates turns out to be the decline of the home-equipment price; Column(1) in Table A5 shows that on its own this drives the marriage rate down to 7.8% annually; hence this accounts for 17% of the marriage decline.¹¹

These changes in preferences should be interpreted as proxies for influences outside the model; the result therefore implies that more structure is required in the model to isolate potential sources of the decline in marriage rates.

6 Implications for Annual Trends

While the main analysis in the paper focusses on the long-run variation in labor supply, it is also possible to do a year-by-year comparison with the paid hours data, using annual variation in observed parameters, such as wages, and linear interpolation of the other model parameters. We use this method, to answer two questions: 1) over what years does bargaining contribute most to accounting for the divergence between the unitary model and the observed trend?, and 2) how much would the assumption of commitment in marriage allocations change our analysis?

In the spirit of the previous analysis, we take as exogenous the actual observed trends in wages and equipment price; these are represented by a 10-year moving average, to minimize the role of short-term fluctuations. We assume agents are myopic, taking current wages and parameters as permanent. A more sophisticated analysis would allow agents to base their behavior on predicted trends, or even assume perfect foresight at the time of marriage, and compute the transition path between the two stationary equilibria we calibrated. What we do here is a much simpler exercise, imposing that agents behave as though the economy were always in a stationary equilibrium. We think of this as an interesting and reasonable point of departure that precludes us having to deal with the complications associated with non-stationary equilibria in the marriage market.

To see how the behavior of labor supply evolves, we compute for each year the equilibrium decision rules for each household type in the economy. We compute three different versions of the model economy. In the first, the Pareto weights μ for all households are fixed at the value from the 1970s calibration, as in the unitary case. In the second, the weights are fully flexible, as in our benchmark model; all households have the same weight in a given year, but the weight changes annually according to the same bargaining solution as in the main model. In the third version, we only allow the Pareto weight for new marriages to respond to current-year's information; previously

¹¹The size of this effect could be increased by imposing a fixed cost of household formation, as in Greenwood and Guner (2009).

married couples retain the value established at the time of marriage. Labor supply in the third experiment will therefore depend on the history of the economy, via the stock of married couples.¹²

The results of these three experiments are shown in Figure 3. The top two panels compare labor supply under the flexible and the fixed specifications; the data series are also shown. In panel (a) we see that for married-women’s labor supply, the model line virtually coincides with the data line except for the period 1976-1984, where it lies slightly below, by about one hour. The line corresponding to the fixed Pareto weight on the other hand diverges from the data line starting in about 1983; the prediction error is already two hours by 1985, and continues to grow to 2003. For men’s labor supply, on the other hand, shown in panel(b), the model with the fixed Pareto weight does better than the benchmark for the first 10 years,. Over the 1985-2003 period however, the data remains stationary at just under 37 hours weekly, while the fixed-weight line continues its steady decline down to 34 weekly hours. Over the same period, the flexible-weight series fluctuates around the data series. Overall we can say, in answer to our first question, that the unitary model fails to track labor supply data after the mid 1980s, so the contribution of the household bargaining model in matching labor supply is greatest after 1985.

Given that flexible Pareto weights play such an important role in matching labor supply over time, a useful next step for future research would be to compare the predictions of different types of bargaining models against the data. One basic question would be the role of commitment: can we assume that Pareto weights are fixed for the duration of the marriage, or do we need to allow the weights to vary within the marriage as well? In our third experiment, the trend is computed for a population in which the weights are fixed for each marriage cohort but allowed to vary between cohorts. In each new marriage, the allocation corresponds to the bargaining outcome from the trend computation described earlier. We refer to this commitment model as the “Cohort-weight” model; it is effectively a weighted average of the unitary and no-commitment bargaining (benchmark) models.

As the stock of married people is always large relative to the flow into marriage each year, the commitment model more closely resembles the unitary model than the benchmark model. Nevertheless, as shown in the lower panels of Figure 3, the Cohort-weight model generates a significant reduction of the prediction error, relative to the unitary model. In panel (c) we see that by the year 2000, the two-hour error for wife’s paid labor in the unitary case in the upper panel has been reduced to one hour, and that the Cohort series follows the data much more closely throughout the period of analysis. A similar pattern holds for married-men’s paid labor, shown in panel (d); husband’s labor supply falls by one more hour than in the case of the flexible model, but this still constitutes a large reduction of prediction error relative to the fixed-weight model. The exercise suggests therefore even with full commitment, the benchmark bargaining process can still account for about half of the deviation between the data and the unitary model.¹³

7 Conclusion

The central point that motivated this paper is that the absence of a strong relation between wages and relative leisure of spouses is far from being an indicator that bargaining may be safely ignored; to the contrary, in the context of Neoclassical models, this is a compelling indicator of the importance

¹²Marriage and divorce rates are imposed to match the annual rates we derived from the stocks of never-married and ever-married singles in the March CPS. This mainly matters for the third experiment, in which the marriages from each year are carried over the following year, subject to the observed divorce rates, and new marriages formed at the observed marriage rates, as summarized in Figure 3.

