Living Arrangements and Labour Supply: Evidence from the United Kingdom*

Sarolta Laczó†

May 31, 2011

Abstract

Female labour supply in terms of labour force participation and hours worked have been rising in developed countries over the past few decades. At the same time, male labour supply have stayed constant or decreased. This paper relates these facts to the changing living arrangements of the prime age population, in particular, to the rise in non-marital cohabitation. I study the labour supply of cohabiting and married men and women, using longitudinal household survey data, focusing on the United Kingdom from 1992 to 2008. Estimating labour supply equations, I find that women work about two hours more on the market per week when cohabiting than when married, controlling for a wide set of demographic variables, individual effects, predicted wages, and selection into the labour force, as well as partner's characteristics. The results suggest no significant difference in men's labour supply by living arrangement. At the same time, men do half an hour more household work when cohabiting than when married. I propose a simple two-period model of family labour supply that can account for the difference in labour supply by marital status. Cohabiting couples are able to sustain less risk sharing in the face of wage risk, because of a lower cost, thus a higher probability of separation. In turn, less intra-household insurance provides incentives for the less productive partner to work more on the market.

Keywords: family labour supply, housework, intra-household risk sharing

JEL codes: J22, D10

*Preliminary, comments and suggestions welcome. I thank Maria Casanova, Gian Luca Clementi, Maurizio Mazzocco, Alessandro Mennuni, and participants of KALER at UCLA and SOLE in Vancouver for useful discussions. All errors are mine. The BHPS data used in this paper were collected by the ESRC Research Centre on Micro-social Change at the University of Essex and made available through the ESRC Data Archive. Neither bears any responsibility for the analyses or interpretations presented here.

†University of California, Los Angeles, Department of Economics, Bunche Hall 8369, Los Angeles, CA 90095, United States. Email: slaczo@econ.ucla.edu.

1 Introduction

The traditional life cycle patterns of marriage and fertility have undergone dramatic changes over the past decades. Divorce rates and remarriages have gone up, and the number of cohabiting couples has increased. At the same time, women entered the labour force in great numbers, and worked more hours on the market and less in household production. This paper examines a link between these changes. More precisely, I study whether and why cohabiting and married individuals differ in their time allocation decisions.

Cohabitation of non-married couples has been on the rise in developed countries. In the United Kingdom in 1996 one tenth of all couples were cohabiting. By 2006 their share rose to one sixth. A similar trend has been documented for the United States: in 1996, only five percent of couples were cohabiting, while in 2008 more than ten percent. In the Nordic countries by the middle of the 2000s about one fourth of all couples living together were not married.[1]

Cohabitation has received little attention in the economic literature on labour supply. Instead, most empirical studies treat married and cohabiting couples equally, even though the legal framework for these two types of unions is substantially different. In many countries, including the UK, cohabitors have no rights to assets acquired by their partner at separation. At the same time, the cost of separation is lower. These institutional differences may provide incentives that affect couples' economic decisions. To my knowledge, there is little empirical evidence on whether married and cohabiting couples behave differently with respect to their main economic decisions, namely consumption, saving, labour supply, and home production.

A few recent papers study the time allocation of cohabiting and married couples. Kalenkoski, Ribar, and Stratton (2005) study time allocation of couples using cross-sectional data from the United Kingdom 2000 Time Use Study. The authors find that once demographic variables are controlled for, there is no significant difference in the time allocation patterns of cohabiting and married individuals. Gemici and Laufer (2011) run simple fixed effects regressions using the Panel Study of Income Dynamics (PSID) to study men's and women's hours of market and housework. Selection into the labour force or the role of wages are not considered. These regressions serve only as descriptive evidence for their structural study. Finally, Adamopoulou (2010) documents differences in living arrangements and time allocation between the US and European countries, as well as over time, and relates these differences to the price of home appliances and the gender wage gap, extending the work of Greenwood and Guner (2008), to account for the rise in cohabitation.

[1] Source: Adamopoulou (2010).

I aim to shed light on the question whether cohabiting and married individuals make different economic decisions. I focus on labour supply and provide complementary evidence on housework hours.[2] The main challenge for this empirical exercise is to distinguish the effects of direct economic incentives from selection. Individuals in the two different living arrangements may differ in their observable and unobservable characteristics. For example, it might be argued that women who derive less disutility from working also prefer cohabitation over marriage. I identify the effects of marital status from longitudinal variation in living arrangements using panel data, controlling for a wide set of observable individual characteristics and time-constant individual effects, which can account for ability and taste for leisure, as well as the partner's characteristics. I use data from the United Kingdom, in particular, the British Household Panel Survey (BHPS) from 1992[3] to 2008. This representative panel dataset contains "living with a partner" as a category for marital status in all waves, unlike the PSID in the United States.[4]

I estimate labour supply equations for men and women, as well as similar regressions for housework hours. The main challenges in such estimation are (i) to deal with the endogeneity of wages, (ii) to correct for selection into the labour force, and (iii) to account for unobserved heterogeneity. I use panel data to control for individual effects, and I impute wages from wage equations, estimated separately for men and women. I take a standard human capital approach to wages, and apply the method proposed by Wooldridge (1995) to correct for selection into the labour force when estimating wage equations.[5] Tax and transfer variables (as in Blundell, Duncan, and Meghir (1998)) and previous experience (for women only) serve as instruments in the wage equations. Finally, inputed wages for both partners are included in the labour supply and housework regressions.

The main results are the following. The estimation results suggest that women work about 2 hours more on the market when cohabiting than when married. I find no significant difference between cohabiting and married men in terms of their hours of market work. However, men do about half an hour more housework per week when cohabiting than when

[2]Studying the consumption and saving behaviour of households by living arrangement is left for future work.

[3]The BHPS has been running since 1991, but data on housework is only available from 1992 onward.

[4]In the PSID, since 1993 it is not possible to distinguish between married and cohabiting couples. Between 1978 and 1993 the PSID classified cohabiting sample members as "married," with the partner of the PSID head of household identified as either a "wife" or "husband." Legally married men and women were classified as husbands and wives (i.e., with no quotation marks).

[5]This method is an extension of Heckman (1979)'s selection correction to panel data (see also Wooldridge, 2002). In the first step, this method involves estimating a selection/participation equation using a Tobit model. No instrument is needed for selection. The Tobit residuals then play the role of the inverse Mills ratio to correct for selection in the wage equation, that can be estimated using a fixed effects approach.

married.

I then consider a simple two-period model of family labour supply in order to explain the differences in hours worked between cohabiting and married couples. Cohabiting and married couples may behave differently, because the cost of separation is higher for married couples. This will imply a higher probability of separation for cohabiting couples. While separation costs are hard to measure, according to BHPS data cohabitors split with 6.49 percent probability from one year to the next, while married couples only with 2.35 percent probability on average.

I extend the model of risk sharing with two-sided limited commitment (Kocherlakota, 1996) to include a labour supply choice and exogenous separation. In this model, intra-household risk sharing plays a key role as a determinant of individual decisions. Risk sharing within the household is subject to limited commitment, meaning that each partner at each period must be at least as well of staying in the couple as separating. In this setting, the probability of separation will influence the level of risk sharing that is sustainable within the household, which in turn influences time allocation decisions.

