Modelling the employment and wage outcomes of spouses: Is she outearning him?

Hans Bloemen, Elena Stancanelli

Document de travail

“ Modelling the employment and wage outcomes of spouses: Is she outearning him? ”

N° 2008-01
January 2008

Hans G. Bloemen
(Free University Amsterdam)

Elena Stancanelli
(CNRS, GREDEG, Université de Nice et OFCE)

Observatoire Français des Conjonctures Économiques
69, Quai d'Orsay 75340 Paris Cedex 07
Tel : 01 44 18 54 00 Fax : 01 45 56 06 15
E-mail: ofce@ofce.sciences-po.fr Web: http://www.ofce.sciences-po.fr

Modelling the employment and wage outcomes of spouses: Is she outearning him?

Hans G. Bloemen[*] and **Elena G. F. Stancanelli**[**]

April 2008[***]

Abstract

This paper is focused on couple households where the wife is the main earner. The economic literature on this subject is particularly scant. According to our estimates, the wife was the main earner in one of every six couple households in France in 2002, including wife-sole-earner households. The proportion of wives outearning their husbands was 18% for dual-earners. About 24% of American women in dual-earner households earned more than their husband in 2004. Using a model of household labour supply behaviour, we show that households where the wife is the main earner may come about either because the husband has a weaker preference for work than his wife, due possibly to her high wage, or because he is hit by adverse circumstances, such as, for example, a decline in the demand for men with his particular qualifications. Positive assortative mating may also come into play. Our empirical model specifies spouse labour-market participation equations within each household, endogenizing wages and allowing for random effects and correlations in spouses' unobservables. We conclude that the determinants of wife-sole-earner households are quite distinct from those for dual-earner households where she outearns him. The probability of observing the first seems to be more related to labour market difficulties of the husband, while the latter is not. Dual-earners where she outearns him are more likely to be found among higher educated couples, and especially, among couple where the wife's education level is high.

Keywords: Marriage, work behaviour, household economics.

Classification JEL : D1, J12, J21

[*] Free University Amsterdam, Department of Economics, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands, Tinbergen Institute, IZA, and Netspar.

[**] CNRS, GREDEG, University of Nice, and OFCE, Sciences-Po, Paris

[***] This paper was presented at the European Meeting of the Econometric Society in Budapest, August 2007, at the AFSE Paris, the AIEL Naples, September 2007, at the Society of Labor Economists New York, May 2008, and at invited seminars at University of Cergy, May 2007, University Paris 1, June 2007, and University Paris 2, February 2008. We are grateful to seminar participants for their comments. This research has benefited from a French National Research Agency (ANR) grant. The data for this paper were made available by the INSEE. All errors are ours.

1 Introduction

The economic literature on couple households where the wife is the main earner is particularly scant. The paucity of studies in this area contrasts sharply with the huge literature on lone mothers.

About 24% of American women in dual-earner households earned more than their husband in 2004 (Winkler, 1998, Bureau of Labor, 2004). This figure is about the same for Canada (Sussman and Bonnell, 2006). The proportion of female breadwinners was also quite remarkable in Australia at about the same time (Drago et al., 2004). According to our estimates, 18% of wives outearned their husbands in French dual-earner households in 2002.

The analysis of households with the wife as the main earner has mainly been carried out by non-economists. In the United States, two popular best-sellers have considered this issue: Minetor (2002) and Pappenheim and Graves (2005), both based on a series of interviews with 'female breadwinners' and their husbands, find a great deal of conflict between spouses in some of these households. Drago et al. (2004) look at the existence and persistence of situations of 'female breadwinnership' in Australia. The authors conclude that when wives' superior earnings result from economic factors, husbands tend to have low socio-economic status, a poor labour market position and few family committments; however, when they are associated with the gender equity principles of spouses, the husband's characteristics are often more positive. Brennan et al. (2001) investigate the impact of earnings dominance on the quality of the spouse's marital role, where the latter is measured via a 52-item scale, including separation. They conclude that changes in wives' earnings do not affect marital role quality, but that the reverse is true for men: changes in men's earnings are positively correlated with the quality of marital roles.

From the economist's point of view, the policy implications of the wife's earning dominance within the household are particularly relevant. Many policies are still implicitly targeted at male-breadwinner households, which are no longer the rule. The literature shows, for example, that joint taxation[1] and tax credits discourage the labour market participation of secondary earners (Eissa and Williamson Hoynes, 2004, Apps and Rees, 2005, Apps, 2006, Stancanelli,

[1] See Bourguignon and Magnac (1990) for an analysis of the impact of taxation on the labour supply of French spouses, using the French Labour Force Surveys.

2008). If some men are the secondary earner in the household, any disincentive effects may apply to them too. Parental leave policies and part-time work are by and large used by women. If all the distortions on the labour-market participation of (married) women were removed, the proportion of 'female breadwinners' may well increase. Further, if women are the sole household earners due to adverse circumstances befalling their husband, (low-educated) 'female breadwinners' may not bring enough income home to meet household needs. Finally, the non-economics literature underlines the conflict within some of the households where the wife is the main earner. Acknowledging their existence will probably make these situations less conflictual.

Using a model of household labour supply behaviour, we show that households where the wife is the main earner may come about either because the husband has a weaker preference for work than his wife, due possibly to her high (potential) wage, or because he is hit by adverse circumstances, such as, for example, a decline in the demand for men with his particular qualifications. Here positive assortative mating, defined as the positive association between spouses' socio-economic characteristics, may also come into play. Pencavel (1998) relates the rising education rates of women, and the positive correlation between spouses' education levels, to the increase in the number of dual-earners in the United States. The same factors may well contribute to explain the incidence of households where the wife is the main earner. Winkler (1998) observes that the process of assortative mating is associated with considerable variance in earnings of the two spouses. We expect positive assortative mating to be positively correlated with dual earnership, but one cannot a priori characterize its correlation to households where the wife is the main earner.

It is the goal of this paper to shed light on the determinants of the wife's earning dominance. Is this explained by the high education of women or rather by husbands' difficulties in the labour market? Is positive assortative mating of spouses correlated with wives' earning dominance? Do the same factors lie behind households where she is the sole earner or dual-earners where she outearns him? To answer these questions, we specify an econometric model of spouses' labour market decisions, whereby we jointly model the employment states of the two spouses and their wages, allowing for random effects and for correlations between spouses' unobservable characteristics. The advantage of this approach over a structural model of household behaviour

is its flexibility, as it does not impose any a priori restrictions on behaviour. It is consistent with the unitary approach but also with a collective model of household behaviour. We are then able to test for the impact of potential wages on labour market outcomes of spouses. In particular, we can disentangle the effect of her and his education on wages and labour market outcomes. We account for positive assortative mating of spouses, by means of a series of proxies for whether spouses enjoy the same education level or belong to the same socio-economic profession and by using an indicator of spouses' age difference -we assume that smaller age differences proxy for positive assortative mating. Our empirical model also controls for macro-economic trends and the local labour-market situation.

