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"Why are Married Men Working So Much?

by

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Why are Married Men Working So Much?*

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Abstract

We document a negative trend in the leisure of men married to women aged 25-45, relative to that of their wives, and a positive trend in relative housework. Taken together, these trends rule out a popular class of labor supply models in which unitary households maximize the sum of the spouse's utility. We develop a simple bargaining model of marriage, divorce and allocations of leisure-time and housework. According to the model, a rise in women's relative wage will reduce husband's leisure and marriage rates when the quality of single life is relatively high for women. Calibration to US data shows the trend in relative wages explains most of the trend in relative leisure and about a third of the trend in housework, while the simultaneous trend in home-durables prices explains the balance of the housework trend..

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

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1 Introduction

Over the last 35 years, the average weekly time married women spend in paid employment has doubled. Two plausible explanations of this change are that women's wages have increased relative to those of men, and that rising productivity in household work has allowed married women to devote more time to market work. A host of recent papers explore one or both of these hypotheses; these include Jones, Manuelli, and McGrattan (2003), which finds in favor of rising female wages and Greenwood and Guner (2004), which claims that the falling price of home appliances is responsible.

This paper argues that a logical step towards resolving this issue is to compare trends in the allocation of husband's time to those of married women. While it is well-known that average market hours worked has been declining for men, time-use surveys show that their housework time has been increasing, while that of women has been falling. Gershuny and Robinson (1988) show that this is true of both the U.S. and the U.K. over the period 1965-85, and Aguiar and Hurst (2005) confirm that, for the US at least, this trend extends through the 1990s. Both papers show that these trends are not explained by trends in demographic composition. According to Robinson and Godbey (1997), the decline in women's home hours since 1975 is "unprecedented" in the 20th century. However these aggregate trends are not informative about the time allocation between spouses; are the men whose market hours are falling married to the women whose market hours are increasing or are they entirely unconnected? This paper argues that the distinction is important for explaining trends in aggregate labor supply.

We use PSID data on market work and housework for households of wives aged 25-45 to examine the allocation of leisure and housework between spouses. We take as a measure of total working time the sum of market labor hours and hours spent in housework We show that for husbands of working women, time spent in household labor has been increasing, while that of their wives has been falling. Furthermore, the husband's leisure time has been falling while the wife's leisure has been increasing.

A common feature of most models of the trends in married-women's time trends is that labor supply decisions are made by a single agent, a common and convenient abstraction from the complications of modeling the individual spouses in a married couple. We first consider a simple version of the additive-utility models of household behavior that constitute the work-horses of the literature in this area. We show that the two types of explanations referred to above, rising relative wage and rising productivity at home, both imply that husband's leisure should be rising relative to wife's leisure. This prediction is indeed corroborated in the data, but only for men married to women older than 55.

It is natural to suspect that the problem is the excessive simplicity of our model, perhaps the Cobb-Douglas preferences, or the absence of the home good from the utility function, or the failure to incorporate wage dynamics or savings. A recent paper by Jones, Manuelli, and McGrattan (2003) refutes this view. In a dynamic model which relaxes all of the above restrictions, and is calibrated to match US data, husband's leisure is still predicted to increase by 5 hours over this period. Furthermore that paper shows that under the alternative hypothesis that women's labor supply is driven by technical change in the home production sector, then the expected increase in men's leisure is considerably larger.

The unitary model fails therefore, even in far more sophisticated incarnations. Some of this could be explained by interdependent preferences, but a simpler and more fertile approach is to assume that the wife's share of household utility has increased over time, contrary to the standard assumption that the household is the decision-making unit.

To explain movements in the wife's share of household utility, we transform the unitary model by incorporating a simple model of bargaining between spouses in which the outside option is life as a single person, as in McElroy and Horney (1981). Relying on a standard solution concept, that the spouses split the marital surplus equally, we can solve explicitly for the equilibrium leisure allocation when the sexes differ in their valuation of single life. The question, when is husband's leisure decreasing in the wife's wage, can therefore be answered explicitly. Roughly, this requires that the attractiveness of single life be sufficiently high for women relative to men. On the basis of relative wages and leisure for married couples in the US, we conclude that this condition was indeed satisfied during the period under consideration.

Empirical support for a similar view of the household can be found in the work of Mazzocco (2003). He shows that US household data on the labor supply and consumption decisions of married couples is consistent with a model in which households choose allocations on the Pareto frontier each period but cannot commit over long periods of time. This means that, as in our model, the wife's share of household utility will increase in response to an increase in her outside options, relative to those of her husband.

Two important components of the attractiveness of single life for women relative to men are marriage prospects and productivity in household work. Since it is likely that both of these have changed substantially since the 1970s, we embed the above household problem into an equilibrium setting where people, whether currently single or married, choose between marriage and single life, taking into account relative wages, productivity in housework, the joy (or misery) of being single, and an idiosyncratic match quality variable. We show that the model has a unique equilibrium marriage rate, and solve for the allocation of leisure.

The trends in leisure in our model are the result of trends in the attractiveness of single life. When single life becomes more appealing to women, then wive's share of household utility increases. The data suggests three different measurable sources of such a change: an exogenous decline in family size over time, a decline in the price of home appliances, and an increase in the relative wage of women. Understanding the trend in married women's market labor therefore requires a calibration of the model to gauge the relative importance of these explanations.

At first glance, such an exercise appears too complex to contribute much to our understanding of the issues. Once again, the separability of the housework allocation comes to our rescue, by allowing us to calibrate the home production component first and then use the results in the calibration of the rest of the model. The results suggest that the price trend accounts for about half of the trend in housework time; the wage trend explains about a third, and the decline in family size about 20%. With regards to leisure trends, we find they are almost entirely due to the price trend. The change in relative wages has two large and offsetting effects on market labor: on the one hand the price of wife's leisure increases, causing her market labor to increase by 50%, and on the other hand, her share of household utility increases, causing her total working time to decline.

To the best of our knowledge, the model developed in this paper is unique in that it allows analytical results for endogenous labor supply of married couples. Previous equilibrium analysis of the relation between marriage and female labor supply has been limited to computational results, as in Caucutt, Guner, and Knowles (2002) and Regalia and Ríos-Rull (1999).[1] Our model can be seen as a simplification of Greenwood, Guner, and Knowles (2003), which also solves for equilibrium marriage rates when married-couple allocations are determined by a bargaining solution and are subject to an idiosyncratic match-quality shock. While Chiappori and Weiss (2000), or Chade and Ventura (2004) also develop very simple equilibrium-marriage models, those models do not allow for labor supply decisions, and assume instead that the gains from marriage are fixed. Theoretically, the key difference is that in our model utility is partially transferable, via the leisure allocation, while in the former, utility is perfectly transferable, and in the latter non-transferable.

The rest of the paper is divided into seven parts: an empirical analysis in Section 2, followed by an analysis of the unitary model in section 3, then an analysis of the allocation of leisure in the bargaining model of the household. Section 5 integrates housework into the model. Section 6 presents the quantitative implications when the model is calibrated to US data. The conclusion contains a summary of the results and suggestions for future research.

2 Trends in Time Allocation

In this section we document trends in the working time for married-couple households in the U.S. The main variables of interest are the market labor time and time spent in housework of each spouse. The sum of these is taken to be total working time, and the remainder of total waking time as free time or leisure.

The data is taken from the 1969-1997 waves of the PSID, excluding those years in which housework data was not collected, such as 1975 and 1982. None

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

of the analysis reported here exploits the panel nature of the study; the PSID is used because it is the only annual cross-sectional dataset in the U.S. that includes housework.

Our sample consists of all wives (or “wives") between the ages of 25 and 80 who report time spent in market labor and house work for both spouses. The sample size grows over time, from 1018 households in 1969, to 3052 in 1997. This results in a total number of annual observations equal to 69,762.To ensure that the sample is representative, all statistics are weighted using the household's cross-sectional weight for each year. We also repeat the exercise for single men and single women, as the model has implications for their time allocations.

The housework variable is the response to the question: "About how much time does your (wife/"WIFE") spend on housework in an average week? I mean time spent cooking, cleaning, and doing other work around the house." A similar question is asked for husbands. This is not an ideal instrument in many ways, particularly as the interpretation of housework may vary across sexes, and over time. Nevertheless, the results reported here seem to be broadly consistent with those reported on the basis of the American Time Use Survey in a number of recent publications, including Aguiar and Hurst (2005), Robinson and Godbey (1997) and Gershuny and Robinson (1988).

We take weekly hours worked in each category to be the annual numbers reported, divided by 52. In order to ensure that extreme values of hours do not distort the results, we top-code both market hours and housework hours at 90 hours weekly; this affects only the top percentile in each case.

Conceptually, this paper assumes there are two categories of time use: discretionary, which is divided into work or leisure, and non-discretionary, such as sleep and personal care. This non-discretionary component corresponds to what time-use researchers such as Robinson and Godbey (1997) call personal time, while work corresponds to what they call "Total Productive Activity". Based on data derived from the Americans Use of Time Project (ATUS), they find that personal time averages about 70 hours weekly for both men and women over the 1965-85 period, leaving 98 hours to divide between free time and productive activity.[2]

The paper focuses on the portion of the sample consisting of women and single men aged between 25 and 45 and the husbands of these women Summary statistics for this sub-sample are shown in Table 1, which reports housework and market hours, as well as annual earnings and family size for married and single households. While the paper will focus on comparing two periods, 1969-75 ("the early 70s") and 1988-1997 ("the 90s"), the table also reports a middle period, 1978-83. As expected, the table shows that the average wife's time in market work doubled over the period, from 12 hours weekly to 25, and that housework hours fell from 34 hours to 21. Total working time for women declined slightly more than an hour, from 47.8 hours to 46.5. For married men, housework hours increased from two to seven weekly, while market hours declined from 44 to

[2]It is likely however that some part of personal time is discretionary; for instance, between 1975 and 1995, Robinson and Godbey (1997) report that time spent eating and grooming fell by more than 5 hours for men compared to about 2 hours for women.