I show analytically how the consumption allocation and labour supplies depend on the continuation probability of the relationship. The model predicts that the partner with a lower wage (typically the woman) will work more if the continuation probability is lower. Incentives provided by the probability of separation affect the partner with a higher wage (typically the man) less, and total household labour supply is higher when separation is more likely. These predictions are consistent with the empirical results.

The rest of the paper is structured as follows. Section 2 briefly describes the dataset used and provides descriptive evidence. Section 3 contains regression results on labour supply and housework hours. The stylised model to explain differences in labour supply between cohabiting and married men and women is detailed in Section 4. Section 5 concludes.

2 Data and descriptive evidence

The principal dataset used in this study is the British Household Panel Survey (BHPS). The BHPS is a comprehensive longitudinal survey for the United Kingdom, running since 1991. Like the PSID, it tracks individuals across household changes and tries to match the population age distribution by taking a refresher sample of new adults in each wave. In the first wave, the sample consisted of around 5000 households (10,000 adult interviews). The BHPS has detailed information on labour and other income, hours worked on the market and at home (from 1992), and information on housing and durables, but little information

on non-durable expenditure. I use data from 1992 to 2008.[6]

I focus on individuals aged 25 to 54 in order to abstract from decisions related to education and retirement. I drop observations when the individual is currently self-employed or long-term sick or disabled. I exclude composite households, meaning that only households consisting of either one adult with or without children, or a couple with or without children, are studied. I study only opposite-sex couples.[7] Finally, I trim the data by dropping the top 1% in terms of hours worked on the market, hours worked at home, and annual labour and non-labour income by gender, and the top and bottom 1% in terms of hourly wages by gender.

First, let us look at how labour force participation and hours worked evolved over the past two decades in the UK. Hours worked includes usual number of hours worked in the main job,[8] usual overtime hours,[9] and hours worked in a second job, if any.[10] I consider an individual to be participating in the labour force if he or she has worked positive hours. Figure 2(a) presents average hours worked per week and average hours worked per week conditional on working positive hours for women, as well as the proportion of men working for pay. Figure 2(b) presents the trends for women. Note the differing scales for the two panels of Figure 1.

Figure 2(a) shows that hours worked by men stayed roughly constant. The participation rate increased, but at the same time hours worked conditional on working decreased by two hours on average.[11] Women also increased their participation rate from around 72% to around 80%, see Figure 2(b). In addition, hours conditional on working have increased by about 2 hours. As a a result, average hours worked on the market by women increased by about 5 hours.

At the same time significant changes have occurred in the living arrangements of the prime age population. Figure 2 shows that, in particular, cohabiting couples are becoming a bigger and bigger proportion of households, while the proportion of married couples has

[6] I thank Ben Etheridge at the IFS for making available his data (till 2005) and codes used in Blundell and Etheridge (2010).

[7] There are only 157 (57) observations where a man (woman) reports living with a same-sex partner among 20334 (25483) observations in my sample.

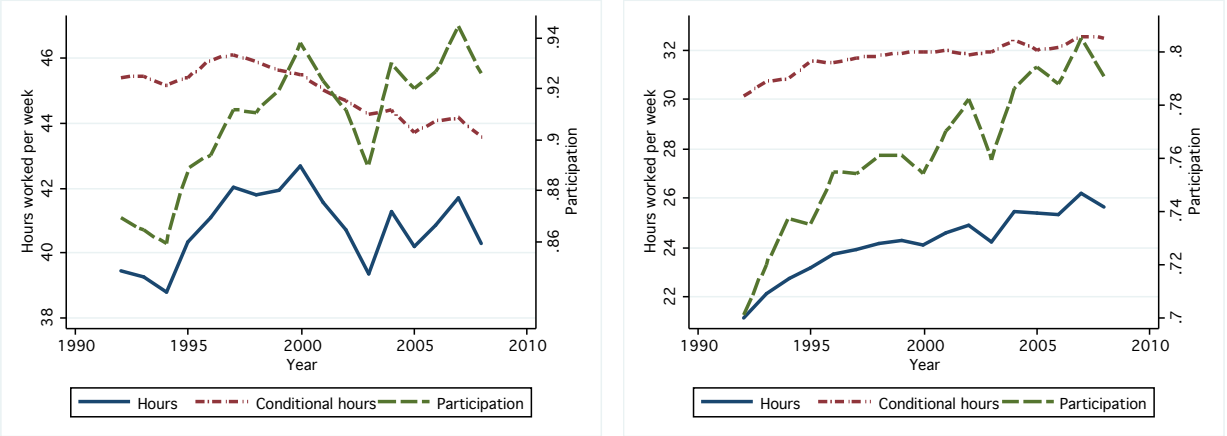
[8] Respondents in the BHPS are asked the following question: "Thinking about your (main) job, how many hours, excluding overtime and meal breaks, are you expected to work in a normal week?" If they have no usual hours, they are then asked for the average.

[9] "And how many hours overtime do you usually work in a normal week?"

[10] "How many hours do you usually work a month in your second/odd job(s), excluding meal breaks but including any overtime you might do?"

[11] The drop in participation in 2003 is in line with the fact that the unemployment rate peaked that year, however, the magnitude of the drop seems overestimated based on the BHPS.

Figure 1: Market hours worked per week and participation by gender



(a) Men

(b) Women

been decreasing. In 1992 there were 6.28 married couples for every cohabiting couple. In 2008 that ratio was only 2.28. The proportion of singles has hardly changed over the past two decades.[12]

Table 1 presents some descriptive statistics by gender and living arrangement. Table 1 shows the average hours of market work and housework,[13] as well as some individual and household characteristics. Figure 3 presents the time trends in hours worked by living arrangements. The first column of that figure presents the descriptive evidence on market work for men, and the second column for women.

Tables 1 shows that on average cohabiting women work 6 hours more on the market than married women (5 hours more conditional on working), and 4 hours more than single women (only 1 hour more conditional on working). The participation rate of cohabiting women is 6 percentage points higher than that of married women and 9 percentage points higher than that of single women. Single and cohabiting women work similar hours at home, while married women do 4 hours more of housework. In terms of time trends, married women's labour supply has been catching up with that of single and cohabiting women, but the gap remains wide in terms of average hours worked per week and average hours worked conditional

[12]Married couples are those who report being legally married and are living together, cohabiting couples are those who report "living with a partner" as their marital status, singles include never married, divorced, separated, and widowed individuals.

[13]Housework hours is measured by the answer to the following question: "About how many hours do you spend on housework in an average week, such as time spent cooking, cleaning and doing the laundry?" Note that the mentioned tasks are typical female tasks, while male tasks, such as house repair, are not mentioned. This would be worrisome if we were to study welfare, for example, but the question is suitable for making comparisons across living arrangement and time.