¹³This suggests that if we were to extend the benchmark bargaining model to allow for commitment, the greater rigidity of the full commitment model implies that we would have to reduce the weight on the Nash bargaining in the calibration, in favor of the more elastic Egalitarian solution.

of household bargaining.

Standard explanations of rising female labor supply have strong implications for husband’s time allocations that have not been explored in the previous literature; the exception is Jones, Manuelli, and McGrattan (2003), who predict that husband’s labor time should decline significantly. Time-use data in the US suggest that this did not happen over the 1975-2003 period when the gender gap in wages was closing. This paper showed that allowing for bargaining between spouses is a simple way to reconcile the trends in time allocation with the usual driving forces proposed in the literature. The size of the effects measured in the current paper suggests that it would be useful for macroeconomics to examine more closely the mechanism by which such inter-spousal allocations actually occur.

Are macro-economists mistaken in ignoring bargaining between spouses? The results indicate that the modeling of bargaining should not be a priority for all macroeconomic questions. Bargaining in the model has little to add to the analysis of events whose impacts on the value of single life are similar for both sexes. Even for events like shifts in relative wages, which do have strong implications for bargaining, the effects on husbands are nearly offset by those on wives, so that bargaining could be ignored in the analysis of per-capita labor supply, at least as a first pass.

Where bargaining appears essential is in the analysis of the response of sex-specific behavior, such as married-men’s labor supply, to changes that affect the relative value of single life. We saw that the errors from the “unitary” version of the model were large relative to those of the bargaining model. The implications for future research are not limited to the shocks analyzed here. The impact of improved birth control, the decline of stigmatization of divorce, or the advent of affirmative action in employment are also likely to have raised the value of single life more for women than for men. In the light of the current results, it would be rash to interpret the impact of such changes on married-women’s labor supply or on marriage rates without considering the implications for bargaining; small or insignificant labor-supply effects for instance may mask large welfare effects for married women.

The emphasis on bargaining in this paper should not be taken too literally; it is intended as a short-hand for any mapping from outside options to the division of surplus, as in the micro-empirical literature on “collective” models of the household. The household model proposed here relies on a bargaining solution with divorce threat-points, but the same argument could apply to other models of intra-household allocation, provided that the the division of surplus is allowed to depend monotonically on some measure of the relative value of disagreement that is increasing in own wages. Whether the actual determination occurs through bargaining, auctions, judicial decisions or shifting social norms would seem to be without consequence for the basic argument.¹⁴

One might ask why married men’s working time declined in the period 1950-1975; the results of the wage-growth experiment in Table A5 suggest that we can expect labor-supply decline to accompany economic growth, and that bargaining has little to say about this effect. There are two further reasons that distinguish the 1950s and 1960s from the period studied here: 1) the gender wage gap was not declining, and 2) divorce was costly and rare, so the outside options were likely to have been less relevant to married couples.

Finally, the model may also be useful for the analysis of tax reform. This did not have a major impact in the experiments because there was not much change in the tax schedules, at least for

¹⁴It should also be noted that there are two strong justifications for divorce threat-points. First, data about the lives of singles, such as labor supply, wages and marriage rates, can be used, in combination with a suitable model of single life, to estimate the threat-points. In this paper, these threat-points are determined in the marriage-market equilibrium, as remarriage plays an important role in the value of being single. Second, the estimation results of Chiappori, Fortin, and Lacroix (2002) at the micro level imply that household labor supply is better described by a bargaining model with divorce threat-points than one with non-cooperative marriage as a threat-point.

married couples, over the 1975-2003 period; the flattening of the tax schedule discussed by Prescott (2004) occurred in the 1980s, and appears to have vanished by the end of the 1990s. It remains to be seen therefore how a change in the progressivity of taxes might affect aggregate labor supply, and hence tax revenues. Because single women are poorer than single men, a more progressive tax system would shift bargaining power to wives, reducing their labor supply relative to that of husbands.