Years	N/Year	Home	Market	Total	Family Size	Number of Kids
			Married Men, Wife aged 25-45			
1969-1975	746	2.14	44.14	47.45	4.63	2.41
1978-1983	1634	6.25	41.89	49.05	3.97	1.77
1988-1997	3333	7.45	41.63	49.78	3.69	1.54
			Married Women, aged 25-45			
1969-1975	578	34.57	12.04	47.79	4.63	2.41
1978-1983	1299	28.37	18.03	47.14	3.97	1.77
1988-1997	2709	20.99	25.08	46.45	3.69	1.54
			Single Men aged 25-45			
1969-1975	54	7.00	37.77	44.77	1.47	0.30
1978-1983	305	9.13	36.32	45.45	1.41	0.29
1988-1997	739	8.42	37.00	45.41	1.38	0.25
			Single Women aged 25-45			
1969-1975	150	19.39	25.32	44.71	3.12	1.77
1978-1983	436	15.68	29.20	44.88	2.37	1.13
1988-1997	1050	13.06	30.43	43.49	2.22	1.02

Table 1: Hours worked, earnings and family size in PSID for households where wife or head is aged 25-45 years.

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Table 2: Hours worked, earnings and family size in PSID for “working" households where wife or head is aged 25-45 years.

41. For this broad sample, the relative leisure of the husband declined from 100% of the wife's leisure time, to 94%. The table also implies that the relative housework time of the wife fell from 16 times that of the husband to three times.

.In Table 2, we further restrict the sample to "working households", by which we mean married households where the wife works 10 hours or more outside the home, and single households where the head works 25 hours or more outside the home. The main difference from Table 1 is that we see a much larger decline in husband's leisure relative to the wife's, from 120% to about 100%. This is an important distinction, because it suggests that wives experience a decline in relative leisure when they move into the labor force, while for women who would have been in the labor force anyway, relative leisure has increased over time.

To ensure that other demographic changes over the same period are not driving the finding of the trends in time allocation, we turn to Table 3, which restricts attention to household where the wife works 30 hours or more weekly. The table shows that the size of the decline in husband's relative leisure when the wife is between 35 and 44 years old ranges from 12% when the wife did not complete high school to 16% for college-educated wives. The change is uniformly

Age	Drop Out	High-School	College
25-34	17.44%	11.61%	6.60%
35-44	11.60%	13.65%	16.10%
45-54	6.61%	2.84%	5.80%
55-65	-12.29%	-9.33%	-4.61%

Table 3: Percent decline in husband's relative leisure in households where the wife spends 25 hours or more weekly in paid market work.

smaller when the wife is aged between 45 and 54 years old: for drop-outs the change in relative leisure is 7%, and only 3% for high-school graduates. For the youngest group, where the wife is aged 25-34, the relative leisure of the husband fell by 17% in the case of dropouts, 12% for high-school graduates, and 7% for college-educated women.

The trends over time for the 25–34 and 35-44 age groups in this sub-sample are shown in Figure 2. The total hours worked of these women declines noticeably, from an average of 59 hours in the early 1970s to 54.4 hours in the 1990s, as home hours decline from 22.5 to 16 hours, while market hours remain constant. The total hours worked of their husbands however increases from 47 to 49 hours on average. Hence the rise in wife's working hours appears to be quite steady since the beginning of the 1970s, as is the increase in husband's working time.

To summarize, we see that for households where wives are under age 55, the shift in the allocation of the leisure away from the husband is somewhat stronger after controlling for age, education and full-time employment. By way of contrast, consider the households where the wife was aged between 55 and 65. In that slightly older group, men's leisure actually increased relative to the wife's, by about 5% for college-educated wives, and by 10% for the others.

What about single people? Table 1 shows that housework hours rise by about 20 percent for single men, fall by about a third for single women, while market hours remained roughly constant for men, and increased for women. Working time of single men increased by about 0.9 hours for single men, and fell by 1.5 hours for single women. In Table 2 we see that conditional on working there was very little change in the total of working time of single women.

The overall picture is perhaps clearer in Figure 3, which shows that average

Variable	Specification			
	1	2	3	4
Intercept	2.980	3.133	3.246	3.199
	(0.008)	(0.010)	(0.012)	(0.013)
Single Male	-1.073	-1.091	-1.138	-1.024
	(0.010)	(0.009)	(0.021)	(0.021)
Single Female	-0.846	-0.857	-0.797	-0.699
	(0.008)	(0.008)	(0.017)	(0.017)
Parent	0.308	0.300	0.304	0.296
	(0.011)	(0.011)	(0.010)	(0.010)
Number of Kids	0.134	0.126	0.114	0.088
	(0.004)	(0.004)	(0.004)	(0.004)
After 1990	.	.	-0.175	-0.109
	.	.	(0.009)	(0.009)
Single Male After 1990	.	.	0.072	-0.008
	.	.	(0.023)	(0.022)
Single Female After 1990	.	.	-0.052	-0.119
	.	.	(0.019)	(0.019)
High-School Graduate	.	-0.137	-0.115	-0.073
	.	(0.008)	(0.008)	(0.008)
Attended College	.	-0.280	-0.258	-0.204
	.	(0.009)	(0.009)	(0.009)
Works Full Time*	.	.	.	-0.160
	.	.	.	(0.007)
Does Not Work*	.	.	.	0.218
	.	.	.	(0.009)
Age 25-34	-0.182	-0.167	-0.164	-0.141
	(0.009)	(0.009)	(0.009)	(0.008)
Age 35-44	-0.195	-0.169	-0.152	-0.126
	0.009	0.0089	0.0089	0.0088
R-Squared	0.483	0.492	0.498	0.518
N	49176	49176	49176	49176

Table 4: Estimated coefficients for log of total weekly housework hours.

working time for singles age 25-44 fluctuated without trend around an average of 45 hours for both sexes.

Table 2 also suggests a possible explanation of the decline in wife's home hours: a decline in family size over the same period. In the early 70s, average family size for married couples was 4.2; this fell to 3.5 by the 1990s. Almost all of this decline was due to the number of children at home, which declined from 1.92 to 1.38. To the extent that mother's time allocation is more responsive to the presence of children, then this decline would in turn cause an increase in wife's leisure relative to the husband's, holding constant the other components of the household allocation.

We attempt to measure the various effects associated with the trend in housework hours by running an OLS regression in which the dependent variable is the log of the sum of the housework hours of both head and spouse for married couples, and of the housework hours of the head for singles. Table 4 reports the results when the excluded group is married with zero kids. Four specifications are reported, the simplest of which shows that single males spend 50% less time than married in housework, and single women about 85% less, while parents of one child spend 43% more time in housework. Additional children appear to increase housework time by 13% each. This result suggests that people are including at least some portion of childcare in their responses to the questions about housework.

Specification 2 shows that the estimates are robust to controlling for education of the head. In the last two specifications, the estimates suggest that home hours fell about 18% for married couples, 5% for single women, and actually rose 7% for single men. This latter effect disappears after adding controls for labor-force status of the head. By contrast, controlling for labor force status causes the 1990's effect to converge to about -11% for both married and single women. The overall picture then, conditional on labor-force status, is one in which housework fell for women, rose for married men, and remained constant for single men. We now turn to consider explanations of the most striking feature of the data, the 20% decline in the relative leisure of the husbands of working women aged 25-45.

3 A Simple Unitary Model

In the analysis that follows we concentrate upon the households of women aged 25-45; we ignore the younger and older groups because their time allocations are likely linked to education and retirement decisions, respectively, which are outside the scope of this paper. We will consider first the question of why the allocation of leisure did not increase in favor of husbands, and then ask why the house-work time of husbands should have increased, while that of their wives declined so dramatically.

Suppose that preferences of individuals are given by:

$$\widetilde{u}(c,l) = \ln \phi c + \delta \ln l$$

where c is household consumption (public good), l is leisure. ϕ is a constant.

Each person i has a time endowment of one unit of time, which is allocated across three competing uses: leisure l_i, market work, n_i and housework h_i.The time constraint is:

$$l_i + n_i + h_i = 1$$

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

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

where

$$I\left(h_i, h_j, k | w_i, w_j, p\right) = \left(w_i + w_j\right) T - w_i h_i - w_j h_j - pk$$

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

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

.

3.0.1 Optimal Time Allocation of Married Couples

Suppose consumption is a public good in the marriage, so that consumption per capita equals ϕc, where c represents expenditures, and $\phi \in [0.5, 1]$ is a constant. [3] The household decisions, given that spouse i has Pareto-weight μ_i in the couple's utility function, are given by the solution to the following problem:

$$\max_{l_i, l_j} \left\{\ln \phi c + \mu_i \delta \ln l_i + \left(1 - \mu_i\right) \delta \ln l_j\right\} \tag{1}$$

subject to the budget and home-production constraints.

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

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

subject to the home-production constraint.

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

Assuming that the solution is interior, then the optimal decisions are:

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

[3] Later we will make this depend on the number of children, but this dependence has no effect on the qualitative model, provided that ϕ is constant over time.

This is an instance of the well-known result that expenditure shares are constant with Cob-Douglas preferences.[4]

3.1 Relative Leisure in the Unitary Household

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

$$l_j/l_i = \frac{1-\mu_i}{\widetilde{w}\mu_i} = \widetilde{l}\,(\widetilde{w}) \tag{2}$$

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

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

. If there were no change in wife's leisure, then, taking average leisure in 1970 to be 40 hours per week each as per Robinson and Godbey (1997), then husband's leisure should have increased by about 10 hours.

For older husbands, those married to women aged 55 or older, we do in fact observe a decline of this order in market hours. However for younger men, the predicted decline is so large relative to any observed trend in the data that it seems unlikely that tweaking the preferences or adding home production are going to solve the problem. The results of Jones, Manuelli, and McGrattan (2003) corroborate this conjecture for both wage-based explanations of the rise in women's market hours.

In this model it is easy to solve for the Pareto weight given the observed leisure and relative wages. We observed in Table 2 that husband's leisure was 1.2 times that of working wives in the 1970s. Setting $\widetilde{w} = 0.60$, and inverting the optimality condition for leisure gives us

$$\mu_i^{1970} = \frac{1}{1+\widetilde{w}_{1970}\widetilde{l}_{1970}} = \frac{1}{1+0.60/1.2} = 0.67$$

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

How do the results change when we plug in the changes in wages and relative leisure? We observed that husband's leisure equalled that of working wives in the 1990s, while the relative wage of wives increased to 0.76:

$$\mu_i^{1990} = \frac{1}{1+\widetilde{w}_{1990}\widetilde{l}_{1990}} = \frac{1}{1+0.76} = 0.57$$

So the Pareto weight of the husband would have to fall by 15% in order to explain the change in leisure allocation of households where the wife was working 10 or more hours outside of the home.