Figure 2: Proportions of households by living arrangement

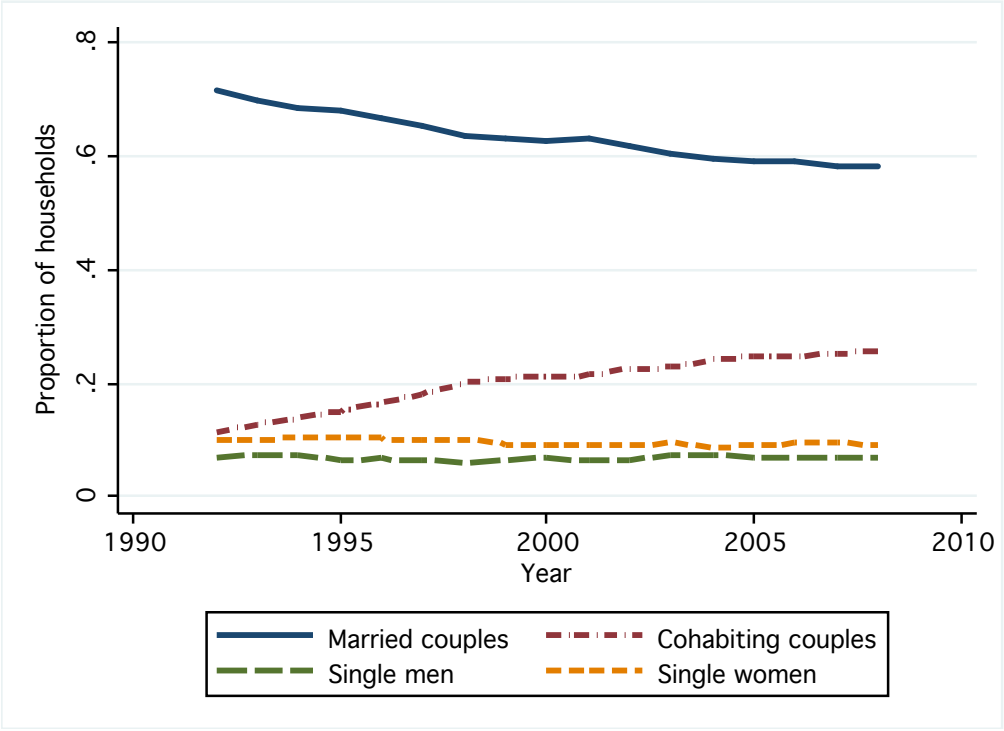
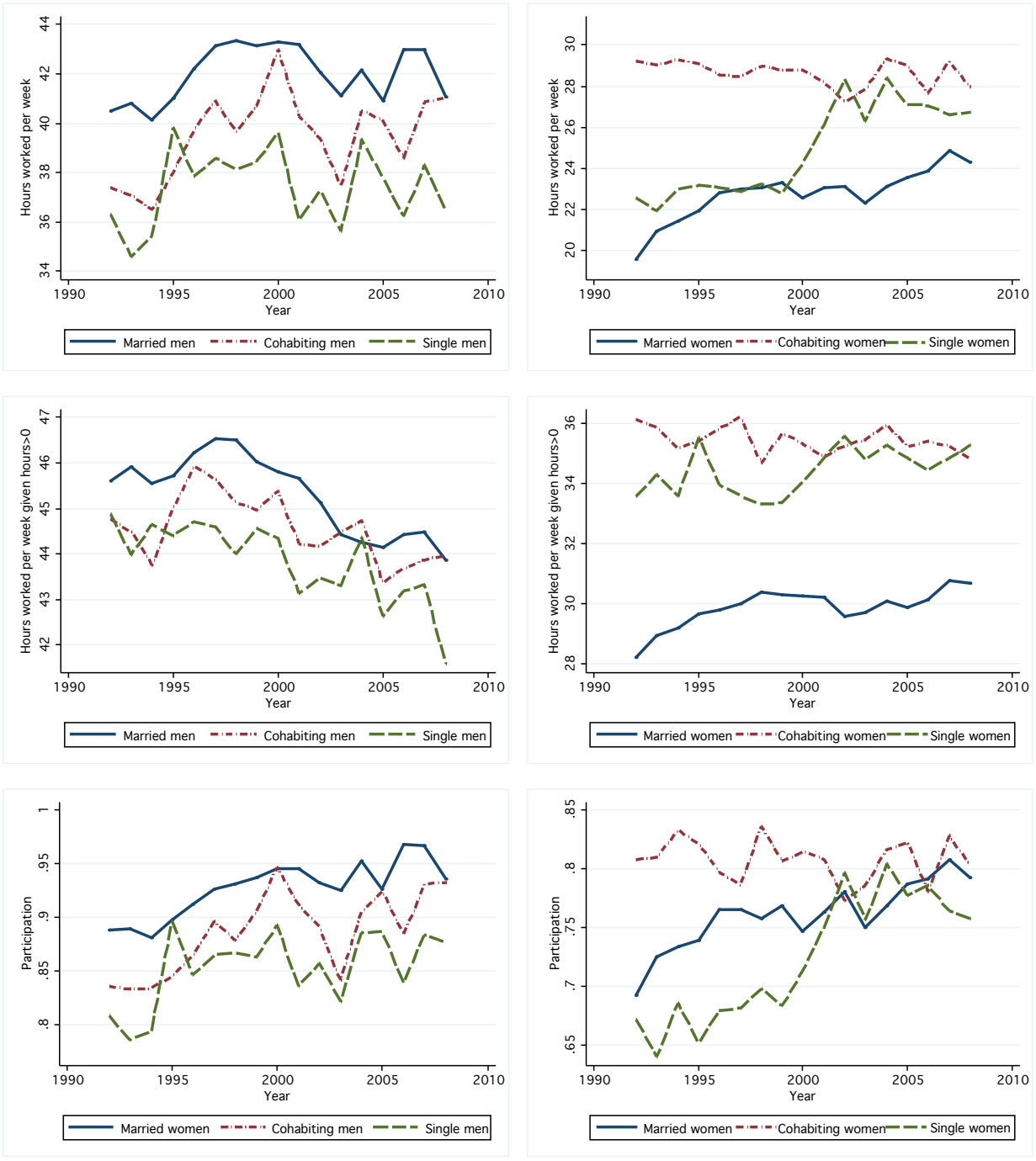


Table 1: Descriptive statistics, BHPS 1992-2008

	Men			Women		
	Single	Cohabiting	Married	Single	Cohabiting	Married
Market hours	37.38	39.72	41.99	24.65	28.58	22.60
Participation	0.840	0.882	0.920	0.704	0.796	0.741
Market hours if >0	44.41	44.92	45.60	34.93	35.85	30.38
Housework hours	6.95	5.64	5.10	13.49	13.51	17.61
Age	38.94	33.74	38.15	37.02	33.47	37.59
Education	0.562	0.533	0.542	0.397	0.474	0.426
# of children (aged 0-18)	0.058	0.656	1.319	0.875	0.774	1.291
# of children aged 0-4	0.002	0.244	0.379	0.136	0.238	0.343
# of children aged 0-2	0.000	0.141	0.182	0.050	0.129	0.160
Own income	24084	23037	28132	17825	16414	13215
Household income	24084	37073	40401	17825	34837	36727
# of observations	2878	3953	12028	4101	4447	15149
# of individuals	735	1290	2177	1055	1362	2632

Notes: Education equals 1 if the respondent completed high school (has A levels), and is 0 otherwise. Household income is measured in 2008 pounds per year. (The retail price index is used to account for inflation.) It includes labour income, pensions, transfers, benefits, and income from investment.