The sample for the analysis consists of 300,000 French couples drawn from the French Labour Force Surveys of 1990 to 2002. The large sample size enables us to observe enough households with the wife as the main earner. In particular, we observe 12,000 couples where the wife is the sole earner and 35,000 dual-earner households where the wife outearns the husband. We exploit the rotating structure of the survey, in which one-third of the sample is replaced each year -so that a household stays in the sample for at most three years- to construct an unbalanced panel. This allows us to include random effects and various correlations in unobservables into the model.

We find that, generally, higher-educated women are more likely to be main earners. Because of the increasing education of women, we may expect 'female breadwinners' to become more common in the future. The determinants of wife-sole-earner households are quite distinct from those for dual-earner households where the wife outearns her husband. The probability of observing the first seems to be more related to the husband's labour market difficulties, while the latter is not. In particular, couples where the wife is the sole worker are more likely to occur when husbands are low-educated, and more so if both spouses are low-educated. Instead, dual-earners where she outearns him are more likely to be found among higher educated couples, and especially, among couple where her education level is high. We conclude that positive assortative mating of spouses significantly increases the probability that the wife outearns her husband but it reduces the incidence of wife-sole-earnership. Spouses' unobservable characteristics and the correlation between them over time suggest considerable persistence in behaviour.

The structure of the paper is as follows. First, the theoretical framework is spelled out. Next, the econometric model is presented. Section 4 presents the data and Section 5 provides a descriptive analysis of spouses' characteristics. The estimation results are found in Section 6, and Section 7 concludes.

2 A theoretical model of spouses' employment statuses and wages

This section presents the theoretical framework. The purpose of this exercise is not so much to put forward an original model, but rather to single out the theoretical predictions concerning the occurrence of couple households where the wife is the main earner.

All models of family labour supply consider the trade-off between income out of work, on the one hand, and the merits of non-work time, on the other. This trade-off is the key to understanding household members' work decisions. In our model, we do not consider bargaining processes between household members; we also do not explicitly deal with household production. Whenever we talk about the 'value of non-work time', this is also understood to include time spent on household production.[2]

The subject of this study are households where the wife works and the husband does not, and dual-earners where the wife outearns the husband. We therefore set up a theoretical model in which employment is the choice variable for the household members.[3]

Employment opportunities

The choice set of household members is determined by employment opportunities, which are driven by the demand side of the labour market. We denote an employment opportunity for the husband by $e_m = 1$ ($e_m = 0$ if no employment is available). In the absence of an employment opportunity, there is no choice and the individual stays out of work. We assume that a job opportunity is available with probability $p_m = P(e_m = 1)$. For the wife, we denote the employment opportunity by e_f and its probability by p_f.

The household's objective function

The household has an objective function that depends on the labour market state of each

[2] See Apps and Rees (1996 and 1997) on this issue.

[3] Hours are not modelled here as they are not within the scope of the paper. Van Soest (1995) puts forward a structural model of spouses' hours' choices.

household member d_j, with $j = m, f$, and on household consumption C.[4] Let $d_j = 1$ if spouse j is working, $d_j = 0$ otherwise. The objective function is:

$$U(d_m, d_f, C) \tag{1}$$

This expression represents a household utility function, as in a unitary model. Alternatively, it can be interpreted as a household welfare function, and, more specifically, a Pareto-weighted average of the utility functions of individual household members.[5] The expression above is also consistent with a cooperative model, in which the sum of the individual utility functions is maximized. The expression (1) may depend on taste shifters that influence the valuation of non-work time, as well as on random variables.[6]

Properties of the household objective function

We assume that the objective function has the following properties:

$$U(0, d_f, C) > U(1, d_f, C) \text{ and } U(d_m, 0, C) > U(d_m, 1, C) \tag{2}$$

The conditions in (2) state that non-work time is preferred to work time.

The marginal utility of consumption is positive:

$$\frac{\partial U(d_m, d_f, C)}{\partial C} > 0 \tag{3}$$

We next assume that the utility gain of non-work time compared to work time is greater at higher consumption levels:

$$U(0, d_f, C) - U(1, d_f, C) < U(0, d_f, \bar{C}) - U(1, d_f, \bar{C}) \text{ if } C < \bar{C} \tag{4}$$

and

$$U(d_m, 0, C) - U(d_m, 1, C) < U(d_m, 0, \bar{C}) - U(d_m, 1, \bar{C}) \text{ if } C < \bar{C} \tag{5}$$

This condition is synonymous with a diminishing marginal rate of substitution between non-work time and consumption.

[4] The model does not explicitly consider private consumption goods for individual household members. This would not provide any additional insights into the income-leisure trade-off. Distinguishing private consumption goods is important in intra-household bargaining models.

[5] See, for example, Bloemen (2004) for a collective model specification that allows for non-participation.

[6] Here we supress any notation for taste shifters or random effects. These last enter into the empirical model.

The household budget constraint

Let $w_j, j = m, f$ be the (potential) labour income of spouse j. The household budget constraint is:

$$C = d_m w_m + d_f w_f \tag{6}$$

Non-labour income is not explicitly considered.[7]

Mazimization

Household members choose d_m, $d_f \in \{0, 1\}$ to maximize the objective function (1) subject to the budget constraint (6).

Dual-earners where the wife outearns the husband

The model characterizes dual-earners where the wife outearns her husband as follows. First of all, two conditions have to be met: (i) $(d_m, d_f) = (1, 1)$ must prevail as the outcome of the maximisation process; and (ii) $w_f > w_m$. This last condition is driven by spouses' (potential) earnings, which are determined outside the model. For example, potential earnings will reflect differential investments in human capital, experience, and the relevant industrial sector or occupational opportunities. A necessary condition for $(d_m, d_f) = (1, 1)$ is that both household members have employment opportunities: $(e_m, e_f) = 1$. Thus, demand side factors may influence the outcome. Given the job opportunities available, both household members will opt to be employed if:

$$\begin{aligned} U(1, 1, w_m + w_f) &> U(0, 1, w_f) \\ U(1, 1, w_m + w_f) &> U(1, 0, w_m) \\ U(1, 1, w_m + w_f) &> U(0, 0, 0) \end{aligned} \tag{7}$$

The first condition above shows the trade-off between the value of labour income w_m, if the husband works, and the value of non-work time. We can also write this as

$$U(0, 1, w_m + w_f) - U(1, 1, w_m + wf) < U(0, 1, w_m + w_f) - U(0, 1, w_f) \tag{8}$$

The left-hand side of (8) can be interpreted as the utility gain from non-work time relative to work time, which is positive according to (2). The right-hand side is the utility gain from higher consumption that results from greater labour income w_m, which is positive according

[7] The data to hand do not contain this information. In the empirical analysis, we specify w_j, with $j = m, f$ as equal to the wage rate.

to (3). Therefore, (8) shows that the utility gain from higher labour income is larger than the utility gain due to non-work time: earnings from work are worth more to the husband than the corresponding value of non-work time. The same holds for the wife, as described by the second condition in (10): her earnings from work must exceed the value of non-work time.