[4] In the appendix we deal with the corner-solution case where wives do not work outside the home. The solution requires that we consider the technology for home production, which we defer until later in the paper. Since the focus of the paper is the change in the allocations of households where the wives are working, we defer all discussion of this case to the end.

To understand aggregate trends in household labor supply therefore requires a theory of these weights. In what follows, we will rely on bargaining models, in which the solution depends on the gains from marriage. Since the motivation for considering a bargaining model involves the observation that husband's leisure is not increasing, it is essential to consider the conditions under which an increase in the wife's wage causes men's leisure to fall.

The optimality condition implies the following response of leisure of spouse i to an increase in her relative wage:

$$\frac{d \ln l_i}{d\widetilde{w}} = \frac{d}{d\widetilde{w}} \ln \left(1 - \mu_j\right) + \frac{1}{1 + \widetilde{w}}$$

.

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

$$\frac{d}{d\widetilde{w}} \ln \widetilde{l}\left(\widetilde{w}\right) > 0 \Leftrightarrow \frac{d\mu_j}{d\widetilde{w}} \left[\frac{1}{\left(1 - \mu_j\right) \mu_j}\right] > \frac{1}{\widetilde{w}} \tag{3}$$

So the more responsive is the wife's share to her wage, the more likely it is that husband's leisure declines when her wage rises. To see under what conditions this might happen, we now consider a simple theory of the weight μ_j.[5]

4 The Allocation of the Marital Surplus

Consider a marriage in which the total surplus is positive. The allocation of the surplus between the two spouses is equivalent to the choice of the Pareto weights μ_j in the couple's problem. To understand how these might evolve over time, in response to trends in relative wages or in non-market productivity, we turn to bargaining models of the married couple. We consider the "egalitarian" solution concept, in which the marital surplus is split equally between the spouses. When utility is perfectly transferable, which is not the case here, this is usually equivalent to the Nash solution, which maximizes the product of the gains from marriage. We abstract from any consideration of the process by which the solutions are attained. The advantage of the egalitarian solution is that it is analytically tractable, as well as simple and plausible.[6]

In general, bargaining theories are mappings from the spouse's marriage gains onto a point on the Pareto frontier. Hence the next step is to compute the gains from marriage. Since this depends on the projected length of the marriage, and the value of being single in turn depends on the probability of marriage, we begin by embedding the static model into a simple infinite-horizon

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

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

marriage model. Because the model abstracts from divorce costs and long-term commitment, the marriage probability determines the divorce probability. We proceed by first working out the equilibrium leisure allocations, taking the marriage rate as given, and then in the next section work out how the equilibrium marriage rates depend on full income by marital status.

We assume there is a very large marriage population with equal number of both sexes, that people live forever and that time is divided into discrete periods. People of a given sex are identical. All marriages and separations are efficient ex post. Couples who married in some previous period cannot choose a different sharing rule than newly-married couples, and divorce or marriage is costless. Also, we assume that the process for match quality is independent of marital status. Finally, we require that the values of the wage and the quality of single life do not change over time.

At the beginning of each period, people are either married or single. Married people receive a match-quality shock ε, and then married couples choose whether to stay together or to divorce and become singles. All singles are then randomly paired with a single of the opposite sex, the new pairs then learn their match quality and decide whether to marry. After the marriage decisions, households choose their time allocations over market and house work, and get utility from leisure, match quality and consumption of household earnings.

4.1 Single People

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

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

A single person of sex i faces budget and home-production constraints given by:

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

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

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

subject to

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

Optimal decisions are given by

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

The flow utility from being single is:

$$\begin{aligned} U_i^s (p, w_i, q_i) &= K_S + (1+\delta) \ln Y^s (p, w_i) - \delta \ln w_i + \delta \ln q_i \\ K_S &= \delta \ln \delta - (1+\delta) \ln (1+\delta) \end{aligned}$$

4.2 The Gains from Marriage

The flow utility from being married, including the idiosyncratic match-quality variable ε is given by:

$$\widetilde{U}_i^M(p,w,q,\varepsilon,\mu_i) = U_i^M(w,p) + \delta\ln\mu_i + \delta\ln\varepsilon$$

where

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

and

$$K_M = \ln\phi + K_S$$

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

$$\widetilde{U}_i^M(p,w,q,\varepsilon,\mu_i) = U_i^M(w,p) + \delta\ln\mu_i(p,w,q,\varepsilon) + \delta\ln\varepsilon$$

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

We show in the appendix that there is a unique equilibrium marriage rate. The main simplifying assumption we need to get this result is that the Pareto weight is independent of the current marriage quality.

4.3 The Egalitarian solution

Suppose that spouses agree to split the gains from marriage evenly, so that the share μ_i solves

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

, where $W_i(w,q,\varepsilon|\mu_i)$ is the gain from marriage for a person of sex i. We call this the Egalitarian solution; it is also known as the "split the surplus rule".

We show in the appendix that if married couples can not condition μ_i on the current match quality ε, then the Egalitarian solution equates the gains in flow utility from marriage. This implies

$$\begin{aligned}\Delta_i(p,w_i,q_i) + \delta\ln\mu_i &= \Delta_j(p,w_i,q_i)\,\delta\ln(1-\mu_i)\\ (1+\delta)\ln\frac{Y^m(w,p)}{Y_i^s(p,w_i)} - \delta\ln q_i &= (1+\delta)\ln\frac{Y^m(w,p)}{Y_j^s(p,w_i)} - \delta\ln q_j\end{aligned}$$

Let $\widetilde{y} = \frac{Y_j^s(p,w_i)}{Y_i^s(p,w_j)}$, $\widetilde{q} = \frac{q_j}{q_i}$ and recall that $\widetilde{w} = \frac{w_j}{w_i}$.The Pareto weight implied by this equation is given by

$$\mu_i(p,w,q,\varepsilon) = \frac{1}{1+\widetilde{q}\widetilde{y}^{\frac{1+\delta}{\delta}}}$$

This says that the bargaining position of spouse j is summarized by the product of her relative wage, her relative enjoyment of single life and her relative full income as a single.[7] Take i to refer to the husband. Since $w < 1$ then for $\beta > \frac{1}{1+\pi^M}$ an increase in the marriage rate will make the relative wage a less important determinant of household allocations.

The leisure of spouse i will fall in response to a decline in $\widetilde{y}$ when the following condition is satisfied:

$$\widetilde{q} > \underline{q} = \frac{1}{\widetilde{y}^a \left[a\left(1+\widetilde{y}\right) - \widetilde{y}\right]} \tag{4}$$

, where $a = \frac{1+\delta}{\delta}$.

For simplicity, suppose that ratio of full incomes $\frac{Y^m(w,p)}{Y^s(p,w_i)}$ equals the wage ratio, $\widetilde{w}$. Then we can compute women's relative joy of single life $\widetilde{q}$, using the solution for μ_i :

$$\mu_i\left(\widetilde{w}\right) = \frac{1}{1+\widetilde{q}\widetilde{w}^{\frac{1+\delta}{\delta}}}$$

Suppose that $\delta = 1.5$, so that average leisure is 60% of the time endowment, and that $\mu_i^{1970} = 0.67$, as in the previous section.. If the relative wage in 1970 is $\widetilde{w} = 0.6$, what does $\widetilde{q}$ have to be to match μ_i^{1970}?

$$\mu_i\left(\widetilde{w_{70}}\right) = \frac{1}{1+\widetilde{q}\left(0.6\right)^{5/3}} = 0.67 \Rightarrow \widetilde{q} = \frac{1}{2\times\left(0.6\right)^{5/3}} = 1.17$$

Therefore women in 1970 enjoyed single life more than men do; or at least, they needed marriage less, holding income constant.

The Egalitarian solution has a very strong implication for trends in relative leisure: suppose that we can write the full-income ratio as $\widetilde{y} = \widetilde{w}^a$. Then relative leisure and the wage are related by

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

Combining with the expression for relative leisure, we can solve for $\widetilde{l}$.

$$\begin{aligned} l_j/l_i &= \widetilde{l} = \frac{1-\mu_i}{\widetilde{w}\mu_i} \\ &\Rightarrow \mu_i = \frac{\widetilde{w}\widetilde{l}}{1+\widetilde{w}\widetilde{l}} = \frac{\widetilde{q}\widetilde{w}^{a+\frac{1+\delta}{\delta}}}{1+\widetilde{q}\widetilde{w}^{a+\frac{1+\delta}{\delta}}} \\ &\Rightarrow \widetilde{l} = \widetilde{q}\widetilde{w}^{\frac{1+a\delta}{\delta}} \end{aligned}$$

This says that if $\frac{1+a\delta}{\delta} > 1$, then the relative leisure of the wife should grow at a faster rate than the relative wage, holding $\widetilde{q}$ constant. This holds whenever

[7] Note that marriage prospects play no role here in determining the impact of changes in relative wages on the Pareto weights. We show in that appendix that in the Nash solution, marriage prospects will affect the Pareto weights.

$a > 1 - \frac{1}{\delta}$.In the next section we show that $a > 1$ is a reasonable assumption, so we should indeed expect relative leisure to grow more quickly. However Table 2 suggests that the growth rates of leisure and the relative wage are roughly equal.

One way to resolve this is to assume that the trend in $\widetilde{w}$ is exaggerated and solve the model for the growth rate of the relative wage that generates the observed growth in leisure:

$$\log \frac{\widetilde{w}_{90}}{\widetilde{w}_{70}} = \frac{\delta}{1 + \delta a} \log \frac{\widetilde{l}_{90}}{\widetilde{l}_{70}}$$

An alternative approach is to consider a bargaining solution that is less responsive to wage changes.

4.4 Nash's Bargaining Solution

We show in the appendix that, whereas the Egalitarian solution sets the ratio of the gains from marriage equal to a constant, the Nash solution sets them equal to the ratio of derivatives of the gains:

$$\frac{W_i(\mu_i)}{W_j(1-\mu_i)} = \frac{W_i'(\mu_i)}{W_j'(1-\mu_i)} = \frac{1-\mu_i}{\mu_i}$$

This implies that the Nash solution will be less responsive to wages because concavity of utility for leisure will make it more costly to give a spouse more utility when her wage increases. Although we cannot solve explicitly for μ_i it is clear that, if the marriage is individually rational, then a unique solution exists, as the LHS is increasing in μ_i from some very large negative number to a large positive one, while the RHS is decreasing in μ_i from some very large positive number to zero.