Figure 3: Hours worked per week and participation by gender and living arrangement



on working positive hours.

The pattern for men is strikingly different. Married men work close to 2 hours more on the market than cohabiting men, who in turn work 2 hours more on average than single men.

Cohabiting men do about half an hour more housework than married men, while single men work more than an hour in addition to what cohabiting men do. Looking a participation rates and hours worked conditional on working, it emerges that the difference in unconditional hours by living arrangement is mainly driven by the difference in participation rates.

These numbers are a first indication that people may behave differently when their marital status is different. However, part of the explanation for these differences is likely to be selection. People with different observable and/or unobservable individual characteristics choose a particular living arrangement. Tables 1 points out the differences in demographics. Cohabitors are younger than single and married individuals. Cohabiting women are more likely to have high education (hold A levels). Finally, the number of children and the number of preschool children are highest in households with a married couple. Given these differences in demographics, I present the time trends for hours worked in terms of deviations from the the hours predicted by age, age squared, education level dummies, and the number of children of different age groups (the number of children below 2 years of age, 3 or 4 years old, 5 to 11, and 12 to 18 in the household). Figure 4 shows the results.

Figure 4: Residuals from hours regression on demographics

Figure 4 shows that controlling for observable individual characteristics does npt alter the pattern found in the raw numbers. Cohabiting women work more than married women, while cohabiting men work less than married women. Two issues remain, however. First, cohabiting and married individual may differ in unobservable characteristics, such as ability and taste for leisure. Second, the partner's characteristics may matter. Table 1 points out that there is less inequality in terms of earnings between unmarried partners. Tabel 2 shows that while the correlation between partners' education level does not vary by marital status,

there is a stronger positive correlation between hourly wages for cohabiting couples. Further, in terms of income, the correlation between married partners' income is negative, while it is positive for cohabiting partners.[14] This evidence indicates that positive assortative mating is stronger for cohabiting couples. In the subsequent regression analysis I control for observable individual and household characteristics, unobservable individual effects, as well as partner's characteristics, including partner's wage and non-labour income.

Table 2: Correlation coefficients

	Education level	Hourly wage	Income
All couples	0.2803	0.2361	−0.0912
Married couples	0.2795	0.2118	−0.1552
Cohabiting couples	0.2831	0.3132	0.1473

Notes: Education level may take three values: O-levels or below or apprenticeship, A-levels, past 18.

Before turning to the regression results, let us also look at time trends in housework hours. Figure 6(a) presents average hours worked at home for men by living arrangement, and Figure 6(b) shows housework hours of women. Figure 6(a) and Figure 6(b) control for demographics (age, age squared, education level, number of children of different age groups). The graph for men is left virtually unchanged. Demographics explain 0.38% of the variation in men's housework hours, while they explain 24.74% of the variation in women's housework hours. The most notable pattern that emerges from these two graphs is that cohabiting men do more housework than the married but less than singles. The results considering cohabiting women are not clear cut. Controlling for basic demographics, cohabiting women seem more similar to married women than to single women in terms of their housework hours in the 2000s.

3 Regression evidence

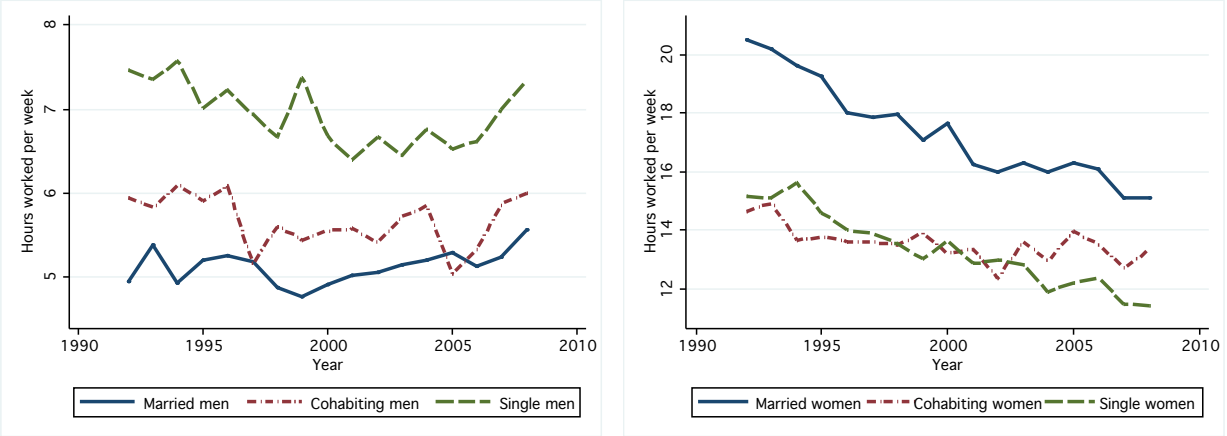
I consider the following two specifications for the labour supply equation:

$$h^*_{it} = \alpha_i + \beta_1 \ln w_{it} + \beta_2 NLInc_{it} + \beta_3 Inc^p_{it} + X'_{it}\gamma + \delta_t + u_{it}, \tag{1}$$

where h^*_{it} denotes the desired hours of work by individual i at time t, w_{it} is the after-tax wage rate, $NLInc_{it}$ is non-labour income (income from pension, transfers, benefits, and

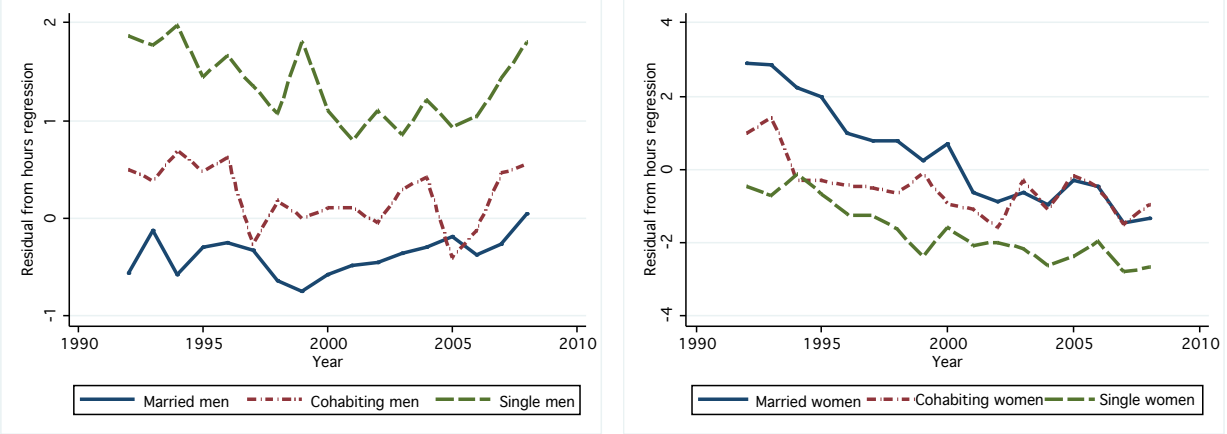
[14] Income taxation is based on individual income in the UK, even for married couples. Eligibility to some transfers and tax credits are determined based on couples' total income (without distinguishing between married and unmarried couples), but are then awarded to an individual.