Because the current model is so abstract, the estimated effects presented above should be seen as provisional. Even a simple change like adding fixed costs of household formation could increase the importance of wage changes for explaining the decline of marriage. It would be interesting to see whether the addition of dynamics in the form of fertility, savings or human-capital investments affect the interpretations presented here, but while it is clear that some of the results will change, the size of the bargaining effects suggests that bargaining will remain an important part of explaining time-allocation shifts over the last 40 years.

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Years	Sample		Weekly Hours	Per-Capita Hours
1962-66	Women	Single	24.22	25.24
		Married	11.79	
	Men	Single	25.71	
		Married	39.44	
1967-75	Women	Single	22.54	25.37
		Married	13.76	
	Men	Single	24.52	
		Married	38.60	
1976-85	Women	Single	23.07	25.45
		Married	16.73	
	Men	Single	25.13	
		Married	35.74	
1986-96	Women	Single	24.89	27.69
		Married	21.36	
	Men	Single	27.20	
		Married	36.20	
1997-2001	Women	Single	25.95	29.01
		Married	23.47	
	Men	Single	28.22	
		Married	37.30	
2002-2006	Women	Single	24.67	27.84
		Married	22.97	
	Men	Single	26.52	
		Married	36.01	

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

Variables	1965		1975		1985		2003	
	Wives	Husbands	Wives	Husbands	Wives	Husbands	Wives	Husbands
Discretionary Time	118	118	118	118	118	118	118	118
Paid Work	11.54	42.07	14.8	38.17	17.6	35.51	21.82	38.2
Unpaid Work	45.28	19.4	36.79	17.91	35.6	21.32	32.32	20.29
Total Working Time	56.82	61.47	51.59	56.08	53.2	56.83	54.14	58.49
Non-Working Time	61.18	56.53	66.41	61.92	64.8	61.17	63.86	59.51
Sample Size	739	696	697	655	1122	966	4116	3774

Table 2(a). *Time allocation of married couples.* Author's computations from married people aged 18-65 in time-use surveys. Observations with more than 4 weekly hours unaccounted for excluded.

Variables	1975		2003	
	Wives	Husbands	Wives	Husbands
Commute+Job-Related	2.71	6.54	2.02	4.06
Cooking and Indoor Chores	21.31	1.98	14.86	3.33
Shopping	6.18	3.8	6.55	4.24
Other Home Production	2.36	4.53	4.06	7.01
Child Care	4.23	1.06	4.83	1.65
Total Unpaid Work	36.79	17.91	32.32	20.29

Table 2(b) *Composition of Unpaid Work* . Author's computations from married people aged 18-65 in time-use surveys.

Variables	1975		2003	
	Wives	Husbands	Wives	Husbands
"Leisure 1"	34.5	33.07	32.43	35.51
Net Personal Care	25.4	23.31	24.44	20.12
Other Non-Working Time	6.51	5.54	6.99	3.88
Total Non-Working Time	66.41	61.92	63.86	59.51

Table 2(c) *Composition of Non-Working Time.* Author's computations from married people aged 18-65 in time-use surveys. "Leisure 1" refers to variable defined in Aguiar & Hurst (2006).

Age	Years					
	62-66	67-74	75-84	85-94	95-00	2000-06
18-24	0.83	0.81	0.84	0.92	0.91	0.90
25-54	0.59	0.60	0.63	0.74	0.76	0.75
55-56	0.65	0.65	0.60	0.64	0.63	0.66
Education						
< HS	0.59	0.58	0.61	0.71	0.74	0.75
HS	0.61	0.61	0.64	0.73	0.76	0.76
College	0.58	0.60	0.66	0.75	0.76	0.75
BA	0.64	0.66	0.66	0.73	0.72	0.69

Table 3(a): Female-Male Wage Ratios by Age and Education. Author's computations from the CPS population of people aged 18-65 who worked at least 10 hours weekly on average.

Subsample		Wife-Husband Ratios of Non-Working Time			
		1965	1975	1985	2003
Years of Education	Less than 12	1.08	1.02	1.08	1.01
	12 Years	1.06	1.14	1.03	1.06
	13-15 years	1.20	0.98	1.03	1.08
	16 or more	1.01	1.07	1.11	1.10
Age	Working	0.89	0.97	1.01	1.04
	25-55	0.83	0.94	1.03	1.04
	55-70	1.12	1.01	0.95	1.06

Table 3(b): Non-Working Time of Married People. Author's Computations from the time-use surveys.