5 Home Production

It is clear from the preceding analysis that we need a theory of the levels of full income by household type even before making predictions concerning leisure, let alone housework time. This requires that we expand the analysis to explicitly model the decisions concerning housework.

If the technology for production of the home good were constant over time, then we could subsume it into the parameters $(\phi, \widetilde{q})$.However Figure 5 shows that the price of home appliances has fallen by 50% since the 1970s, and as Greenwood and Guner (2004) point out, this could affect both the attractiveness of single life and the opportunity cost of market labor.[8]

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

There is another potential effect in our model: a decline in p may cause the attractiveness of single life to women to change at a different rate than that for men, changing the Pareto weights of the married couples and therefore affecting the allocation of leisure time. In what follows we are going to rig the model so that all of these effects are present, maximizing the opportunity for the trend in durables prices to explain both the trend in housework hours and in leisure time of married couples. We do this by allowing the effect of the durables on productivity to differ by sex, as otherwise the decline in p cannot explain the rise in husband's home hours relative to the wife's.

5.1 Technology

We now turn to the determination of full income. Recall from the discussion of the unitary model that this can be written as the solution to the following problem of the married couple:

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

subject to

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

Lets start from the assumption that the married-couples technology is separable between capital and some homothetic aggregate $H(h_i,h_j)$ of the spouse's home time. Then the first-order conditions imply that the ratio of housework times at the optimum is independent of the price p :

$$\frac{w_i}{w_j} = \frac{H_1}{H_2}$$

This would preclude the trend in appliance prices explaining the rapid rise in ratio $\frac{h_i}{h_j}$ that we documented in the empirical section. For a decline in p to match observed rise in $\frac{h_i}{h_j}$ requires that k be more complementary with h_i than with h_j.We therefore assume a CES production function that allows for sex bias in the technology:

$$G(k,h_i,h_j) = \left[z_i k^{\theta_i} h_i^{1-\theta_i} + z_j k^{\theta j} h_j^{1-\theta_j}\right]^\eta$$

5.2 Home Hours of Single People

Another advantage of this technology is that it is easily applied to singles. Consider a single person of sex i. Once again, we can consider the income maximization problem separately:

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

subject to

$$g^s = G^s(k_i,h_i) \equiv z_i k^{\theta_i} h_i^{1-\theta_i}$$

For singles it is easy to solve the model for optimal household hours. An interior solution occurs at:

$$\begin{aligned} h_i &= \frac{g^s}{z_i}\left(\frac{w_i}{p}\right)^{-\theta}\left(\frac{\theta}{1-\theta}\right)^{\theta} \\ k_i &= \frac{g^s}{z_i}\left(\frac{w_i}{p}\right)^{\theta}\left(\frac{1-\theta}{\theta}\right)^{1-\theta} \end{aligned}$$

. The cost function is

$$\frac{g^s}{z_i}C_i w_i^{1-\theta_i}p^{\theta_i}$$

where

$$C_i = \left[\left(\frac{\theta_i}{1-\theta_i}\right)^{\theta_i} + \left(\frac{1-\theta_i}{\theta_i}\right)^{1-\theta_i}\right]$$

This means that costs increase less than proportionally with wages, so the percent increase in full income resulting from a wage change is greater than the percentage increase in the wage.

Another implication is that the ratio of full income $\frac{w_i - \frac{g^s}{z_i}C_i w_i^{1-\theta_i}p^{\theta_i}}{w_j - \frac{g^s}{z_j}C_j w_j^{1-\theta_j}p^{\theta_j}}$ is greater than the wage ratio when $\theta_i = \theta_j$ and $z_i = z_j$.The high-wage sex will substitute away from labor, and so costs increase by less than wages. The elasticity of the housework cost with respect to wages is $1-\theta_i$, so if the high-wage is also the one with high θ_i, this will further increase the income ratio over the wage ratio. In this case, convergence of relative wages will cause the income ratio to fall by more than the decline of the relative wage. Given the dependence in our model of the Pareto weight on the relative wage, this implies that in this case home production magnifies the effect of wage changes on leisure.

Finally the elasticity of the housework cost with respect to p is given by θ_i.This implies full income will increase more for the sex with higher θ when there is a decline in p.

What about the effect of trends in w and p on marriage rates? We showed earlier this depends on the ratio of full income of singles to that of married. Since the cost function is more complicated for married couples than for singles, we defer this analysis to the quantitative section below.

6 Calibration

The objective of this section is to learn how much of the trends in relative housework and leisure time of married couples can be attributed to each of the competing explanations. To achieve this, we now calibrate the model to match average time allocations for the US in the 1970s, as well as the married couple's home hours in the 1990s.

We then use this calibrated model as a benchmark to compare to restricted versions of the model, in which we allow only for one of these trends at a time:

the relative wage, the appliances price or family size. From these exercises we infer how the relative importance of each hypothesis.

We require that the model match summary statistics from the PSID sample analyzed in Tables 2 and 4 above; recall that the statistics are drawn from the portion of the sample where the head or the wife is aged 45 or less and the wife is working at least 10 hours weekly.. We look at the means over the 70s and the 90s, by marital status, as well as the partial effects of demographic differences on total housework time, as reported in Table 4.

Since the home-hours allocation in the model is related to the leisure allocation only through the determination of full income, we start by calibrating the home-production side of the model in order to generate estimates of full income by marital status over the two periods. We then use the output of this calibration to calibrate the remainder of the model to match the leisure allocation observed in the 1970s, as well as the change in the prevalence of marriage between the 1970s and the 1990s.

6.1 Housework

We assume the production of the home good is given by the function $G(k, h_i, h_j)$ described above with z_j normalized to one. This leaves as free parameters $(\theta_i, \theta_j, z_i, \eta)$. To parametrize the housework model we also need a functional form for the dependence of the home constraint on family composition. We assume this is given by

$$\underline{g}^m(ms, n_k) = \alpha_{ms} + \alpha_{nk} n_k^{\alpha_2}$$

. Here α_{ms} is a constant that varies according to whether the household is a married couple, a single man or a single woman, α_{nk} and α_2 are constants that are the same for all households.

The housework model makes predictions only about home hours and spending on appliances, so we choose as targets both the mean time married couples spent in housework from Table 2 above (expressed as a fraction of 98 hours), and the partial effects of being single or a parent from Table 4. To identify the role of technology, we need a target from 1997; we target the housework hours of husbands. We also require the model to match share of household income spent by married couples on home durables in 1970.[9] To compute the partial effects, we solve the model for married and single women households with different number of children under the 1970 parameters.

For the benchmark model, we assume that the relative wage $\widetilde{w}$ evolves from 0.61 in the 1970s to 0.76 in the 1990s, to match the observations in Blau and Kahn (2000), and that ten percent of this change is illusory. [10]the price p of home capital k, relative to the husband's wage, evolves from 3.2 to 1.6, matching

[9] We compute this from the CEX in 1972-73. Details are in the appendix.

[10] We know that the observed wage change is likely to include the effects of selectivity and investment, as pointed out by many recent papers on the gender gap, including Blau and Kahn (2004) and Mulligan and Rubinstein (2005).

Parameters	Benchmark Model
Family Size	
Married Couples	1.718
Single Women	1.242
Single Men	0.852
Additional Child	0.763
Curvature	0.338
Home Technology	
Women's Durables Share	0.080
Men's Durables Share	0.220
Men's Relative TFP	1.401
Returns to Scale	0.664

Table 5: Benchmark Parameters for the Housework Allocation

the evolution of the ratio of the price of home durables to the GDP deflator documented in the previous section. The resulting parameter values are shown in Table 5. In the home technology, the crucial point is that men have a higher share of durables in their production function than do women. This means that as households acquire more durables, men become relatively more productive in home work. The value of 1.4 for men's total factor productivity does not imply that men are more productive than women in the home; without appliances, men are severely handicapped according to these parameters.

Table 6 shows the match between the targets and the model. This is very close; the main discrepancy is that the model cannot get husband's hours at home sufficiently low in the 1970s without screwing up on the other dimensions. However, relative to the wife's hours the discrepancy is very small.

Table 7 shows home labor in the 1990s for the benchmark, and then three experiments, all using the benchmark parameters. In the benchmark model, husband and wife's home labor were targets, so the close match is by construction. However it is interesting to note that the hours of single women are quite close to the data; the model explains about 2/3 of the decline in home hours of single women.

So what then explains the decline in wife's home hours from 0.26 of her time endowment to 0.17? The results for the experiments show that the decline in family size explains about 20% of the decline, the trend in wages about 33% and the trend in the home appliances price about 50%. We conclude from this table that the trend in the price of durables is the most important component for explaining the trends in the wife's home hours. On the other hand, it is the rise in women's relative wage that explains most of the increase in husband's home hours.

One final point about the results in Table 7. We see the effect of all these

Targets	Data	Benchmark Model
Home Hours in 1970		
Wife	0.26	0.26
Husband	0.03	0.04
Single Women	0.19	0.19
Single Men	0.07	0.07
Home Hours Partial Effects		
Mother	0.43	0.43
Each Child	0.13	0.13
Home Hours, 1997		
Wives	0.17	0.17
Husbands	0.07	0.07
Durables Share of Income	0.02	0.02

Table 6: Calibration targets for Housework Allocation

Results	Data	Benchmark	Family Trend Only	WageTrend Only	Price Trend Only
Home Labor Hours in 1990s					
Wife*	0.17	0.17	0.24	0.23	0.22
Husbands*	0.07	0.07	0.04	0.06	0.05
Single Women	0.13	0.15	0.16	0.19	0.18
Single Men	0.07	0.06	0.07	0.07	0.06
Full Income, 90s/70s					
Married Couples	--	1.07	1.01	1.04	1.01
Single Women	--	1.19	1.04	1.13	1.02
Single Men	--	1.02	1.01	1.00	1.02

Table 7: Other Results for the housework model

changes on full income, according to the benchmark model, was an increase of 7 per cent for married couples, 19 per cent for single women, and a much smaller increases, 2% for single men. In contrast to the effects on home hours, the table shows that the wage trend is far more important than the price trend for explaining the increase in the full income of single women. This will have strong implications for the allocation of leisure in the married couple household.