Figure 5: Housework hours per week by gender and living arrangement



(a) Men (b) Women

Figure 6: Residuals from housework hours regression on demographics



(a) Men (b) Women

investment), Inc^p is partners income if present (labour and non-labour income), X_{it} is a vector of individual characteristics, α_i accounts for unobservable individual effects (ability, taste for leisure), δ_t controls for time effects, and u_{it} is the error term; and

$$h^*_{it} = \alpha_i + \beta_1 \ln w_{it} + \beta_2 \ln w^p_{it} + \beta_3 NLInc_{it} + \beta_3 NLInc^p_{it} + X'_{it}\gamma_1 + X^{p\prime}_{it}\gamma_2 + \delta_t + u_{it}, \quad (2)$$

where w^p_{it} is the partner's after-tax wage, $NLInc^p_{it}$ is the partner's non-labour, and X^p_{it} is a vector of the partner's individual characteristics. The vector of observable individual characteristics, X_{it}, includes living arrangement dummies (married, cohabiting, single (only in specification 1)), seven education level dummies, age, age squared, experience, experience squared, the number of children below 2 years of age, 3 or 4 years old, 5 to 11, and 12 to 18

in the household), and region dummies. X_{it}^{p} includes age, age squared, and education level dummies. Let h_{it} denote observed hours of work. That is,

$$h_{it} = \max\{h_{it}^{*}, 0\}$$

The distinction between h_{it}^{*} and h_{it} is particularly important for women's market work hours.

Equation 1 can be thought of as representing a non-cooperative, Nash-equilibrium outcome in the case of couples. Each individual takes his/her partner's labour income as given. Equation 2 allows for joint time allocation decisions. It captures the decision making within a household that achieves Pareto efficiency. I estimate equation (1) both for the whole sample. Equation (2) is only relevant for couples.

Estimating labour supply equations involves three main challenges: (a) wages are endogenous, (b) wages are only observed for those working, who have self-selected into the labour forces, and (c) unobserved heterogeneity (in ability and taste for leisure, for example). In order to deal with these difficulties I apply an extended Instrumental Variables (IV) approach using panel data, which involves three steps: (i) estimating participation/selection equations, (ii) estimating wage equations, and (iii) estimating the labour supply equations. To estimate wage equations (steps (i) and (ii)), I use a method proposed by Wooldridge (1995) to control for selection into the labour force, that is an extension of Heckman (1979)'s method to panel data (see also Wooldridge, 2002). I first estimate a Tobit selection equation allowing parameters to vary over time. I then estimate the wage equations by fixed effects including the Tobit residuals interacted with time dummies to correct for selection (see procedures 3.1 and 4.1.1 in Wooldridge, 1995). I use previous experience (for women only), and the differing impact of tax and transfer policy changes on different education groups as a source of exogenous variation in after-tax wages (see Blundell, Duncan, and Meghir, 1998 for a similar approach). Table 5 on the Appendix gives a brief description of the tax and transfer system by year. I then impute wages for both partners from the estimated wage equations in the labour supply equations.

Tables 3 and 4 show the main empirical results of this paper for men and women, respectively. The estimated wage regressions, as well as labour supply equations and housework hours regressions are presented there. For women's labour supply, Tobit regressions (not reported) give similar results.

Table 3: Men's time allocation

Dependent variable:	Log wage	Market hours		Housework hours	
		Model 1	Model 2	Model 1	Model 2
Cohabiting	−0.002	−0.401	−0.839	0.725***	0.511*
	(0.008)	(0.406)	(0.746)	(0.158)	(0.252)
Single	0.024**	0.235		2.507***	
	(0.012)	(0.686)		(0.286)	
Log wage		−5.903	−6.916	0.400	0.064
		(7.614)	(11.899)	(2.487)	(3.564)
Partner's log wage			−2.918		0.948
			(4.000)		(1.028)
Non-labour income	0.022***	−1.241***	−1.089***	0.044	0.035
	(0.002)	(0.192)	(0.300)	(0.056)	0.080()
Partner's (non-lab.) inc.	0.004***	−0.016	−0.026	0.036***	−0.049
	(0.001)	(0.020)	(0.110)	(0.007)	(0.036)
Age	0.061***	0.871	0.831	0.107	−0.031
	(0.004)	(0.550)	(1.011)	(0.176)	(0.306)
Age squared	−0.006***	−0.114*	−0.146	−0.007	0.017
	(0.000)	(0.058)	(0.107)	(0.018)	(0.029)
# of children aged 0-2	0.022***	−0.254	0.454	0.485***	0.327*
	(0.006)	(0.383)	(0.589)	(0.124)	(0.197)
# of children aged 3-4	0.026***	0.144	0.469	0.001	−0.040
	(0.006)	(0.389)	(0.578)	(0.133)	(0.194)
# of children aged 5-11	0.014**	0.381	0.519	0.096	0.244
	(0.006)	(0.330)	(0.549)	(0.116)	(0.159)
# of children aged 12-18	0.010*	0.822**	0.952*	0.012	0.017
	(0.006)	(0.349)	(0.564)	(0.119)	(0.156)
Tax variables	yes	no	no	no	no
Education level dummies	yes	yes	yes	yes	yes
Partner's age and educ.	no	no	yes	no	yes
Year dummies	yes	yes	yes	yes	yes
Individual effects	yes	yes	yes	yes	yes
# of observations	15481	18332	8396	18332	8396
# of individuals	2728	3186	1675	3186	1675

Notes: Married are the excluded group. Experience and age are measured in years, their square is measured in years^2/10, non-labour income is measured in thousands of pounds per year. The selection correction terms (Tobit residuals interacted with time dummies) are jointly significant in the wage equation. The Sargan test does not reject the exogeneity of the instruments. In model 2, partner's wage is inputed as well. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at 5%, and * at 10%.