Statistic	1975		2003	
	Data	Model	Data	Model
Wives HP home time	35.23	35.15	30.03	29.99
Husbands home time	11.7	11.68	17.55	17.53
single womens home time	21.72	21.77	21.14	21.14
single mens home time	10.5	10.5	13.21	13.25
equipment share	0.056	0.056	0.046	0.046
Wives leisure	65.05	64.91	62.78	62.7
Husbands leisure	61.93	61.79	59.97	59.89
single womens leisure	70.91	71.08	70.21	70.2
single mens leisure	77.42	77.4	74.63	74.87
Wives paid work	15.08	15.23	23.06	22.88
Husbands paid work	38.01	37.8	36.62	36.68
single womens paid work	21.26	21.34	24.09	24.09
single mens paid work	25.55	25.55	26.9	27.01

Table 4(a) Time-allocation results

Statistic	1975		2003	
	Data	Model	Data	Model
Marriage Rate	0.0929	0.0854	0.0458	0.0442
Divorce Rate	0.0249	0.0241	0.0178	0.0352
Wife/Husband Leisure Ratio	1.0505	1.0553	1.0469	1.0423

Table 4(b) Marriage-market calibration results.

Type	Year	Theta	Utility Weights		
			Consumption	Home Good	Leisure
Married	1975	0.898	0.260	0.051	0.689
	2003	0.919	0.323	0.070	0.607
Single Men	1975	0.817	0.224	0.026	0.750
	2003	0.879	0.254	0.038	0.709
Single Women	1975	0.906	0.193	0.072	0.735
	2003	0.928	0.213	0.072	0.715
Work Costs					
	1975	0.178	Substitutability of Home Labor		0.475
	2003	0.106			

Table 5(a) Values of Time-Allocation parameters

Parameter	Value
Joy of single life: women/men	1.25
Men's joy of single life 1975	0.83
Men's joy of single life 2003	0.71
Divorce Cost	5.29
Weight on Egalitarian Solution	0.38

Table 5(b) Values of free parameters

Statistic		Bargaining Model			Unitary Model			BenchMark 1975
		2003	Preferences	Relative Wage	2003	Preferences	Relative Wage	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Marriage rate	0.040	0.064	0.102	0.04	0.07	0.10	0.09
	Divorce Rate	0.037	0.029	0.021	0.04	0.03	0.02	0.02
	Wife/husband leisure ratio	1.04	1.12	1.02	0.93	1.06	0.93	1.06
Paid work	Wives	22.94	15.04	23.22	26.42	16.67	25.90	14.97
	Husbands	36.52	43.40	32.70	33.82	42.32	30.61	37.63
	Single women	24.09	23.13	21.29	24.09	23.13	21.29	21.34
	Single men	27.01	27.67	25.26	27.01	27.67	25.26	25.55
Home work	Wives	30.02	41.05	24.72	30.02	41.05	24.72	35.15
	Husbands	17.55	13.64	14.45	17.55	13.64	14.45	11.68
	Single women	21.14	21.60	21.70	21.14	21.60	21.70	21.77
	Single men	13.25	13.07	10.54	13.25	13.07	10.54	10.50
Leisure	Wives	62.49	58.69	65.26	58.64	56.77	62.10	64.63
	Husbands	59.93	52.49	64.30	62.92	53.76	66.75	61.24
	Single women	70.20	69.14	71.22	70.20	69.14	71.22	71.08
	Single men	74.87	72.33	77.69	74.87	72.33	77.69	77.40

Table 6: Main results with flexible (*Bargaining Model*) and rigid (*Unitary Model*) Pareto weights. The Unitary model imposes the mapping from marriage quality to Pareto weight that is derived from the 1975 Benchmark calibration.