We can observe dual-earner households where the wife outearns her husband when the wife's (potential) wage is relatively high. Now, it would be too simplistic to characterize dual-earners as high-earnings individuals. Conditions (4) and (5) indicate that the value of non-work time increases with household consumption. This means, for example, that if the husband is a high-wage earner, the value of leisure of the wife is higher. This would, in turn, decrease her incentives to work unless her wage-income is so high as to be greater than the value of non-work time. Other mechanisms may also be at work. We do not explicitly model intra-household bargaining here, but being employed and bringing in one's own labour income might also translate into a better bargaining position. This could be an additional incentive for him to work even when his wife enjoys substantial labour income. Further, positive assortative mating may matter: individuals with similar caracteristics, and notably similar preferences for work, may tend to marry each other. Positive assortative mating is bound to be positively correlated with dual earnership, but one cannot a priori characterize its correlation to wife-outearning dual-earners, nor to wife-sole-earner households.

Wife sole-earner

We now consider households where the wife is the sole earner as her husband does not work. This could arise under two different scenarios. First, it could be that the husband has not received an opportunity to work, $e_m = 0$, and is out of work by constraint rather than choice. His wife opts to work. It follows that:

$$U(0, 1, w_f) > U(0, 0, 0) \tag{9}$$

Either the value of non-work time is relatively low for the wife (see equation 5) or she may choose to work even though her wage is not very high, because her husband does not bring in any income. This case corresponds to the so called 'added worker effect'.

Under the alternative scenario the observed outcome is the result of choice. The husband

may well have a job opportunity ($e_m = 1$), but with a low wage relative to his value of leisure:

$$\begin{aligned} U(0,1,w_f) &> U(1,1,w_m + w_f) \\ U(0,1,w_f) &> U(1,0,w_m) \\ U(0,1,w_f) &> U(0,0,0) \end{aligned} \tag{10}$$

The wife might, for example, be a high-wage worker, which could increase the value of her husband's leisure.

We can therefore observe households where the wife works and the husband is out of work under two different scenarios: in the first, the husband would like to work but there are no employment opportunities; in the second, the wife's high (potential) wage lies behind the outcome.

3 The empirical model

We specify employment and wage equations for husbands and wives within the same household. The advantage of this approach is that wages are estimated simultaneously with employment outcomes. This model does not impose any a priori restrictions on spouses' behaviour. It is consistent with the unitary approach but also with a collective model of household behaviour. In addition to this, we are able to include in the model individuals for whom wages are not observed (see model full specification in the Appendix). For each household, we model the employment and the wage rate of husband and wife and their correlations. We include random effects in the employment and wage equations. These represent unobserved individual heterogeneity, such as, for example, unobserved preferences and characteristics. This specification allows us to estimate the probability that the wife outearns her husband in dual-earner households. We can also make inferences about persistence in labour market and wages outcomes.

Let d_{jit} denote the labour market status of spouse $j = m, f$, where m stands for husbands and f for wives, and $i = 1, ..., N$ denotes the couple, and $t = 1, ..., T$ time. Let $d_{jit} = 1$ if the individual is employed, $d_{jit} = 0$ otherwise. Labour-market status is explained by observable characteristics $z_{jit}, j = m, f$, an unobserved random effect $\alpha_{ji}, j = m, f$, and an idiosyncratic error, $\epsilon_{jit}, j = m, f$:

$$\begin{aligned} &d^*_{jit} = \gamma_j \prime z_{jit} + \alpha_{ji} + \epsilon_{jit}, j = m, f, t = 1, ..., T, i = 1, ..., N \\ &d_{jit} = \iota(d^*_{jit} > 0) \end{aligned} \tag{11}$$

Wage rates, w_{jit}, depend on observed characteristics x_{jit}, a random effect, ω_{ji}, and an idiosyncratic error, $u_{jit}, j = m, f$:

$$\ln w_{jit} = \eta_j' x_{jit} + \omega_{ji} + u_{jit}, \tag{12}$$

with j = m,f, t = 1,...,T, and i = 1,..., N.

We assume that the random effects of the employment and wage equations are identically and independently normally distributed across households. We allow for correlation between the wage and employment statuses of each pair of spouses:

$$\begin{pmatrix} \alpha_i \\ \omega_i \end{pmatrix} \equiv \begin{pmatrix} \alpha_{mi} \\ \alpha_{fi} \\ \omega_{mi} \\ \omega_{fi} \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2_{m,\alpha} & \sigma_{mf,\alpha} & \sigma_{m,\alpha\omega} & \sigma_{mf,\alpha\omega} \\ \sigma_{mf,\alpha} & \sigma^2_{f\alpha} & \sigma_{fm,\alpha\omega} & \sigma_{f,\alpha\omega} \\ \sigma_{m,\alpha\omega} & \sigma_{fm,\alpha\omega} & \sigma^2_{m,\omega} & \sigma_{mf,\omega} \\ \sigma_{mf,\alpha\omega} & \sigma_{f,\alpha\omega} & \sigma_{mf,\omega} & \sigma^2_{f,\omega} \end{pmatrix} \right) \tag{13}$$

Similar assumptions are made for the idiosyncratic errors:

$$\begin{pmatrix} \epsilon_{it} \\ u_{it} \end{pmatrix} \equiv \begin{pmatrix} \epsilon_{m,it} \\ \epsilon_{f,it} \\ u_{m,it} \\ u_{f,it} \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \sigma_{mf,\epsilon} & \sigma_{m,\epsilon u} & \sigma_{mf,\epsilon u} \\ \sigma_{mf,\epsilon} & 1 & \sigma_{fm,\epsilon u} & \sigma_{f,\epsilon u} \\ \sigma_{m,\epsilon u} & \sigma_{fm,\epsilon u} & \tau^2_m & \tau_{mf} \\ \sigma_{mf,\epsilon u} & \sigma_{f,\epsilon u} & \tau_{mf} & \tau^2_f \end{pmatrix} \right) \tag{14}$$

To construct the likelihood function, we determine the joint probability of the observed labour market statuses of the household members in each year and the joint density of their wage rates. The likelihood contributions for different observations are given in Appendix A.

4 The French labour force surveys

The analysis sample is drawn from the French Labor Force Surveys (LFS) from 1990 to 2002. We cannot extend our analysis to more recent years, as the LFS series was broken in 2003 to comply with the harmonization requirements of the European Union statistical offices.[8] The LFS surveys up to year 2002 had a rotating-sample structure which enables us to construct a longitudinal sample. Around 60,000 households were interviewed in the March of each year, with a third of the sample being replaced each year. All household members were interviewed, and interviews were carried out in the respondents' household. For our analysis, we select a sample of individuals with the following characteristics:

[8] The new LFS series started in 2003. It is now carried out on a continuous-time basis instead of once a year for the older series. Further, the questionnaire has been modified substantially and the questions on employment status are not directly comparable to those from the older surveys.

- they reported that they were the household head or the spouse of the head;

- they were aged between 16 and 54;

- they were not doing their military service;

- and they were not self-employed.

The self-employed were dropped from the sample as no earnings were recorded for them. The sample cut at 55 is designed to exclude households with (early) retirees.

The records for husbands and wives within the same household were then matched to each other. We include both married and unmarried couples in the sample. Records for which either the husband or the wife were not interviewed were dropped. Records for which the partner changed over time were dropped, although these represented only very few observations, about 70 in all. The final sample consisted of roughly 23,000 couples for each of the years considered. Observations relating to the different years were pooled together over time to construct the analysis sample, which contains only couples.