In terms of the larger question of what determines labor supply, the results so far are in rough accordance with Greenwood and Guner (2004). If we left leisure out of our model, as they do, then the decline in home hours would be reflected entirely in an increase in market work. In such a simplified version of the model therefore, we would find the decline in durables prices to be responsible for more than half of the increase in female labor supply. Whether this argument is modified by considering the allocation of leisure depends on two features of the model: the weight δ of leisure in the utility function, and the responsiveness of the Pareto weight to changes in the full income of singles.

6.2 Leisure

Given the results for full income and spouse's leisure we can now turn to understanding the changes in leisure allocation, and hence labor supply. We begin by abstracting from the effect of the decline in family size. The remaining parameters are the values by sex of single life, and the utility weight on leisure. We normalize the husbands joy of single life to $q_i = 1$.As we saw earlier, the remaining parameters are pinned down by the labor supply, once we know the full income for each type of household. Using the full-income results from the calibration, and the leisure for married people in the 1970s, from Table 2, we solve the model for the parameters. This implies the following values: $(\widetilde{q}, \delta) = (1.54, 1.36)$.

The implications of this parameterization for leisure and market labor are shown in Table 8. The first finding is that the benchmark model accounts for about 80% of the rise in wife's market labor time, and 90% of the fall in the ratio of husband's relative leisure, from 1.19 in the 1970s to 1.0 in the 1990s. Since the wives in the data are working in the market, we are not claiming to explain the rise in married-women's labor force participation of course, only the rise in hours of women conditional on participating. For single men the results are within 10 percent of the observed labor supply, which is the same in both periods, while the model has trouble explaining the low hours of single women.

The experiments reported in Table 9 show how omission of one or the other of the trends changes these results, holding the model parameters constant. Experiment 1 shows that if all but the relative wage had been constant, then wive's labor supply would not have increased significantly. This is because the rise in her wage causes her Pareto weight to increase from 0.35 to 0.4, and hence the wife gets more leisure; husband's relative leisure declines from 1.19 to 1.08 instead of 1.02. However in Experiment 2, when all but the price of home appliances is constant, we see that the leisure ratio is remains constant at the 1970s level. While the price trend appears to explain the entire increase in wife's labor supply, the Pareto weights are constant, because, as we saw in Table 6,

Bargaining Results	Data	Benchmark
Married Leisure in 1970s		
Wife	0.44	0.44
Husband	0.52	0.52
Leisure Ratio	1.19	1.19
Married Labor in 1990's		
Wife	0.35	0.34
Husband	0.44	0.43
Married Leisure in 1990's		
Wife	0.48	0.49
Husband	0.48	0.50
Leisure Ratio	1.00	1.02
Husband's Pareto weight		
1970's	0.66	0.65
1990's	0.57	0.59
Singles Labor in 1970's		
Men	0.38	0.41
Women	0.27	0.36
Singles Labor in 1990's		
Men	0.38	0.41
Women	0.32	0.37

Table 8: Benchmark Leisure and Market Labor Allocations

Results	Experiments 1 Wage Trend Only	2 Price Trend Only	3 Family Trend Only	4 Wage Trend Only in Home	5 Fixed Pareto Weight
Married Labor in 1990's					
Wife	0.31	0.34	0.30	0.25	0.42
Husband	0.44	0.42	0.44	0.44	0.38
Married Leisure in 1990's					
Wife	0.46	0.45	0.46	0.52	0.42
Husband	0.50	0.53	0.52	0.50	0.56
Leisure Ratio	1.08	1.19	1.12	0.96	1.34
Husband's Pareto weight					
1970's	0.65	0.65	0.65	0.65	0.65
1990's	0.60	0.65	0.64	0.60	0.65

Table 9: Computational Experiments for Leisure Allocation

the full income of singles grows at roughly the same rate for men and women. So then what explains the decline in the leisure ratio from 1.08 to 1.02? In Experiment 3 the only difference between the 70's and the 90s is the family size. We see that relative leisure declines to 1.12, fully accounting for the residual that was not explained by the wage trend. Therefore the wage trend accounts for 3/4 of the movement in relative leisure, and family-size trends for 1/4.

To clarify the effect of the wage trend it is useful to separate the effects of the wage and price trends on leisure from the effect on home production. Suppose that in the 1990s, households took into account the wage change only in the home production decisions, and then made leisure decisions as if the relative wage were still as in the 1970s. This means taking full income as given by the 1990s relative wage, and the cost of leisure according to the 1970s wages. The results are shown in Experiment 4. Relative leisure drops to 0.96, far below what we see in the data, because although the resulting bargaining weight is the same as in the benchmark, the cost of wife's leisure did not increase. with the wage. Consequently, wife's labor supply actually drops by 33%. In other words the model says that, when wife's wages increase relative to the husband's, the shift in bargaining power that results from her higher wage almost completely offsets the increase in the cost of her leisure, so the effect of a permanent wage change on married women's labor supply is very small.

To compare with the unitary model, Table 9 includes an experiment in which the utility share of the marriage is held constant. Experiment 5 shows that both wife's labor supply and husband's leisure should have increased much more than we see in the data, as we would expect, given the discussion of the unitary model. The role of the bargaining in the model is seen most clearly by comparing the leisure ratios; whereas the 1990s ratio was 1.02 in the benchmark model, in Experiment 5 it rises to 1.34.

In summary, the calibration results tell us that trends in relative wages have little effect overall on married women's labor supply, conditional on the wife working, but large effects on the allocation of leisure within the household. The effect of the wage trend is much larger than that of the decline in family size. The trend in wife's labor supply, at least on the intensive margin, appears to be entirely due to the price trend in home durables.

7 Conclusion

This paper had three closely-related goals. The first was to determine whether the trends in the time allocation of married men did actually fit the pattern implied by the class of models generally used to explain labor supply of married women. The second goal was to develop an alternative model in which trends in the optimal allocation of leisure and housework could potentially be accounted for by the two most prominent explanations in the current literature, a rise in women's wages relative to men's, and a decline in the price of labor-saving home technology. The third goal was to use the model to measure the relative importance of each explanation.

We used data from the PSID to show that there has been a significant decline in the leisure of men married to women who work and are between the ages of 25 and 45. From a theoretical point of view the critical observation is that the ratio of husband's leisure time to that of the wife has declined from 1.2 to 1.00. Husband's relative leisure declined by 17% in households where the wife did not complete high-school, works more than 25 hours weekly, and was between 25 and 34 years old, and by 16% when the wives were aged 35-44 with a college education.

We showed that labor-supply models in which unitary households maximize the sum of the spouse's utility could not explain this negative trend in husband's relative leisure. It is easy to see that plugging the observed change in relative wages into a unitary model with Cobb-Douglas preferences results in a predicted 20% increase in the husband's leisure relative to the wife's.

To remedy the problem with the unitary model, we proposed a simple bargaining model of marriage, divorce and allocations of leisure-time and housework. Using the "egalitarian" solution concept and an infinite-horizon assumption allowed us to solve analytically for the married-couple's Pareto weights and the optimal decisions. What mattered for predicting leisure, in addition to the relative wage, was the extent to which the non-pecuniary quality of single life was higher for women than for men. A rise in women's relative wage was found to reduce husband's leisure when the quality of single life is relatively high for women. A fall in the price of home durables can also cause husband's leisure to fall, if this causes full income of single women to rise faster than that of single men.

Calibration to US data shows the trend in relative wages explains 3/4 of the trend in relative leisure and about a half of the trend in hours of housework, while the simultaneous trend in home-durables prices explains the balance of the housework trend. The balance of the trend in relative leisure is explained by the trend in family size. To answer the question in the title, the reason married men are working so much is that the husband's share of household utility is falling in response to the rise in women's relative wages.

The small rise in wife's market hours in our sample is entirely explained by the trend in home-durables prices. The trend in relative wages has little effect on wife's market hours because the wife's Pareto weight in the marriage increases with her wage, causing her leisure to increase. This is in part because the solution concept does not consider the cost of awarding utility to each spouse. Nash's solution concept on the other hand would be less responsive to the relative wage, and hence the wage elasticity of wife's market labor would be higher.

As they stand, the results have no direct implications for female labor supply trends, because we ignore movements on the extensive margin, which are known to be the most important component of these trends. However we did show that relative leisure of husbands is likely to increase when wives enter the labor force, and this is indeed what we see in the data. The results suggest that future work could distinguish between competing hypotheses of this trend on the extensive margin by considering the implications of movements on the intensive margin for the allocation of leisure between spouses.

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A Appendix

A.1 Labor-Force Participation

In the body of the paper, we have assumed that the wife labor supply to the market is greater than zero. This is what permits us to separate the leisure allocation from home production. In this section we show that if the wife's optimal market labor is zero, then a decline in the price of home goods will cause the relative leisure of the husband to fall. This implies we cannot infer shifts in Pareto weights for households where women are not supplying market labor unless we model the home-production technology.

To keep things simple, let's assume that the husband does not do housework unless the wife works. In this case, when the wife is not working outside the home, the household problem is:

$$\max_{l_i, l_j} \{\ln [\theta w_i (1 - l_i) - pk] + \mu_i \delta \ln l_i + (1 - \mu) \delta \ln l_j\}$$

subject to:

$$g_m = z_j (1 - l_j)^{1-\theta_j} k^{\theta_j}$$

This implies wife's leisure is a function of home durables k :

$$l_j = 1 - \left[\frac{g_m}{z_j}\right]^{\frac{1}{1-\theta_j}} k^{-\frac{\theta_j}{1-\theta_j}} = 1 - ak^{-b}$$

, where a and b are both positive constants:

$$\begin{aligned} a &= \left[\frac{g_m}{z_j}\right]^{\frac{1}{1-\theta_j}} \\ b &= \frac{\theta_j}{1-\theta_j} \end{aligned}$$

. If we substitute for l_j then the household solves this unconstrained problem:

$$\max_{l_i, k} \left\{\ln [\theta (w_i (1 - l_i) - pk)] + \mu_i \delta \ln l_i + (1 - \mu_i) \delta \left[1 - ak^{-b}\right]\right\}$$

$$\begin{aligned}
\frac{w_i}{w_i(1-l_i)-pk} &= \frac{\mu_i \delta}{l_i} \\
\frac{p}{w_i(1-l_i)-pk} &= \frac{(1-\mu_i)\,\delta}{l_j} abk^{b-1}
\end{aligned}$$

$$\frac{(1-\mu_i)}{pl_j} abk^{b-1} = \frac{\mu_i}{w_i l_i}$$

The first-order conditions for this problem imply that the leisure ratio is a function of the price of home durables.

$$\frac{l_i}{l_j} = \frac{\mu_i}{1-\mu_i}\frac{p}{w_i}\frac{k^{1-b}}{ab}$$

. The marginal effect of a decline in p is to increase the leisure of the wife, relative to that of the husband, provided that she continues not to work, and provided that the price elasticity of k is less than $\frac{1}{1-b} = 1-\theta_j$.