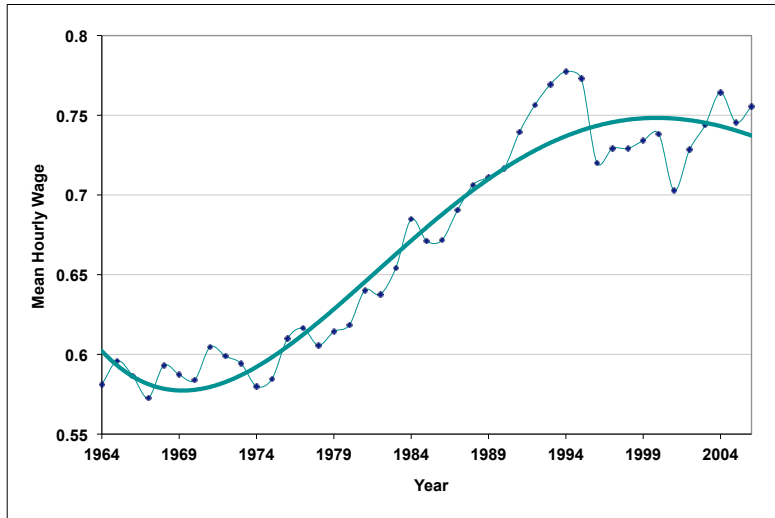


Figure 1(a): Ratio of Mean Wages of Women to those of Men. Author's computations from the March CPS for population 18-65 years old working 10 hours or more weekly at paid employment

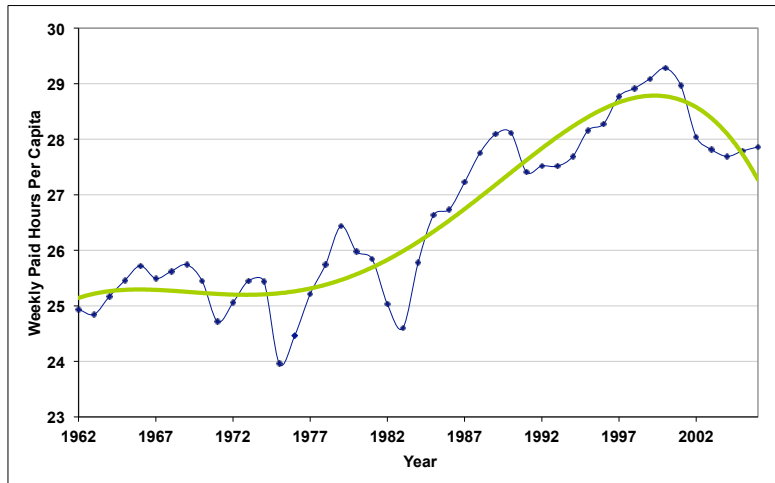


Figure 1(b): Per-capita hours in the March CPS. Based on author's computations from reported hours worked in previous week by persons aged 18-65. With fitted quartic trend line.

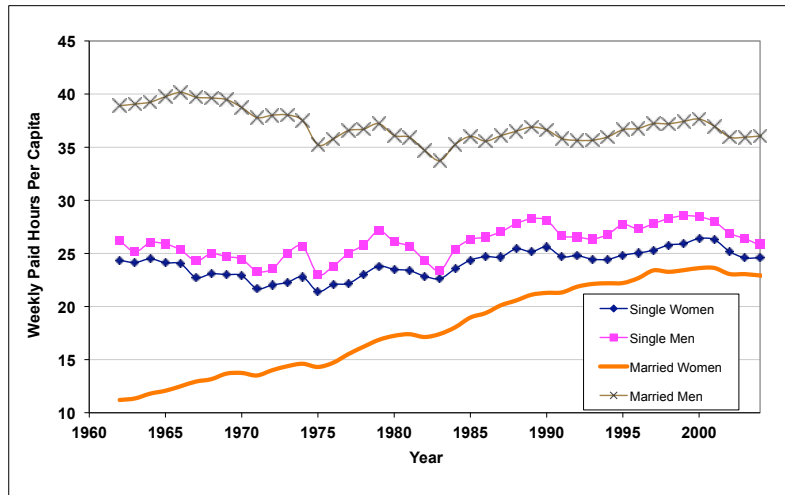


Figure 1(c): Per-capita hours by sex and marital status. Based on author's computations from March CPS, persons aged 18-65