Labour market status is self-reported. The non-employed include the unemployed and other inactive individuals, such as 'housewives'. The survey collects information on current monthly wage, measured at the time of the survey. Wages are gross of (before) income tax but net of (after) employers' and employees' social security contributions. Information on usual hours of work, asked at the time of the survey, is used to construct hourly wage rates. Wages lower than half of the minimum (hourly) wage were set to missing. Earnings information is only collected for salaried workers. No information is collected on non-labour income in the survey.

We construct a series of completed-education dummies. These increase in education level, with level 1 corresponding to at most the compulsory education level. The omitted category is the highest education level, a university or higher degree. The survey also collects information on the individual's two-digit socio-economic and professional category. We construct a series of variables which account for any positive relationship between the socio-economic characteristics of the spouses as follows:

- a dummy which equals one if the two spouses enjoy the same level of completed education, and zero otherwise;

- an interaction variable of the above dummy for the same education with an individual dummy for low-education; this new variable is, then, equal to one when both spouses are low-educated and zero otherwise;

- a dummy which equals one if the two spouses belong to the same socio-economic and professional category, and zero otherwise;

- a dummy which equals one if the husband is more than five years older than his wife, and zero otherwise; and

- a dummy which equals one if the wife is more than five years older than her husband, and zero otherwise.

These last two dummies pick up larger than average spousal age differences: the mean age difference between spouses is two years with a standard deviation of around three years. Positive assortative mating is likely to be associated with smaller age differences.

We also construct cohort dummies, as follows:

- the first cohort includes the generations born after 1964;

- the second cohort consists of individuals born between 1955 and 1964;

- and the reference group consists of individuals born before 1955.

Finally, we account for the number of children and the presence of children aged under three. Almost 100% of children aged three and older are at (kindergarten) school in France. This is available to everyone and free of charge, and so is not rationed.

Local labour market conditions are captured by the region of residence and size of area of residence dummies. Small cities include rural neighbourhoods or urban neighbourhoods with less than 20,000 inhabitants; large cities are those with more than 200,000 inhabitants; Paris stands on its own. The reference group is medium-size cities with populations of 20,000 to 200,000 inhabitants.

5 Descriptive analysis for different types of households

We distinguish households according to the spouses' labour market status and their wage, as follows:

- husband-sole-earner or 'male-breadwinner' households;

- wife-sole-earner or 'female-breadwinner' households;[9]

- dual-earners;

- dual-earners with the wife outearning her husband;

- out-of-work spouses, where the state of being 'out-of-work' includes all non-employment states, including unemployment and inactivity.

Table 1 shows the evolution of these different types of households over time. The proportion of husband-sole-earners (conventionally, male-breadwinner households) has declined over time, falling from 35% in 1990 to 25% in 2002. Male-breadwinner households account for an important share of the population. They represented about a quarter of all households in 2002. However, the majority of households are dual-earners. The proportion of dual-earners increased over the period considered by 9 percentage points, from 58% in 1990 to 67% in 2002. The proportion of women outearning their husbands increased by three percentage points over the period considered, according to the comparison of spouses' gross[10] hourly (monthly, W) wages, w. In 2002, women outearned their husbands in almost one out of every five dual-earner households. In the same year, women outearned their husbands in more than one out of every ten households in the population.[11]

Descriptive statistics are provided for the full sample in Table 2. Table 2 also shows descriptive statistics for dual-earners and for households where both spouses are out of work. Table 3 provides descriptive statistics for male-breadwinner and female-breadwinner households. Table 4 focuses on dual-earners, split up into 'conventional' dual-earner households - where the husband earns more than his wife - and 'wife-outearning' households - where the wife earns at least the same wage as her husband. Here, earnings are defined as gross monthly earnings, before

[9] In some of the earlier literature, and in other parts of our paper, the term 'female breadwinners' includes, more loosely, any household with the wife as the main earner.

[10] Wages are gross of (before) income tax but net of (after) employers' and employees' social security contributions.

[11] Women outearned their husbands in about 12% (10%) of the population of households considered, according to hourly (monthly) wages. In particular, about 67% (80%) of women who outearned their husbands on the basis of observed hourly (monthly) wages, also did so according to monthly (hourly) wages.

tax, and without adjusting for hours of work. Table 5 shows the summary statistics of the distribution of gross monthly earnings of husbands and wives in different types of households.

Men in 'conventional' dual-earners households - where the husband earns more than the wife - have higher average gross earnings than male breadwinners.[12] Men in 'unconventional' dual-earner households, who are outearned by their wives, have lower average gross earnings than the average over the full sample, while their outearning wives earn, on average, much more than do other wives in the population. 'Outearning' wives have a similar earnings distribution to 'outearning' men in the sample (see Table 5).

The average age difference between spouses in the sample is about two years (see Table 2). Men in wife-outearning households are on average one year younger than men in other household types (see Table 4). Husbands are more likely to be much older than their wife (more than five years older) in 'sole-worker' households (19-21% of husbands are in this situation, see Table 3) and when both spouses are out of work (28%) than in dual-earner households (13%, see Table 2). Younger cohorts of men, born after 1964, are over-represented in female-breadwinner couples and wife-outearning dual-earners (24% and 27% respectively, against 22% for the full sample). Younger cohorts of women are more likely to be found amongst both-out-of-work spouses (34%, against 29% for the full sample). Because wives are, on average, younger than their husbands, we find relatively more women in the younger cohort. Dual-earner spouses are more likely to belong to the same socio-occupational category (12% of 'conventional' dual-earners and 16% of 'unconventional' ones are in this situation) than are spouses in male-breadwinner households (2%). Women outearning their husbands are more likely to be higher educated. Marriage is more frequent for male-breadwinner households (84%) and 'conventional' dual-earners (80%) than for wife-outearning couples (74%) or female-breadwinners (68%). The average number of children in the household is two for both-out-of-work spouses and male-breadwinner households. It is a little over one in wife-outearning households. The proportion of children under three is also highest among out-of-work spouses and male-breadwinner couples.

Female-breadwinner and wife-outearning households are more likely to live in inner Paris (19% and 17%, respectively) than are male-breadwinner couples (12%) and couples where both spouses are out of work (12%). 'Conventional' dual-earners are somewhere in the middle, with

[12] Although taxation may partly cancel these differences out.

15% of them living in inner Paris. Concerning nationality, it is striking that just above 70% of spouses are French when both are out of work, against over 90% for dual-earner and 87% for male-breadwinner households. Further, in both-out-of-work, female-breadwinner and wife-outearning households, husbands are on average about 3 percentage points less likely to be French than their wife.

6 Results of estimation: marginal effects of the covariates on the probabilities of 'female breadwinnership'

According to our theoretical predictions, households where the wife is the main earner may come about either because the husband has a weaker preference for work than his wife, due possibly to her high (potential) wage, or because he is hit by adverse circumstances, such as, for example, a decline in the demand for men with his particular qualifications. Estimates of the effect of husbands' and wives' education on the probability of observing a female-breadwinner household may help us to distinguish between these competing hypotheses. Higher levels of education may proxy for higher wages as well as better employment opportunities. Equally, lower education may capture lower wages and, possibly, poorer employment opportunities. In addition, we include year dummies to measure other year-specific effects, using 1990 as the reference year.[13] Further, wife-sole-earner households could be quite distinct from dual-earner households where the wife outearns her husband. To capture the impact of demand side factors on employment, we also include gender-specific unemployment rates. Finally, we expect positive assortative mating to be positively correlated with dual earnership, but we can not a priori characterize its correlation to wife-outearning dual-earners or wife-sole-earner households.