Table 4: Women's time allocation

Dependent variable:	Log wage	Market hours		Housework hours	
		Model 1	Model 2	Model 1	Model 2
Cohabiting	-0.028^{***}	2.522^{***}	2.191^{**}	-0.545^{**}	-0.700
	(0.008)	(0.484)	(0.887)	(0.267)	(0.511)
Single	-0.006	1.218^{**}		-1.922^{***}	
	(0.012)	(0.593)		(0.335)	
Log wage		15.24^{***}	20.13^{***}	-4.122^{**}	-9.641^{***}
		(2.340)	(3.712)	(1.801)	(3.686)
Partner's log wage			-18.94^{**}		5.775
			(9.107)		(6.095)
Non-labour income	0.009^{***}	-0.803^{***}	-0.543^{***}	0.161^{***}	0.108
	(0.002)	(0.064)	(0.130)	(0.031)	(0.078)
Partner's (non-lab.) inc.	0.005^{***}	-0.055^{***}	0.082	0.015^{**}	-0.024
	(0.001)	(0.014)	(0.223)	(0.007)	(0.144)
Age	-0.015	0.337	0.452	-0.007	0.114
	(0.020)	(0.230)	(0.548)	(0.133)	(0.377)
Age squared	-0.003^{***}	-0.061^{**}	-0.077	-0.008	-0.011
	(0.001)	(0.028)	(0.069)	(0.016)	(0.039)
# of children aged 0-2	0.067^{***}	-10.40^{***}	11.44^{***}	4.917^{***}	5.383^{***}
	(0.008)	(0.424)	(0.676)	(0.259)	(0.426)
# of children aged 3-4	0.048^{***}	-9.521^{***}	-10.13^{***}	4.974^{***}	5.512^{***}
	(0.008)	(0.392)	(0.643)	(0.253)	(0.419)
# of children aged 5-11	-0.025^{***}	-4.257^{***}	-4.953^{***}	3.178^{***}	3.319^{***}
	(0.007)	(0.433)	(0.565)	(0.194)	(0.320)
# of children aged 12-18	-0.030^{***}	-2.533^{***}	-3.46^{***}	2.671^{***}	2.827^{***}
	(0.007)	(0.367)	(0.571)	(0.205)	(0.339)
Experience	0.049^{**}				
	(0.020)				
Experience squared	-0.001				
	(0.001)				
Tax variables	yes	no	no	no	no
Education level dummies	yes	yes	yes	yes	yes
Partner's age and educ.	no	no	yes	no	yes
Year dummies	yes	yes	yes	yes	yes
Individual effects	yes	yes	yes	yes	yes
# of observations	13988	21143	8667	21143	8667
# of individuals	2780	3548	1657	3548	1657

Notes: Married are the excluded group. Experience and age are measured in years, their square is measured in years^2/10, non-labour income is measured in thousands of pounds per year. The selection correction terms (Tobit residuals interacted with time dummies) are jointly significant in the wage equation. The Sargan test does not reject the exogeneity of the instruments. In model 2, partner's wage is inputed as well. Robust standard errors are in parentheses. *** indicates significance at the 1% level, ** at 5%, and * at 10%.

Table 3 shows that there is no significant difference between men's labour market hours depending on their living arrangement at the 5 percent level. While non-labour income has a negative effect on men's hours worked, the partner's income does not affect labour market hours. Columns 4 and 5 show that, on the other hand, the living arrangement and the partner's income matter for housework hours of men. Men work the most around the house when single, and cohabiting men work significantly more than married men by between half and hour and 45 minutes per week. When the partner earns more, men increase their weekly housework hours using the full sample. Men's time allocation is not influenced by predicted own wages.

Table 4 shows that women work the most on the market when cohabiting, followed by when they are single. A woman is predicted to work two to two and a half hours more on the labour market when cohabiting than when married. On the other hand, marriage induces women to work more at home, by about half an hour relative to cohabitors (and by about two hours relative to singles). The difference is no longer significant once I restrict the sample to couples. Unlike men, women reallocate their time as a result of wage shocks. As expected, when current wage is higher, women work more on the market and less at home.Women work less on the market and more at home when household non-labour income is higher. The partner's wage has a strong negative impact on women's labour market hours.

The coefficients related to children show that women shift hours from market work to housework, and reduce market hours by a lot when having children of 4 years of age or younger. Men only increase their housework hours substantially when they have a child of 2 years of age or younger, while they increase their labour market hours as children grow.

4 A two-period model of family labour supply

This section considers a simple model that can account for the differences in labour supply between cohabiting and married individuals. The aim of this section is to demonstrate a mechanism at play, namely, the effect of the separation probability on labour supply. Therefore, I assume that the only difference between cohabiting and married couples in this model is the separation rate. According to BHPS data, cohabitors split with 6.49 percent probability from one year to the next, while married couples only with 2.35 percent probability on average.[15] I study the effects of changing the continuation probability of the relationship on intra-household risk sharing and, in turn, on labour supply, taking separation as exogenous.

[15]These transition probabilities are unconditional on length of the relationship, age, etc., and time trends in these probabilities are to be studied in the future as well.

Consider the following setup. Individuals live for two periods. They consume a private and perishable consumption good c and leisure each period. Hours worked is denoted h, and the total time endowment of each individual is normalised to 1. The instantaneous utility function is

$$u(c, l) = \alpha \ln(c) + (1 - \alpha) \ln(1 - h),$$

where $0 \leq \alpha \leq 1$. This Cobb-Douglas type utility function was chosen in order to provide analytical results. Individuals do not have nonlabour income, and cannot save or borrow.

Let w_{it} denote the wage of individual i, $i \in \{f, m\}$,[16] at time t, $t \in \{1, 2\}$. I assume that $w_{m1} > w_{f1}$, that is, male wages are higher than female wages at time 1. This assumption is crucial for the main result of this theoretical exercise. As men's wages are typically higher than women's wages, it is hardly a controversial assumption. Wages are assumed stochastic at time 2. This means that there is a role for intra-household risk sharing. The state of the world at time 2 is denoted s. I assume that the only benefit to being in a couple is to share the wage risk.

Let β denote the discount factor, and δ^{mar} (δ^{coh}) denote the continuation probability of marriage (cohabitation). Cohabiting couples are more likely to split than married couples, thus $\delta^{coh} < \delta^{mar}$. These probabilities are assumed exogenous.[17] Risk sharing within the household is subject to limited commitment. That is, each partner may decide to separate at time 1 once current wages are known.[18] In other words, individuals will only be in a relationship if they are at least as well off as being single. This has to be true not just from an ex ante perspective, but given current wage realizations as well.

The timing is the following. At time 0, everybody is randomly matched with a person of the opposite sex, and couples are randomly assigned to possibly cohabit or marry. While unrealistic, this set-up is consistent with comparing cohabiting and married couples 'everything else equal.' At time 1, wages are realised and couples may separate if at least one partner chooses to do so. Afterwards, individuals work and consume. At time 2, an exogenous separation may occur. Finally, individuals work and consume, as at time 1.

The solution can be characterised by a sharing rule (Chiappori, 1988) that allocates the

[16] For simplicity of language and notation, I assume that couples can only be formed by a man and a woman.

[17] Taking the cost of separation as exogenous and introducing a random variable that describes 'relationship quality' would endogenise separations, as in Mazzocco, Ruiz, and Yamaguchi (2007). Given that the direct costs of divorce are higher than the direct costs of separation for cohabiting couples, this set-up would generate $\delta^{coh} < \delta^{mar}$.