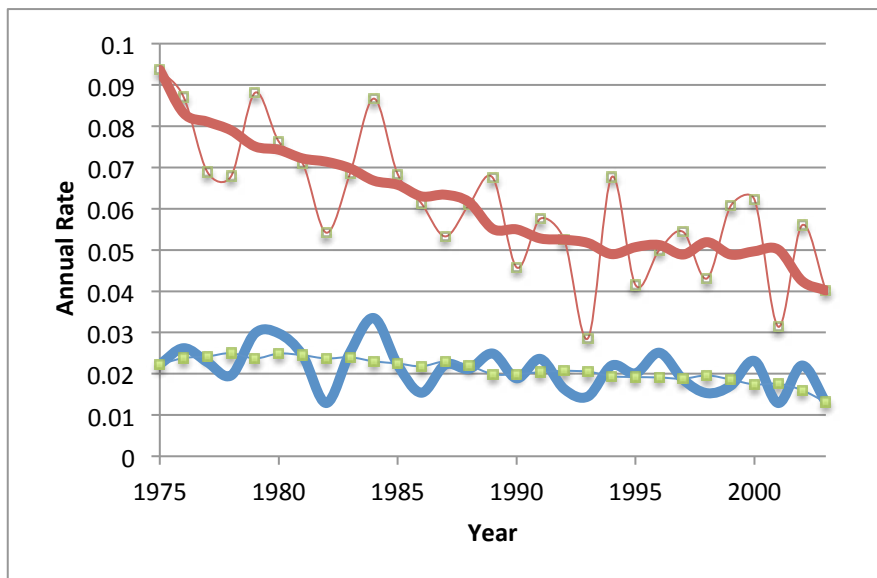


Figure 2: *Marriage and divorce rates.* Per single woman aged 18-65, as imputed from March CPS.

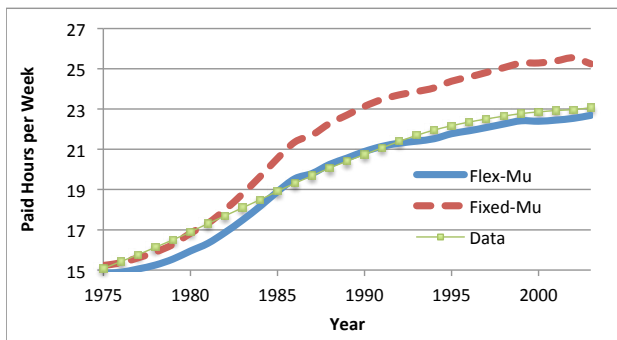


Figure 3(a): Married Women's Paid-Labor Supply with fixed and flexible pareto weights.

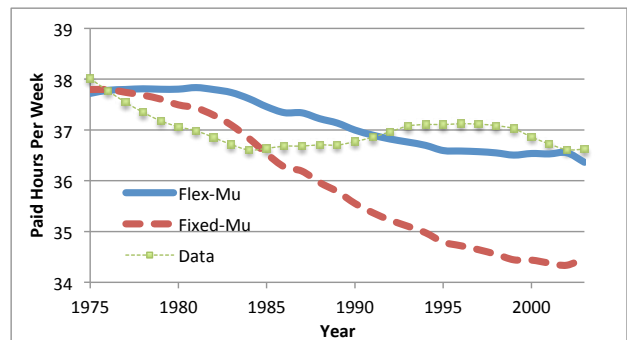


Figure 3(b): Married Men's Paid-Labor Supply with fixed and flexible pareto weights.

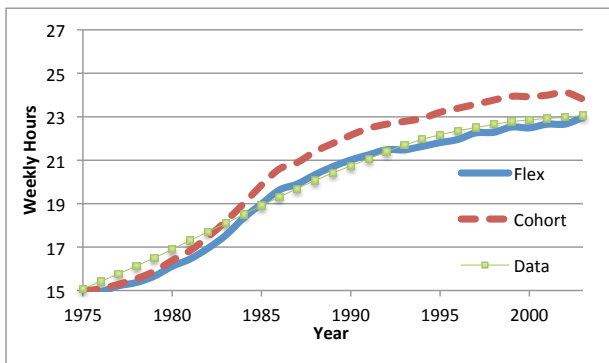


Figure 3(c): Wives' paid labor hours, with cohort-specific Pareto weights ('Cohort') versus flexible weights ('Flex'), compared to data.

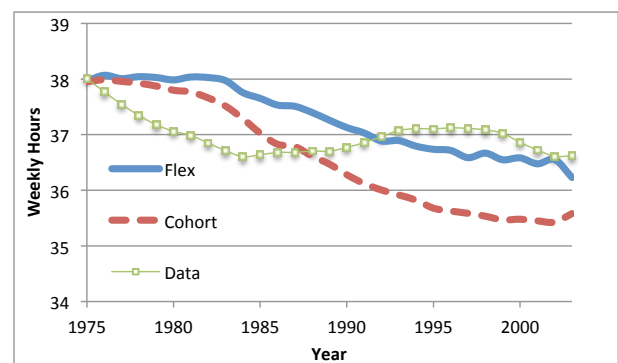


Figure 3(d): Husband's paid labor hours, with cohort-specific Pareto weights ('Cohort') versus flexible weights ('Flex'), compared to data.