The estimation results for the coefficients γ_m and γ_f in the employment equations (equation 11) are given in Table A, in the Appendix, together with the estimates of the coefficients in the wage equations (equation 12)in Table B. The regressors of the wage equation include experience, which is measured by the number of years since completion of education. Since the age of completion varies with the level of education, we also include cross effects of education and experience. The impact of the covariates on the employment probabilities and the wages of husbands and wives follow standard patterns. Table C provides the estimates of the parameters

[13] We have normalized 1991 and 1992 to zero.

of the covariance matrices in (13) and (14). For ease of interpretation, we have reparametrized the covariance matrices in terms of correlation coefficients[14]. Most of the estimated correlation coefficients are significantly different from zero. In particular, the estimate of $\rho_{f,\alpha\omega}$ is quite large, indicating a strong and persistent correlation between the wage rate and the labour market status of wives.

The empirical model fits well the data according to the predicted probabilities. These were computed for each household type and averaged over time (see Table 6). They are very close to the actual probabilities that were shown in the last line of Table 1. The model slightly overpredicts the probability of observing wife-outearning dual-earners. The predicted probability is 0.26 while the observed probability is 0.20.

Therefore, we go ahead and use the estimation results of the model, shown in the Appendix, to derive the marginal effects of the covariates on the probabilities of the occurrence of 'female-breadwinners' households. These marginal estimates are shown in Table 7 for different household types with respect to spouses' labour market status and wages[15].

The second column of Table 7 relates to households where the wife is the sole worker.[16] The probability of observing this type of household increases with the wife's education level but falls with the husband's education level. The latter effect is greater, in absolute value, than the first. On average, if the husband has the lowest education level -compulsory education or less- the probability that the wife be the sole worker increases by 6% points. This probability increases further, by 4% points, if both spouses are low-educated, having completed at most compulsory education. On the contrary, the marginal effect of the variable for spouses enjoying the same (above compulsory schooling) education is negative. Similarly, belonging to the same socio-economic profession negatively affects this probability. These results indicate that couples where the wife is the sole worker are very likely to occur when husbands are low-educated, and even more if both spouses are low-educated.

[14] For instance, for the employment equation, the correlation coefficient of unobservables over time is equal to $\sigma^2_{\alpha,j}/(\sigma^2_{\alpha,j}+1), j = m, f$. This equals 0.23 for husbands and 0.63 for wives. In the wage equation, the correlation in unobservables is given by $\sigma^2_{\omega,j}/(\sigma^2_{\omega,j}+\tau^2_j), j = m, f$, which equals 0.80 for husbands and 0.86 for wives.

[15] To compute the marginal probabilities, the covariates of continuous and count variables were set equal to their sample means. To compute the marginal effects of age (experience) we increased the sample mean of age (experience) by one year. Dummy variables have been set at their reference values, so the marginal effects show deviations from the reference category.

[16] The probability that the wife be the sole worker in the household equals $P(d_m = 0, d_f = 1)$.

The age of either husband or wife does not have a large influence and cohorts effects are also quite small. But the larger the age difference between the spouses, the stronger the probability. This reinforce the findings that this probability is negatively associated with positive assortative mating.

The gender-specific unemployment rates do not have a significant impact on the probability that the wife be the sole earner. In particular, the marginal effect of male unemployment rate is positive but not significant. Finally, the largest marginal effects are those relating the husband's nationality, with French nationality having a negative impact, and marital status, with being unmarried having a positive impact.

For reference purposes, we show in the third column of Table 7 the probability of observing a male-breadwinner household. It can be seen that, analogously, this falls the higher the education level of the wife.

We next consider the marginal impact of the covariates on the probability of observing a 'wife-outearning' dual-earner household[17], which is shown in the final column of table 7. Spouses' education levels strongly affect this probability, but in opposite directions. The wife's higher education increases the probability, while the husband's higher education reduces it. The coefficients on the education dummies suggest that it is unlikely for women to outearn their husband if the husband is high educated[18]. On the other hand, if spouses enjoy the same level of education, above compulsory schooling, the probability increases, while it falls if both spouses have at most compulsory education. Belonging to the same socio-economic profession positively affects this probability. Larger age differences reduce this probability -we have assumed that smaller age differences proxy for positive assortative mating. Therefore, this last set of results suggests that this probability is positively associated with positive assortative mating of spouses. Being French increases it, and especially so if the husband is French. The unemployment rate of the husband is not significant.

For reference purposes, we also show in the fourth column of Table 7 the unconditional

[17] The probability that the wife outearns her husband equals $P(d_m = 1, d_w = 1, w_f > w_m)$. The empirical specification allows for the joint probability of satisfying (i) $(d_m, d_f) = (1, 1)$ and (ii) $w_f > w_m$ (conditions (i) and (ii) in section 2.0.2).

[18] Higher education of women increases not only the probability of observing dual-earners but also her potential wage. Higher education of the husband increases the probability of observing dual-earners but decreases the chances that she outearns him. For husbands, the marginal effect of going from education level 6 (university degree, which is the reference category) to the lower education level 5 is 0.201.

probability of observing dual-earners. This increases strongly with the education levels of both husband and wife. A large age difference between husband and wife has a strongly negative impact. Households where the wife belongs to the oldest cohort are less likely to be dual-earners. Being married, not having French nationality, the number of children, and the presence of young children all decrease the probability of observing dual-earners. A higher unemployment rate of the husband (wife) increases (decreases) the probability of observing dual-earners. The negative effect of the wife's unemployment rate is larger, in absolute value, implying that if gender-specific unemployment rates increase by the same percentage, there will be fewer dual-earners.

Tu sum up, our findings suggest that, generally, higher-educated women are more likely to be the main earner. The determinants of wife-sole-earner households are quite distinct from those for dual-earner households where the wife outearns her husband. The probability of observing the first seems to be more related to labour market difficulties of the husband, while the latter is not. In particular, wife-sole-earner are strongly correlated with low education level of husbands. Instead, wife-outearning dual-earners are more likely to be found among higher educated couples, and especially, among couple where the wife's education level is high. We also conclude that positive assortative mating of spouses significantly increases the probability that the wife outearns her husband while it reduces wife-sole-earnership. Last, spouses' unobservable characteristics and the correlation between them over time suggest considerable persistence in behaviour.

7 Conclusions

The aim of this paper is to shed light on the determinants of households where the wife is the main earner. These represent about one of every six couple households in France over the period considered, including wife-sole-earner households. The proportion of wives outearning their husbands was 18% for dual-earners. About 24% of American women in dual-earner households earned more than their husband in 2004. This figure is about the same for Canada.

The economic literature on households where the wife is the main earner is particularly scant. We have set out the theoretical framework for the analysis, showing that these households may come about either because the husband has a weaker preference for work than his wife or

because he is hit by adverse circumstances, such as, for example, a decline in the demand for men with his particular qualifications. Further, we expect positive assortative mating to be positively correlated with dual earnership, but one cannot a priori characterize its correlation to households where she is the main earner.