Let λ be the shadow price of wife's leisure. Then the home production problem is

$$\max\{w_i - pk - \lambda h_j\}$$

subject to:

$$g_m = z_j (1-l_j)^{1-\theta_j} k^{\theta_j}$$

The factor demand functions for this problem imply

$$\begin{aligned}
h_j &= \frac{g_m}{z_j}\left(\frac{\lambda}{p}\right)^{-\theta_j}\left(\frac{1-\theta_j}{\theta_j}\right)^{1-\theta_j} \\
k &= \frac{g_m}{z_j}\left(\frac{\lambda}{p}\right)^{\theta_j}\left(\frac{1-\theta_j}{\theta_j}\right)^{1-\theta_j}
\end{aligned}$$

The price elasticity of k is θ_j, so holding λ constant, the husband's leisure will fall relative to the wife's when p falls, provided that $\theta_j < 1-\theta_j \Leftrightarrow \theta_j < 1/2$. Given that the value of the average wife's housework time appears very large relative to spending on durables in the data, it is likely that this condition is easily met.

Is husband's relative leisure greater in households where wives do not work, holding μ_i constant? This requires that $\frac{k^{1-b}}{ab} > 1$. Given that k is small relative to spending on housework time, this appears unlikely. Therefore the entry of non-working wives into the labor force is likely to cause husband's relative leisure to rise, holding μ_j constant. This can explain why the change in relative leisure that we observe in the data is much stronger when we condition on wives working in the market.

Of course the gains from marriage also contain an important dynamic component. We therefore turn to a consideration of marriage prospects.

A.2 Equilibrium in the Marriage Market

To solve for the equilibrium marriage rate, we make some simplifying assumptions regarding the process for match quality. We take match quality to be iid with a uniform distribution function F over support $(0, \overline{\varepsilon}]$. To ensure that marriage occurs in the equilibrium, we assume that a marriage with match quality $\overline{\varepsilon}$ generates a positive net surplus.

Since the gains from marriage are increasing in match quality, there is some minimum threshold value ε^M such that people will get married if and only if $\varepsilon > \varepsilon^M$. This determines the marriage probability, which we denote $\pi^M = 1-F\left(\varepsilon^M\right)$. Let the expected marriage quality, conditional on remaining married be $E\left(\ln\varepsilon|\varepsilon > \varepsilon^M\right)$.

Lemma 2 *The gains from marriage are given by*

$$\begin{aligned} W_i(\varepsilon) &= \widetilde{U}_i^M(\varepsilon, \mu_i(\varepsilon)) - U_i^S \\ &\quad + \frac{\beta\left(1-\pi^M\right)\pi^M}{1-\beta\left(1-\pi^M\right)\pi^M}\left(E\left[\widetilde{U}_i^M(\varepsilon, \mu_i(\varepsilon))\,|\varepsilon_{ij} > \varepsilon^M\right] - U_i^S\right) \end{aligned}$$

Proof. Let $\mu_i(\varepsilon)$ denote the equilibrium of the bargaining game, conditional on the deterministic state variables (q, w, p).Let's fix these, so we can drop them from the function arguments. Given the assumed preferences, we can write the flow utility from marriage as

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

where

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

Let $\widetilde{V}_i^M(\varepsilon_{ij})$ denote the value of being currently married with match quality ε_{ij}, and EV_i^M be the expected continuation value:

$$\widetilde{V}_i^M(\varepsilon_{ij}) = \widetilde{U}_i^M(\varepsilon, \mu_i(\varepsilon)) + \beta EV_i^M$$

Part of the gain from being married is that in the future, married people have the option of staying together. This happens with probability π^M.If they separate, then either they remarry, with probability π^M, or they remain single. The expected continuation value for married people is:

$$\begin{aligned} EV_i^M &= \pi^M E\left[\widetilde{V}_i^M(\varepsilon_{ij})\,|\varepsilon_{ij} > \varepsilon^M\right] \\ &\quad + \left(1-\pi^M\right)\left[\pi^M E\left[\widetilde{V}_i^M(\varepsilon_{ij})\,|\varepsilon_{ij} > \varepsilon^M\right] + \left(1-\pi^M\right)V_i^S\right] \\ &= \left(2-\pi^M\right)\pi^M E\left[\widetilde{V}_i^M(\varepsilon_{ij})\,|\varepsilon_{ij} > \varepsilon^M\right] + \left(1-\pi^M\right)^2 V_i^S \end{aligned}$$

where V_i^S is the value of being single in the future, which is independent of the current match quality.

The value of being currently single is that one gets a flow utility plus a continuation value that depends on whether one gets married next period;

$$V_i^S = U_i^S + \beta \left[\pi^M E \widetilde{V}_i^M (\varepsilon_{ij}) + \left(1 - \pi^M\right) V_i^S\right]$$

where

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

Thus the gains from being married this period are

$$\begin{aligned}
\widetilde{V}_i^M (\varepsilon_{ij}) - V_i^S &= \widetilde{U}_i^M (\varepsilon, \mu_i (\varepsilon)) - U_i^S + \beta \left[E V_i^M - \pi^M E \widetilde{V}_i^M (\varepsilon_{ij}) - \left(1 - \pi^M\right) V_i^S\right] \\
&= \widetilde{U}_i^M (\varepsilon, \mu_i (\varepsilon)) - U_i^S \\
&\quad + \beta \left(2 - \pi^M\right) \pi^M E \left[\widetilde{V}_i^M (\varepsilon_{ij}) | \varepsilon_{ij} > \varepsilon^M\right] + \beta \left(1 - \pi^M\right)^2 V_i^S \\
&\quad - \beta \pi^M E \widetilde{V}_i^M (\varepsilon_{ij}) - \beta \left(1 - \pi^M\right) V_i^S \\
&= \widetilde{U}_i^M (\varepsilon, \mu_i (\varepsilon)) - U_i^S \\
&\quad + \beta \left(1 - \pi^M\right) \pi^M E \left[\widetilde{V}_i^M (\varepsilon_{ij}) | \varepsilon_{ij} > \varepsilon^M\right] \\
&\quad - \beta \left(1 - \pi^M\right) \pi^M V_i^S \\
&= \widetilde{U}_i^M (\varepsilon, \mu_i (\varepsilon)) - U_i^S \\
&\quad + \beta \left(1 - \pi^M\right) \pi^M \left[E \left[\widetilde{V}_i^M (\varepsilon_{ij}) | \varepsilon_{ij} > \varepsilon^M\right] - V_i^S\right]
\end{aligned}$$

The expected gains from marriage are the same in every period. Using the previous result:

$$E \left[\widetilde{V}_i^M (\varepsilon_{ij}) | \varepsilon_{ij} > \varepsilon^M\right] - V_i^S = E \left[\frac{\widetilde{U}_i^M (\varepsilon, \mu_i (\varepsilon)) - U_i^S}{1 - \beta \left(1 - \pi^M\right) \pi^M}\right]$$

Substituting this into the previous expression gives the result. ■

Lemma 3 *Person i will prefer being married if and only if he is awarded a Pareto share $\mu_i \geq \underline{\mu}_i \left(\varepsilon | \pi^M\right)$ defined as follows:*

$$\underline{\mu}_i \left(\varepsilon | \pi^M\right) = \varepsilon^{-\beta \left(1 - \pi^M\right) \pi^M} \frac{q_i}{\phi^{1/\delta}} \left(\frac{Y^m}{Y_i^s}\right)^{-\frac{1+\delta}{\delta}} \left(\exp E \left[\delta \ln \varepsilon | \varepsilon_{ij} > \varepsilon^M\right]\right)^{-\beta \left(1 - \pi^M\right) \pi^M}$$

Proof. Use the definition of $\widetilde{U}_i^M$ to solve for the per-period gain from marriage of person i :

$$\begin{aligned}
\widetilde{U}_i^M (\varepsilon, \mu_i (\varepsilon)) - U_i^S &= K_M + (1+\delta) \ln Y^m - \delta \ln w_i + \delta \ln \mu_i (\varepsilon) \\
&\quad + \delta \ln \varepsilon - K_S - (1+\delta) \ln Y^s + \delta \ln w_i - \delta \ln q_i \\
&= \ln \phi + (1+\delta) \ln \frac{Y^m}{Y^s} + \delta \ln \mu_i (\varepsilon) + \delta \ln \varepsilon - \delta \ln q_i \\
&\Rightarrow E \widetilde{U}_i^M (\varepsilon, \mu_i (\varepsilon)) - U_i^S = - \ln \phi + (1+\delta) \ln \frac{Y^m}{Y^s} \\
&\quad - \delta \ln q_i + \delta E \left[\ln \mu_i (\varepsilon) + \delta \ln \varepsilon | \varepsilon_{ij} > \varepsilon^M\right]
\end{aligned}$$

$$
\begin{aligned}
W_i(\varepsilon) &= -\ln\phi + (1+\delta)\ln\frac{Y^m}{Y_i^s} + \delta\ln\mu_i(\varepsilon) + \delta\ln\varepsilon - \delta\ln q_i \\
&\quad + \frac{\beta\left(1-\pi^M\right)\pi^M}{1-\beta\left(1-\pi^M\right)\pi^M}\left(-\ln\phi + (1+\delta)\ln\frac{Y^m}{Y_i^s} - \delta\ln q_i + \delta E\left[\ln\mu_i(\varepsilon) + \delta\ln\varepsilon | \varepsilon_{ij} > \varepsilon^M\right]\right) \\
&= \delta\ln\mu_i(\varepsilon) + \delta\ln\varepsilon + \frac{\ln\phi + (1+\delta)\ln\frac{Y^m}{Y_i^s} - \delta\ln q_i}{1-\beta\left(1-\pi^M\right)\pi^M} \\
&\quad + \frac{\beta\left(1-\pi^M\right)\pi^M\delta}{1-\beta\left(1-\pi^M\right)\pi^M} E\left[\ln\mu_i(\varepsilon) + \delta\ln\varepsilon | \varepsilon_{ij} > \varepsilon^M\right]
\end{aligned}
$$