[18] In this simple setting there is no real difference between not forming a couple and separating at time 1. While the possibility of endogenous separation does affect outcomes, separation will not occur in equilibrium. This is because the surplus of each match is always nonnegative, since the wage risk can be shared.

same share of total household income to partners in each period. Note that at time 2 the agreed upon sharing rule has to be honoured. This is equivalent to honouring promised utilities in the infinite horizon setting. Time 2 can be thought of as representing all future periods. Otherwise no risk sharing would take place.

A single individual i solves the following problem:

$$\max \alpha \ln(c_{i1}^{si}) + (1-\alpha)\ln(1-h_{i1}^{si}) + \beta \sum_s \pi(s) \left[\alpha \ln\left(c_{i2}^{si}(s)\right) + (1-\alpha)\ln\left(1-h_{i2}^{si}(s)\right)\right],$$

$$\text{s.t.} \quad c_{i1}^{si} = w_{i1}h_{i1}^{si} \quad \text{and} \quad c_{i2}^{si}(s) = w_{i2}(s)h_{i2}^{si}(s),$$

where the upper index si refers to singles and $\pi(s)$ is the probability of state s occurring.

It is easy to see that the solution of this problem is static and is given by

$$h_{i1}^{si} = h_{i2}^{si}(s) = \alpha, \quad c_{i1}^{si} = \alpha w_{i1}, \quad \text{and} \quad c_{i2}^{si}(s) = \alpha w_{i2}(s).$$

The expected lifetime utility of individual i when single can be written as

$$U_i^{si} = \alpha \ln(\alpha w_{i1}) + (1-\alpha)\ln(\alpha) + \beta \sum_s \pi(s) \left[\alpha \ln\left(\alpha w_{i2}(s)\right) + (1-\alpha)\ln(\alpha)\right].$$

Let us now turn to the couples' problem. Remember that partners may split if they are better off single. They stay together only if their expected utility when in the couple is at least as great as their expected utility when single. In other words, the intra-household allocation must be self-enforcing in the sense of Kocherlakota (1996).

Let λ_i denote the Pareto-weight assigned to partner i. Then, the couples' problem can be written as

$$\begin{aligned}\max \sum_i \lambda_i \Bigg(& \alpha \ln(c_{i1}^{co}) + (1-\alpha)\ln(1-h_{i1}^{co}) \\ & + \delta\beta \sum_s \pi(s) \left[\alpha \ln\left(c_{i2}^{co}(s)\right) + (1-\alpha)\ln\left(1-h_{i2}^{co}(s)\right)\right] \\ & + (1-\delta)\beta \sum_s \pi(s) \left[\alpha \ln\left(c_{i2}^{si}(s)\right) + (1-\alpha)\ln\left(1-h_{i2}^{si}(s)\right)\right] \Bigg),\end{aligned}$$

$$\text{s.t.} \qquad c_{f1}^{co} + c_{m1}^{co} = w_{f1}h_{f1}^{co} + w_{m1}h_{m1}^{co} \tag{3}$$

$$c_{f2}^{co}(s) + c_{m2}^{co}(s) = w_{f2}(s)h_{f2}^{co}(s) + w_{m2}(s)h_{m2}^{co}(s) \tag{4}$$

$$\begin{aligned}& \alpha \ln(c_{i1}^{co}) + (1-\alpha)\ln(1-h_{i1}^{co}) + \delta\beta \sum_s \pi(s) \left[\alpha \ln\left(c_{i2}^{co}(s)\right) + (1-\alpha)\ln\left(1-h_{i2}^{co}(s)\right)\right] \\ & + (1-\delta)\beta \sum_s \pi(s) \left[\alpha \ln\left(c_{i2}^{si}(s)\right) + (1-\alpha)\ln\left(1-h_{i2}^{si}(s)\right)\right] \geq U_i^{si} \quad \forall i,\end{aligned} \tag{5}$$

where constraint (3) (constraint (4)) is the resource constraint in period 1 (2), and constraint (5) is the participation constraint (PC), or, enforcement constraint, of individual i, $i \in \{f, m\}$. Remember that δ denotes the exogenous continuation probability oft the relationship. The upper index *co* refers to being in a couple.

We first solve the couples' problem ignoring the participation constraints. Normalise $\lambda_m + \lambda_f = 1$. It is easy to see that, given Pareto-weights and wages, the solution for individual labour supplies and the consumption allocation in both periods can be written as

$$h_f = 1 - \lambda_f(1-\alpha)\left(1 + \frac{w_m}{w_f}\right) \text{ and } h_m = 1 - \lambda_m(1-\alpha)\left(1 + \frac{w_f}{w_m}\right),$$

and

$$c_f = \alpha\lambda_f(w_f + w_m) \text{ and } c_m = \alpha\lambda_m(w_f + w_m),$$

respectively, where time indexes, as well the reference to the state the world at time 2, s, have been dropped for simplicity. Note that h_f and h_m are nonnegative if $\lambda_f(1-\alpha)\left(1 + \frac{w_f}{w_m}\right) \leq 1$ and $\lambda_m(1-\alpha)\left(1 + \frac{w_m}{w_f}\right) \leq 1$, respectively. I assume that this is the case.

Suppose that for $\lambda_m = \frac{1}{2}$ and for both δ^{mar} and δ^{coh}, the man's PC is binding. Otherwise the problem is not interesting, since the separation probability would not matter.

To solve the problem, we have to find $\tilde{\lambda}_m > \frac{1}{2}$ such that the participation constraint (5) for $i = m$ holds with equality (Marcet and Marimon, 2009; Ligon, Thomas, and Worrall, 2002). Replacing the above allocation and by simple algebra the PC of the man simplifies to

$$\begin{aligned}
&\ln\left(\tilde{\lambda}_m(w_{f1} + w_{m1})\right) + \delta\beta\sum_s \pi(s)\ln\left(\tilde{\lambda}_m(w_{f2}(s) + w_{m2}(s))\right) \\
&= \ln(w_{m1}) + \delta\beta\sum_s \pi(s)\ln\left(w_{m2}(s)\right).
\end{aligned}$$

It is easy to see that for a lower δ, $\tilde{\lambda}_m$ has to be bigger to satisfy this constraint. This is because at time 1 the man is bearing a cost, since he has to make a transfer to his partner. He is only willing to do this if he is rewarded in the future. If the probability of this reward is smaller, that is, the couple is more likely to split, he has to be rewarded by a bigger share of resources within the household. It is optimal to reward him by a bigger share of consumption both today and tomorrow.

Finally, we can write the labour supply of the woman and the man at time 1 as a function of $\tilde{\lambda}_m$, dropping time indexes for simplicity, as

$$h_f = 1 - (1-\tilde{\lambda}_m)(1-\alpha)\left(1 + \frac{w_m}{w_f}\right)$$

and

$$h_m = 1 - \tilde{\lambda}_m(1-\alpha)\left(1 + \frac{w_f}{w_m}\right),$$

respectively. It is easy to see that h_f in increasing in $\tilde{\lambda}_m$, thus decreasing in δ, therefore cohabiting women work more, given $w_m > w_f$. Similarly, h_m in decreasing in $\tilde{\lambda}_m$, thus increasing in δ, therefore married men work more.