We have specified an empirical model whereby wages are estimated simultaneously with employment outcomes for husband and wife within each household, and we have included random effects. Spouses for whom wages were not observed are included in this model. This model does not impose any a priori restrictions on spouses' behaviour. It is consistent with the unitary approach but also with a collective model of household behaviour. The model was estimated using data drawn from the French Labour Force Surveys over 1990-2002, which have a rotating-panel structure. Our sample is made up of about three hundred thousand households.

We conclude that, generally, higher-educated women are more likely to be the main earner. The determinants of wife-sole-earner households are quite distinct from those for dual-earner households where the wife outearns her husband. The probability of observing the first seems to be more related to labour market difficulties of the husband, while the latter is not. In particular, couples where the wife is the sole worker are more likely to occur when husbands are low-educated, and even more so if both spouses are low-educated. Instead, dual-earners where she outearns him are more likely to be found among higher educated couples, and especially, among couple where her education level is high. We find that positive assortative mating of spouses significantly increases the probability that the wife outearns her husband but it reduces the likelihood of wife-sole-earnership. Last, spouses' unobservable characteristics and the correlation between them over time suggest considerable persistence in behaviour.

Because of the increasing education of women, we may expect 'female breadwinners' to become more common in the future.

References

Apps. P. (2006), Family taxation: an unfair and inefficient system, mimeo.

Apps, P. and Rees, R. (2005), Gender, Time Use and Public Policy over the life cycle, IZA Working Paper No. 1855, November.

Apps, P. F. and Rees, R. (1997), Collective Labor Supply and Household Production, Journal of Political Economy, Vol. 105, pp. 178-190.

Apps, P. F. and Rees, R. (1996), Labor Supply, Household Production and Intra-Family Welfare Distribution, Journal of Public Economics, Vol. 60, pp. 199-209.

Bloemen, Hans G. (2004), An Empirical Model of Collective Household Labour Supply with Nonparticipation, Tinbergen Institute Discussion Papers 04-010/3

Börsch-Supan, A. and V. Hajivassiliou (1993), Smooth unbiased multivariate probability simulators for maximum likelihood estimation of limited dependent variable models, Journal of Econometrics, Vol. 58, no. 3, pp.347-368.

Bourguignon, F. and Magnac, T. (1990), Labour Supply and Taxation in France, Journal of Human Resources, Vol. 25, No. 3, pp. 358-389.

Bureau of Labor (2004), Women in the Labor Force: a databook (report 973), Washington DC, Bureau of Labor Statistics, US Department of Labor.

Drago, R., Black, D. and Wooden, M. (2004), Female breadwinner families: their existence, persistence and sources, IZA, Discussion Paper No. 1308, September.

Eissa, N. and Williamson Hoynes, H. (2004), Taxes and the labour market participation of married couples: the earned income tax credit, Journal of Public Economics, Vol. 88, pp. 1931-1958.

Minetor, R. (2006), Breadwinner wives and the men they marry: how to have a successful marriage while out-earning your husband, New Horizon Press Publisher.

Pappenheim, H. And Graves, G. (2005), Bringing home the bacon: making marriage work when she makes more money, Harper Collins publishers, New York.

Pencavel, J. (1998), Assortative Mating by Schooling and the Work Behavior of Wives and Husbands, American Economic Review, Vol. 88, No. 2, pp. 326-329.

Van Soest, A. (1995), Structural models of family labor supply: a discrete choice approach, Journal of Human Resources, Vol. 30, No. 1, pp. 63-88.

Sussman, D. abd Bonnell S. (2006), "Ces femmes qui sont le principal soutien de famille", Statistique Canada, Perspective, No. 75-001-XIF, pp.10-18.

Stancanelli, E. (2007), Marriage and work: an analysis for French couples in the last decade, OFCE working paper No 10, 2007.

Stancanelli, E. (2008), Evaluating the impact of the French tax credit on the employment rate of women, Journal of Public Economics, forthcoming.

Winkler, A. E. (1998), "Earnings of husbands and wives in dual-earner families", Monthly Labor Review, Vol. 121, No. 4, April, pp. 42-48.

A Likelihood contributions

The model equations (11) and (12) and the distributional assumptions (13) and (14) are used to construct the likelihood contributions for the different types of observations.

Consider a household i with both spouses employed in year t, $(d_{mit} = 1, d_{fit} = 1)$, and where wages, respectively, w_{mit} and w_{fit}, are observed for both spouses. Unobserved characteristics are denoted by $(\alpha_i, \omega_i)'$. We first construct the probability that both spouses are employed, conditional on the unobservables $(\alpha_i, \omega_i)'$

We define the covariance matrix of the idiosyncratic errors (14) as:

$$\begin{pmatrix} \Sigma_\epsilon & \Sigma_{\epsilon u}\prime \\ \Sigma_{\epsilon u} & \Sigma_u \end{pmatrix} \equiv \begin{pmatrix} 1 & \sigma_{mf,\epsilon} & \sigma_{m,\epsilon u} & \sigma_{mf,\epsilon u} \\ \sigma_{mf,\epsilon} & 1 & \sigma_{fm,\epsilon u} & \sigma_{f,\epsilon u} \\ \sigma_{m,\epsilon u} & \sigma_{fm,\epsilon u} & \tau_m^2 & \tau_{mf} \\ \sigma_{mf,\epsilon u} & \sigma_{f,\epsilon u} & \tau_{mf} & \tau_f^2 \end{pmatrix} \tag{15}$$

We assume that the density distribution of the idiosyncratic errors of the employment equation, $\epsilon_{mit} = (\epsilon_{mit}, \epsilon_{fit})'$, conditional on the errors $u_{it} = (u_{mit}, u_{fit})'$ of the wage equation, is normal:

$$\epsilon_{it}|u_{it} \sim N(\Sigma'_{\epsilon u}\Sigma_u^{-1}u_{it}, \Sigma_\epsilon - \Sigma'_{\epsilon u}\Sigma_u^{-1}\Sigma_{\epsilon u}) \tag{16}$$

$$\Sigma_{\epsilon|u} := \Sigma_\epsilon - \Sigma'_{\epsilon u}\Sigma_u^{-1}\Sigma_{\epsilon u} := \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix} \text{ and } \begin{pmatrix} \mu_1(u_{it}) \\ \mu_2(u_{it}) \end{pmatrix} = \Sigma'_{\epsilon u}\Sigma_u^{-1}u_{it} \tag{17}$$

We write $P(d_{m,it} = 1, d_{f,it} = 1|w_{m,it}, w_{f,it}, \alpha_i, \omega_i)$.