If $\mu_i(\varepsilon)$ is independent of ε then we have that μ must be the same in the future as now.

$$
\begin{aligned}
W_i(\varepsilon) &= \delta\ln\varepsilon_{ij} + \frac{\delta\ln\mu_i(\varepsilon) + \ln\phi + (1+\delta)\ln\frac{Y^m}{Y_i^s} - \delta\ln q_i}{1-\beta\left(1-\pi^M\right)\pi^M} \\
&\quad + \frac{\beta\left(1-\pi^M\right)\pi^M\delta}{1-\beta\left(1-\pi^M\right)\pi^M} E\left[\ln\varepsilon | \varepsilon_{ij} > \varepsilon^M\right] \qquad (5)
\end{aligned}
$$

Therefore given ε, we can solve for the threshold $\ln\underline{\mu}_i\left(\varepsilon|\pi^M\right)$:

$$
\begin{aligned}
0 &= \delta\ln\varepsilon + \frac{\ln\underline{\mu}_i\left(\varepsilon|\pi^M\right) + \ln\phi + (1+\delta)\ln\frac{Y^m}{Y^s} - \delta\ln q_i}{1-\beta\left(1-\pi^M\right)\pi^M} \\
&\quad + \frac{\beta\left(1-\pi^M\right)\delta}{1-\beta\left(1-\pi^M\right)\pi^M}\pi^M E\left[\ln\varepsilon | \varepsilon_{ij} > \varepsilon^M\right]
\end{aligned}
$$

$$
\begin{aligned}
\delta\ln\underline{\mu}_i\left(\varepsilon|\pi^M\right) &= \delta\ln q_i - \ln\phi - (1+\delta)\ln\frac{Y^m}{Y_i^s} \\
&\quad - \left[\beta\left(1-\pi^M\right)\pi^M\delta\right]\left(\ln\varepsilon + E\left[\delta\ln\varepsilon | \varepsilon_{ij} > \varepsilon^M\right]\right)
\end{aligned}
$$

The result follows directly from this expression.

Lemma 4 *Suppose that in the future marriages will take place if and only $\varepsilon > \varepsilon^M$.Then for a matched pair with match quality ε, marriage in the current period is the efficient outcome if and only if $\varepsilon > \varepsilon^*\left(\varepsilon^M\right)$.This marriage threshold is a function of ε^M and the deterministic state variables:*

$$
\begin{aligned}
\varepsilon^*\left(\varepsilon^M\right) &= \left[\frac{q_i}{\phi^{1/\delta}}\left(\frac{Y_i^s}{Y^m}\right)^{\frac{1+\delta}{\delta}} + \frac{q_j}{\phi^{1/\delta}}\left(\frac{Y_j^s}{Y^m}\right)^{\frac{1+\delta}{\delta}}\right]^{\frac{1}{a\left(\varepsilon^M\right)}} \\
&\quad \times\left(\exp E\left[\ln\varepsilon | \varepsilon_{ij} > \varepsilon^M\right]\right)^{-\delta}
\end{aligned}
$$

,where $a\left(\varepsilon^M\right) = \beta\left(1-\pi^M\left(\varepsilon^M\right)\right)\pi^M\left(\varepsilon^M\right)$.

The result follows directly from the fact that the marriage threshold ε^M solves

$$\underline{\mu}_i\left(\varepsilon^M|\pi^M\right)+\underline{\mu}_j\left(\varepsilon^M|\pi^M\right)=1$$

Using the previous Lemma, we get

$$\varepsilon^{-a\left(\varepsilon^M\right)}\left[\frac{q_i}{\phi^{1/\delta}}\left(\frac{Y^m}{Y_i^s}\right)^{-\frac{1+\delta}{\delta}}+\frac{q_j}{\phi^{1/\delta}}\left(\frac{Y^m}{Y_j^s}\right)^{-\frac{1+\delta}{\delta}}\right]\left(\exp E\left[\ln\varepsilon|\varepsilon_{ij}>\varepsilon^M\right]\right)^{-\delta a\left(\varepsilon^M\right)}=1$$

Proposition 5 *There is a unique equilibrium marriage rate π^M in the marriage economy.*

Consider the case where $\pi^M > 1/2$.Since $\pi^M\left(\varepsilon^M\right)$ is declining in ε^M, and since for $\pi^M > 1/2$, $a\left(\varepsilon^M\right)$ is declining in $\pi^M\left(\varepsilon^M\right)$, then $a'\left(\varepsilon^M\right) > 0$. To get $\pi^M > 1/2$ requires that $\varepsilon^M < \overline{\varepsilon}/2$. So the RHS is decreasing in ε^M for all $\varepsilon^M < \overline{\varepsilon}/2$. For $\varepsilon^M > \overline{\varepsilon}/2$, $a'\left(\varepsilon^M\right) < 0$, therefore the LHS may continue to decline but is eventually increasing in ε^M, as the exponential term dominates. By assumption, $\varepsilon^*(0) > 0$ and $\varepsilon^*(\overline{\varepsilon}) < \overline{\varepsilon}$, so there is a unique fixed point to the mapping $\varepsilon^*\left(\varepsilon^M\right)$.[11] The marriage rate is given by

$$\pi^M = 1 - F\left(\varepsilon^*\left(\varepsilon^*\right)\right)$$

■

A.3 Determination of the Pareto Weights

Proposition 6 *Under the egalitarian solution, the Pareto weight of spouse j in the household utility function is given by*

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

Proof. The solution equates the gains from marriage:

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

[11] The first assumption means that even if people stay married for sure in the future, there are some matches that will not result in marriage. The second says that even if everyone divorces for sure in the future, there will be some marriages today.

Given the expression (5) for $W_i(\varepsilon)$, this implies

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

The result follows by symmetry. ■

Proposition 7 *Suppose that the bargaining solution is the Nash solution. Then the Pareto weight solves:*

$$\frac{W_i(\mu_i)}{W_j(1-\mu_i)} = \frac{1-\mu_i}{\mu_i}$$

Proof. The Nash solution maximizes the product of the gains from marriage:

$$W_i(\mu_i)\, W_j(1-\mu_i)$$

Assuming an interior solution, the following holds at the optimum:

$$W_i'(\mu_i)\, W_j(1-\mu_i) - W_i(\mu_i)\, W_j'(1-\mu_i) = 0$$

Rearranging gives

$$\frac{W_i(\mu_i)}{W_j(1-\mu_i)} = \frac{W_i'(\mu_i)}{W_j'(1-\mu_i)}$$

Since μ appears in the gains as $\delta \ln \mu$ then the derivatives are δ/μ, which gives the result. ■

Note that in the Nash solution, marriage prospects will affect the Pareto weights, because the term $\pi^M E\left[\ln \varepsilon | \varepsilon_{ij} > \varepsilon^M\right]$ does not drop out as it does in the egalitarian solution. This is given by

$$\begin{aligned}
\pi^M E\left(\ln \varepsilon | \varepsilon > \varepsilon^M\right) &= \int_{\varepsilon^M}^{\overline{\varepsilon}} \ln \varepsilon dF(\varepsilon) \\
&= (\ln \overline{\varepsilon} - 1) - \frac{\varepsilon^M}{\overline{\varepsilon}}\left(\ln \varepsilon^M - 1\right)
\end{aligned}$$

A.4 Married-couple's expenditure share

For the calibration exercise in Section 6, it was essential to compute the share of household wealth devoted to home appliances. This ensures that the model does not rely on an unrealistically important role of such goods in determining the allocation of household time. In this section we explain how we computed the empirical measure of this variable.

The data was drawn from the 1972-73 summary data set of the Consumer Expenditure Survey. All variables in this data set are recorded on an annual basis, unlike the raw CES, which lists expenditures by quarter and income by year. The sample was all married households where the age of the wife was between 25 and 55 and for whom the sum of the labor incomes of the spouses was positive. The measure of spending on home appliances was the sum of two categories in the data: Major Appliances and Minor Appliances. The average ratio of this to labor income was 0.0156. This is the value we use as a calibration target.

There are a number of serious quantitative issues involved in setting this target. First, we know that total expenditures in the CES are much lower than the total from NIPA data. In the course of the 1980s, Cordoba (1996) shows that this category is 60 per cent lower in the Consumer Expenditure Survey than in the NIPA. Second we don't know to what extent the CES variable corresponds to home appliances as defined in the production function of home goods. Jones, Manuelli, and McGrattan (2003) argue for a broader interpretation that includes motor vehicles and housing. Also, in our model consumption equals market income but in the data, due to taxes and savings, consumption is considerably less. All of these would suggest the calibration target should be considerably higher. For instance the NIPA data show that Equipment and Furniture average about 5% of personal consumption over this period.

On the other hand, in the1970s, husbands worked about 45% of their time endowment and wives 12%. Yet in the calibration we divide by full income instead of actual labor income. This means we should be using a lower target. However the results are quite robust to fairly large changes in this target, as the calibration procedure easily adjusts the parameters in response to a change of target. The main point is to force the model to cleave to a target that is the right order of magnitude, which this appears to be.