We can also compare overall family labour supply of cohabiting and married couples. In order to do this, we can write total family labour supply as

$$H = h_f + h_m = 2 + (1-\alpha)\left(1 + \frac{w_m}{w_f}\right) + \tilde{\lambda}_m(1-\alpha)\left(\frac{w_m}{w_f} - \frac{w_f}{w_m}\right)$$

H in increasing in $\tilde{\lambda}_m$, thus decreasing in δ, therefore cohabiting couples supply more labour. This also means that the difference in women's labour supply between cohabiting and married women (which is positive) is bigger than the difference for men (which is negative). These predictions are consistent with data from the BHPS.

5 Concluding remarks

Using longitudinal variation in living arrangements, this paper has found that women work more on the market and men do more housework when cohabiting than when married. Therefore, it is important to distinguish between cohabiting and married couples when studying female labour supply, time allocation, and/or household production.

The results suggest that the changing household structure, in particular, the rise in cohabitation and the fall in marriage provides new incentives for households' economic decisions. The changing living arrangements were considered exogenous. The two decades studied in this paper saw a remarkable shift in the marital status of couples. Endogenising this shift using changes that are exogenous to individual decisions (changes in the gender wage gap, household production technology, the availability and cost of childcare) would be an important next step, which would require a more structural approach.

The analysis presented in this paper points to the emergence of an alternative way for the functioning of households. This alternative, cohabitation, is becoming widespread. It involves a more equal division of labour, or, less specialization, moving away from the Beckerian view of the household (Becker, 1981). The descriptive evidence presented in this paper also suggests that the shift from marriage to cohabitation leads to stronger positive assortative matching in terms of income, which is likely to imply less inequality within the household and more inequality across households.

This paper has focused on cross-sectional facts. Analyzing the life-cycle patterns of living arrangements and labour supply is an obvious next step. Future research should also incorporate households' inter-temporal decisions. Consumption and saving decisions may be influenced by both the cost of separation and the different legal treatment of assets at separation.

Appendix

Table 5 presents an incomplete description of the the tax and transfer system in the UK by year. The income tax rate is 0 for income up to the personal allowance (additional allowances, not reported here, were in effect at least part of the period), then the starting rate is paid for the next portion defined by the starting rate limit, then the basic rate is paid for the next portion defined by the basic rate limit, and finally the higher rate is paid. The higher rate of income tax remained at 40% over the period. The main reform year was 1999. In that year, the starting rate was reduced to 10%, and the Working Families' Tax Credit was introduced, increasing government spending on in-work benefits by about 50 percent (Brewer and Ratcliffe, 2010). See Brewer, Duncan, Shephard, and Suárez (2006) for a description of the reform and its effects on labour supply.

Table 5: Some elements of the UK tax and transfer system, 1992-2008

	1992	1993	1994	1995	1996	1997	1998	1999	2000
Personal allowance	5,343	5,259	5,135	5,078	5,296	5,517	5,532	5,630	5,531
Starting rate	20	20	20	20	20	20	20	10	10
Starting rate limit	3,102	3,817	4,472	4,610	5,486	5,592	5,670	1,948	1,917
Basic rate	25	25	25	25	24	23	23	23	22
Basic rate limit	36,756	36,182	35,328	35,008	35,870	35,595	35,734	36,363	35,821
NI main rate	9	9	10	10	10	10	10	10	10
WFTC	0	0	0	0	0	0	0	1	1
WTC and CTC	0	0	0	0	0	0	0	0	0
	2001	2002	2003	2004	2005	2006	2007	2008	
Personal allowance	5,621	5,626	5,468	5,459	5,476	5,459	5,432	6,035	
Starting rate	10	10	10	10	10	10	10	0	
Starting rate limit	2,330	2,341	2,322	2,324	2,338	2,331	2,319	0	
Basic rate	22	22	22	22	22	22	22	20	
Basic rate limit	36,440	36,450	36,136	36,126	36,248	36,107	35,973	34,800	
NI main rate	10	10	11	11	11	11	11	11	
WFTC	1	1	0	0	0	0	0	0	
WTC and CTC	0	0	1	1	1	1	1	1	

Notes: WFTC refers to Working Families' Tax Credit, WTC is Working Tax Credit, and CTC is Child Tax Credit. Rates are in percentages, the personal allowance and tax rate limits are in 2008 pounds per year, the tax credits are binary variables where 1 means "in effect."

References

Adamopoulou, E. (2010). Will You "Quasi-marry" Me? The Rise of Cohabitation and Decline of Marriages. Economics Working Papers 1026, Universidad Carlos III.

Becker, G. S. (1981). *A Treatise on the Family*. Harvard University Press, Cambridge, Massachusetts.

Blundell, R., A. Duncan, and C. Meghir (1998). Estimating Labor Supply Responses Using Tax Reforms. *Econometrica 66*(4), pp. 827–861.

Blundell, R. and B. Etheridge (2010). Consumption, Income and Earnings Inequality in Britain. *Review of Economic Dynamics 13*(1), 76–102.

Brewer, M., A. Duncan, A. Shephard, and M. J. Suárez (2006). Did Working Families' Tax Credit Work? The Impact of In-Work Support on Labour Supply in Great Britain. *Labour Economics 13*(6), 699 – 720.

Brewer, M. and S. Ratcliffe, Anita andd Smith (2010). Does Welfare Reform Affect Fertility? Evidence from the UK. *Journal of Population Economics*, forthcoming.

Chiappori, P.-A. (1988). Rational Household Labor Supply. *Econometrica 56*(1), 63–90.

Gemici, A. and S. Laufer (2011). Marriage and Cohabitation. Mimeo.

Greenwood, J. and N. Guner (2008). Marriage and Divorce since World War II: Analyzing the Role of Technological Progress on the Formation of Households. In *NBER Macroeconomics Annual 2008, Volume 23*. National Bureau of Economic Research.

Heckman, J. J. (1979). Sample Selection Bias as a Specification Error. *Econometrica 47*(1), pp. 153–161.

Kalenkoski, C. M., D. C. Ribar, and L. S. Stratton (2005). Parental Child Care in Single-Parent, Cohabiting, and Married-Couple Families: Time-Diary Evidence from the United Kingdom. *The American Economic Review, Papers and Proceedings 95*(2), pp. 194–198.

Kocherlakota, N. R. (1996). Implications of Efficient Risk Sharing without Commitment. *Review of Economic Studies 63*(4), 595–609.

Ligon, E., J. P. Thomas, and T. Worrall (2002). Informal Insurance Arrangements with Limited Commitment: Theory and Evidence from Village Economies. *Review of Economic Studies 69*(1), 209–244.

Marcet, A. and R. Marimon (2009). Recursive Contracts. Mimeo.

Mazzocco, M., C. Ruiz, and S. Yamaguchi (2007). Labor Supply, Wealth Dynamics, and Marriage Decisions. Mimeo.

Wooldridge, J. M. (1995). Selection Corrections for Panel Data Models under Conditional Mean Independence Assumptions. *Journal of Econometrics 68*(1), 115 – 132.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. MIT Press, Cambridge, Massachusetts.