The employment probability of spouse j (see equation (11)) is as follows:

$$d_{jit} = 1 \text{ if } d^*_{jit} = \gamma'_j z_{jit} + \alpha_{ji} + \epsilon_{jit} > 0 \text{ or } \epsilon_{jit} > -\gamma'_j z_{jit} - \alpha_{ji} \tag{18}$$

Given (18), (16) and (17), we can write:

$$P(d_{m,it} = 1, d_{f,it} = 1|w_{m,it}, w_{f,it}, \alpha_i, \omega_i) =$$

$$\int_{-(z'_{fit}\gamma_f + \mu_2(u_{it}) + \alpha_{fi})/\sigma_2}^{\infty} \Phi\left(\frac{z'_{mit}\gamma_m + \alpha_{mi} + \mu_1(u_{it}) + \frac{\sigma_{12}}{\sigma_2}\nu}{\sqrt{\sigma_1^2 - \frac{\sigma_{12}^2}{\sigma_2^2}}} \right) \frac{1}{\sqrt{2\pi}} \exp\left\{ -\frac{1}{2}\nu^2 \right\} d\nu \tag{19}$$

with

$$u_{jit} = \ln w_{jit} - \eta'_j x_{jit} - \omega_{ji}, j = m, f$$

The joint density of wages, conditional on $(\alpha_i, \omega_i)'$ is then:

$$f(w_{mit}, w_{fit}|\omega_i, \alpha_i) = \frac{1}{w_{mit}, w_{fit} 2\pi|\Sigma_u|^{1/2}} \exp\{-\frac{1}{2}(\ln w_{it} - \eta' x_{it} - \omega_i)'\Sigma_u^{-1}(\ln w_{it} - \eta' x_{it} - \omega_i)\} \tag{20}$$

with $\eta' x_{it} \equiv (\eta'_m x_{mit}, \eta'_f x_{fit})'$ and $\ln w_{it} \equiv (\ln w_{mit}, \ln w_{fit})'$. Finally, let $l_{it}(\alpha_i, \omega_i)$ be the joint probability density of this household with $(d_{mit} = 1, d_{fit} = 1, w_{mit}, w_{fit})$:

$$l_{it}(\alpha_i, \omega_i) = P(d_{mit} = 1, d_{fit} = 1 | w_{mit}, w_{fit}, \alpha_i, \omega_i) \times f(w_{mit}, w_{fit} | \omega_i, \alpha_i) \tag{21}$$

Second, we consider households in which we observe the employment status of the spouses, but not the wage rate (for either one or both spouses). This occurs if either monthly earnings or usual hours of work are missing. The wage rate is also set to missing if it is less than half of the mimimum wage (see the data section). Take first the case of dual-earners, $(d_{mit} = 1, d_{fit} = 1, w_{fit})$, where we do not observe the husband's wage rate. From (14) we know the joint distribution of the idiosyncratic errors of the employment equation and the error of the wife's wage equation:

$$\begin{pmatrix} \epsilon_{m,it} \\ \epsilon_{f,it} \\ u_{f,it} \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \sigma_{mf,\epsilon} & \sigma_{mf,\epsilon u} \\ \sigma_{mf,\epsilon} & 1 & \sigma_{f,\epsilon u} \\ \sigma_{mf,\epsilon u} & \sigma_{f,\epsilon u} & \tau_f^2 \end{pmatrix} \right) \tag{22}$$

The conditional density of ϵ_{it} on u_{fit} is normal

$$\begin{pmatrix} \epsilon_{mit} \\ \epsilon_{fit} \end{pmatrix} | u_{fit} \sim N\left(\begin{pmatrix} \mu_1(u_{it}) \\ \mu_2(u_{it}) \end{pmatrix}, \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix} \right) \tag{23}$$

with

$$\begin{aligned} \mu_1(u_{it}) &= \tfrac{\sigma_{mf,\epsilon u}}{\tau_f^2} u_{fit} \\ \mu_2(u_{it}) &= \tfrac{\sigma_{f,\epsilon u}}{\tau_f^2} u_{fit} \\ \sigma_1^2 &= 1 - \tfrac{\sigma_{mf,\epsilon u}^2}{\tau_f^2} \\ \sigma_{12} &= \sigma_{mf,\epsilon u} - \tfrac{\sigma_{mf,\epsilon u}\sigma_{f,\epsilon u}}{\tau_f^2} \\ \sigma_2^2 &= 1 - \tfrac{\sigma_{f,\epsilon u}^2}{\tau_f^2} \end{aligned} \tag{24}$$

We can then compute $P(d_{mit} = 1, d_{fit} = 1 | w_{fit}, \alpha_i, \omega_i)$ as in expression (19), but applying the conditional means and variances specified in the block (24). The complete likelihood contribution, $l(\alpha_{it}, \omega_{it})'$ for this household in year t, is obtained by multiplying this probability by the marginal density of the wife's wage, conditional on the unobservables.

Similarly, we can construct the likelihood contribution of dual-earner households where the

wife's wage is missing. The relevant conditional means and variances are:

$$\begin{aligned}
\mu_1(u_{it}) &= \tfrac{\sigma_{m,\epsilon u}}{\tau_m^2} u_{mit} \\
\mu_2(u_{it}) &= \tfrac{\sigma_{fm,\epsilon u}}{\tau_m^2} u_{fit} \\
\sigma_1^2 &= 1 - \tfrac{\sigma_{m,\epsilon u}^2}{\tau_m^2} \\
\sigma_{12} &= \sigma_{mf,\epsilon u} - \tfrac{\sigma_{fm,\epsilon u}\sigma_{m,\epsilon u}}{\tau_m^2} \\
\sigma_2^2 &= 1 - \tfrac{\sigma_{fm,\epsilon u}^2}{\tau_m^2}
\end{aligned} \tag{25}$$

For dual-earner households with missing wages for both spouses, we write:

$$P(d_{m,it} = 1, d_{f,it} = 1 | \alpha_i, \omega_i) =$$

$$\int_{-(z'_{fit}\gamma_f + \alpha_{fi})}^{\infty} \Phi\left(\frac{z'_{mit}\gamma_m + \alpha_{mi} + \sigma_{mf,\epsilon}\nu}{\sqrt{1 - \sigma_{mf,\epsilon}^2}} \right) \frac{1}{\sqrt{2\pi}} \exp\left\{ -\frac{1}{2}\nu^2 \right\} d\nu \tag{26}$$

Third, we construct the likelihood contribution of wife-sole-earner households when we observe the wage:

$$P(d_{m,it} = 0, d_{f,it} = 1 | w_{f,it}, \alpha_i, \omega_i) =$$

$$\int_{-(z'_{fit}\gamma_f + \mu_2(u_{it}) + \alpha_{fi})/\sigma_2}^{\infty} \left[1 - \Phi\left(\frac{z'_{mit}\gamma_m + \alpha_{mi} + \mu_1(u_{it}) + \frac{\sigma_{12}}{\sigma_2}\nu}{\sqrt{\sigma_1^2 - \frac{\sigma_{12}^2}{\sigma_2^2}}} \right) \right] \frac{1}{\sqrt{2\pi}} \exp\left\{ -\frac{1}{2}\nu^2 \right\} d\nu \tag{27}$$

with the conditional means and variances defined as in block (24). The likelihood contribution for this household in year t, conditional on the random effects, $l_{it}(\alpha_i, \omega_i)$, is obtained by multiplying this probability by the marginal distribution of the wife's wage.