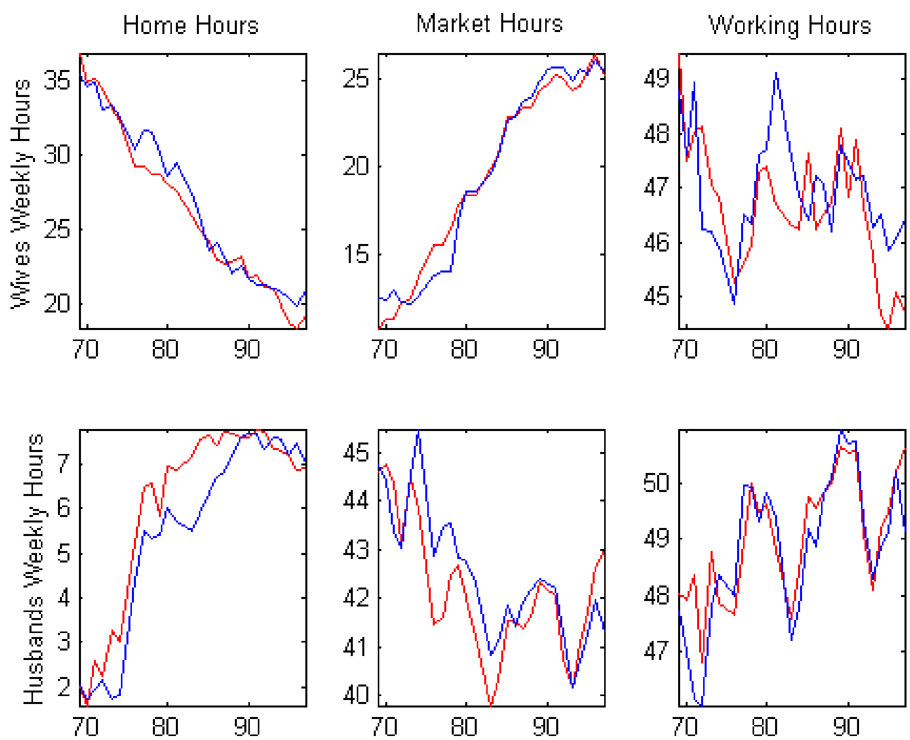

Figure 1: Working hours for married couples where wife is 25-34 years old or 35-44

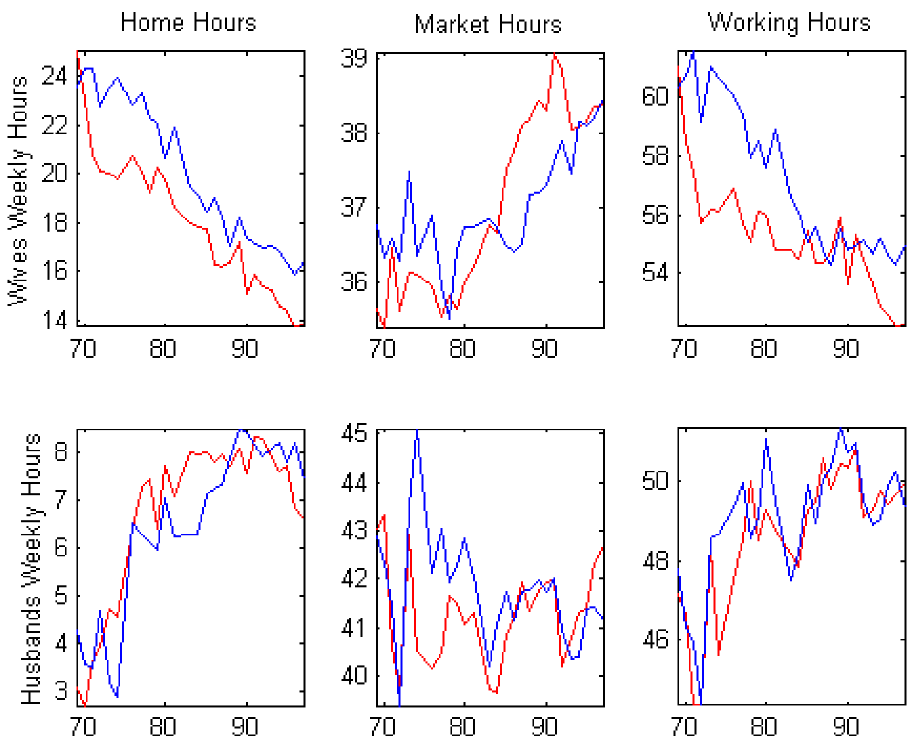

Figure 2: Weekly working hours for married couples in PSID, where wife is 25-34 or 35-44 years old and works at least 25 hours weekly,1970-1997

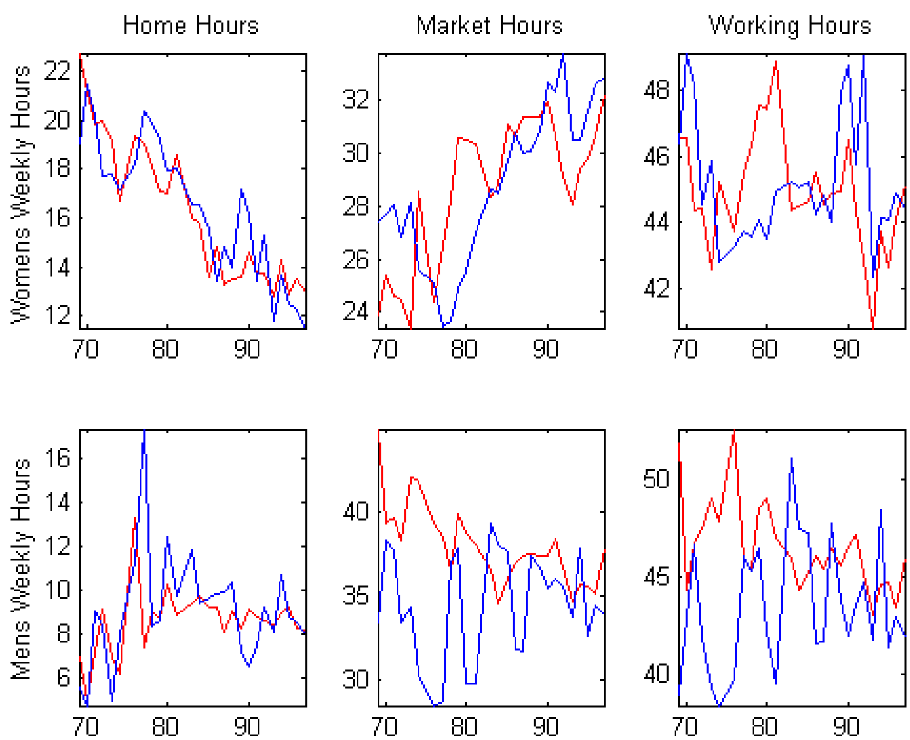

Figure 3: Hours of work of unmarried household heads in PSID, ages 30-44 and 45-54

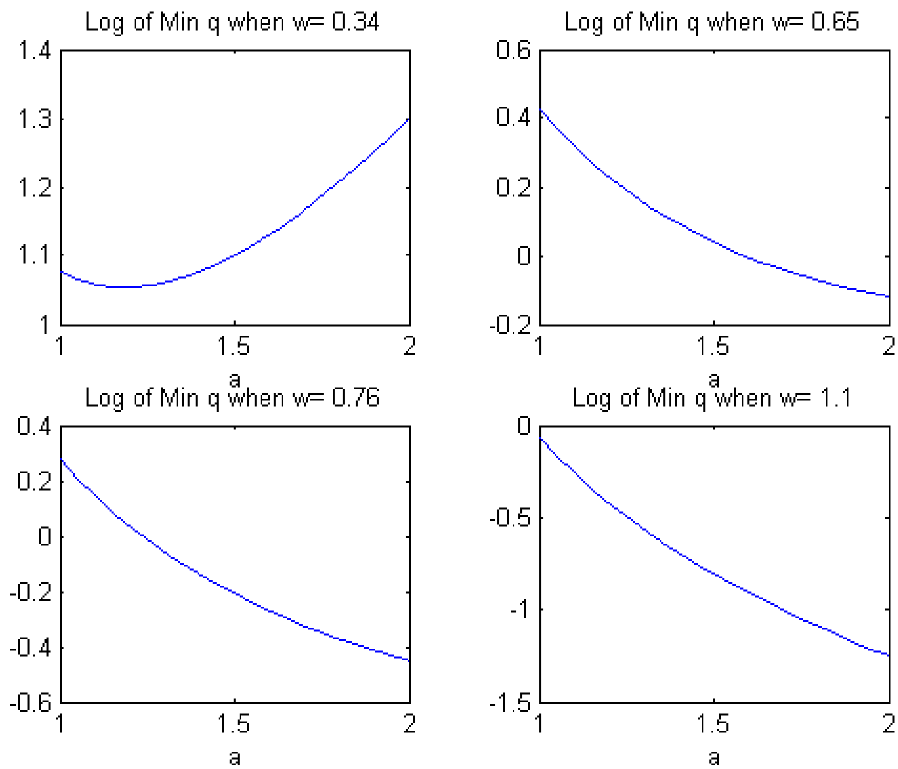

Figure 4: How the minimum q ratio for husbands leisure to fall depends on wages and the exponent "a" in condition (4)

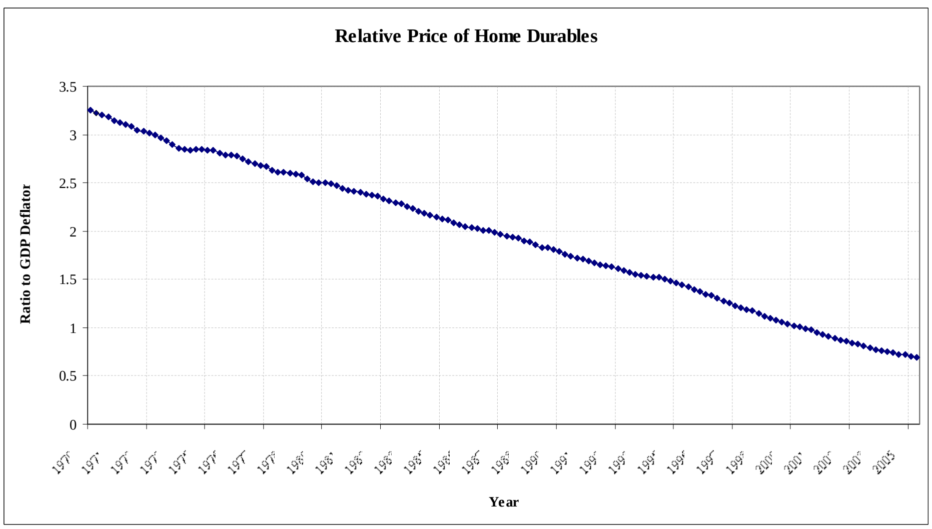

Figure 5: The NIPA price index for furniture and household equipment, expressed as a ratio to the GDP deflator.