If information on the wife's wage, w_{fit}, is missing, we write

$$P(d_{m,it} = 0, d_{f,it} = 1 | \alpha_i) =$$

$$\int_{-(z'_{fit}\gamma_f + \alpha_{fi})}^{\infty} \left[1 - \Phi\left(\frac{z'_{mit}\gamma_m + \alpha_{mi} + \sigma_{mf,\epsilon}\nu}{\sqrt{1 - \sigma_{mf,\epsilon}^2}} \right) \right] \frac{1}{\sqrt{2\pi}} \exp\left\{ -\frac{1}{2}\nu^2 \right\} d\nu \tag{28}$$

Fourth, the likelihood contribution of a male-breadwinner household with observed wages can be written as:

$$P(d_{m,it} = 1, d_{f,it} = 0 | w_{m,it}, \alpha_i, \omega_i) =$$

$$\int_{-\infty}^{-(z'_{fit}\gamma_f + \mu_2(u_{it}) + \alpha_{fi})/\sigma_2} \Phi\left(\frac{z'_{mit}\gamma_m + \alpha_{mi} + \mu_1(u_{it}) + \frac{\sigma_{12}}{\sigma_2}\nu}{\sqrt{\sigma_1^2 - \frac{\sigma_{12}^2}{\sigma_2^2}}} \right) \frac{1}{\sqrt{2\pi}} \exp\left\{ -\frac{1}{2}\nu^2 \right\} d\nu \tag{29}$$

where the conditional means and variances are defined by (25). The likelihood contribution, $l_{it}(\alpha_i, \omega_i)$ for this household in year t, conditional on random effects, is obtained by multiplying this probability by the marginal distribution of the husband's wage.

If the husband's wage is not observed, the likelihood contribution is:

$$P(d_{m,it}=1, d_{f,it}=0|\alpha_i) =$$

$$\int_{-\infty}^{-(z'_{fit}\gamma_f+\alpha_{fi})} \Phi\left(\frac{z'_{mit}\gamma_m+\alpha_{mi}+\sigma_{mf,\epsilon}\nu}{\sqrt{1-\sigma^2_{mf,\epsilon}}}\right)\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\nu^2\right\}d\nu \tag{30}$$

Finally, we look at the case of spouses who are both out of work. Their likelihood contribution is determined as follows:

$$P(d_{m,it}=0, d_{f,it}=0|\alpha_i) =$$

$$\int_{-\infty}^{-(z'_{fit}\gamma_f+\alpha_{fi})} \left[1-\Phi\left(\frac{z'_{mit}\gamma_m+\alpha_{mi}+\sigma_{mf,\epsilon}\nu}{\sqrt{1-\sigma^2_{mf,\epsilon}}}\right)\right]\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\nu^2\right\}d\nu \tag{31}$$

Having constructed the likelihood contributions for different types of households in a given year, conditional on the random effects (α_i, ω_i), $l_{it}(\alpha_i, \omega_i)$, we now see how these change when the household is observed for more than one year. Households stay in the sample for at most three years. If either spouse does not answer the survey, the household is dropped from the sample. If one of the spouses changes over time, then the household is also dropped (see the data section for more details). Take a household i that is observed from year T_{i1} to year T_{i2}. Its likelihood contribution, conditional on random effects, is

$$l_i(\alpha_i, \omega_i) = \prod_{t=T_{i1}}^{T_{i2}} l_{it}(\alpha_i, \omega_i) \tag{32}$$

Finally, we complete the likelihood function by integrating over the random effects. Let $f(\alpha_i, \omega_i)$ denote the joint normal density of the random effects (see expression (13)). The complete likelihood contribution for household i is then:

$$l_i = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} l_i(\alpha_i, \omega_i) f(\alpha_i, \omega_i) d\alpha_i d\omega_i \tag{33}$$

where both α_i and ω_i have dimension 2. It follows that the computation of the likelihood contributions requires up to five-dimensional integration, depending on the type of household observed. We use the method of simulated maximum likelihood (SML) to estimate the model, replacing integration by simulation (see Börsch-Supan and Hajivassiliou, 1993). We use 20 replications for each observation to simulate the integrals.

Table 1: The evolution of household types

Years	a) Male breadw.	b) Female breadw.	c) Dual earners	d) Both out-of-work	e) Wf>Wm(*)	f) wf>wm(**)
1990	0.35	0.03	0.58	0.04	0.15	0.18
1991	0.33	0.03	0.60	0.04	0.14	0.17
1992	0.32	0.03	0.60	0.04	0.15	0.18
1993	0.31	0.05	0.59	0.05	0.17	0.20
1994	0.31	0.05	0.59	0.05	0.18	0.22
1995	0.30	0.04	0.61	0.04	0.18	0.22
1996	0.30	0.04	0.61	0.04	0.16	0.18
1997	0.30	0.04	0.61	0.04	0.17	0.21
1998	0.29	0.04	0.62	0.04	0.16	0.20
1999	0.28	0.04	0.63	0.04	0.16	0.19
2000	0.27	0.04	0.64	0.04	0.18	0.21
2001	0.26	0.03	0.66	0.04	0.18	0.21
2002	0.25	0.04	0.67	0.04	0.18	0.21
90-02	0.30	0.04	0.62	0.04	0.17	0.20

These are unweighted sample figures.

Male (female) breadwinners are defined as husband(wife)-sole-earner couples.

(*) Households with Wf>Wm are a subsample of dual-earners;

W stands for monthly before-tax wages;

(**) Households with wf>wm are a subsample of dual-earners;

w stands for hourly before-tax wages.

For each line, a) + b) + c) + d) sums to one.

Table 2: Summary Statistics: dual-earners and out-of-work couples

Variable	Sample N =306571		Dual-earners N = 189506		Both out of work N = 13150	
	Mean	St Dev	Mean	St Dev	Mean	St Dev
F Age	37.11	8.26	37.33	8.15	36.36	9.02
M Age	39.29	8.24	39.27	8.18	39.60	8.99
M is >5 years older	0.16	0.37	0.13	0.34	0.28	0.45
F is >5 years older	0.03	0.16	0.03	0.16	0.04	0.21
F Education level 1(lowest)	0.31	0.46	0.23	0.42	0.65	0.48
F Education level 2	0.09	0.28	0.09	0.28	0.07	0.25
F Education level 3	0.27	0.44	0.28	0.45	0.17	0.38
F Education level 4	0.135	0.34	0.16	0.36	0.06	0.24
F Education level 5	0.12	0.32	0.15	0.36	0.03	0.17
M Education level 1(lowest)	0.28	0.45	0.23	0.42	0.58	0.49
M Education level 2	0.07	0.25	0.07	0.25	0.05	0.22
M Education level 3	0.36	0.48	0.37	0.48	0.25	0.43
M Education level 4	0.11	0.31	0.12	0.32	0.05	0.22
M Education level 5	0.08	0.28	0.10	0.30	0.03	0.17
Married	0.80	0.40	0.79	0.41	0.72	0.45
Number of children	1.56	1.21	1.35	1.03	2.07	1.71
Children, age <3	0.16	0.37	0.12	0.33	0.24	0.73
Ile de France	0.17	0.38	0.18	0.39	0.13	0.34
Paris	0.14	0.35	0.16	0.36	0.12	0.32
F French nationality	0.91	0.28	0.95	0.22	0.74	0.44
M French nationality	0.90	0.30	0.94	0.24	0.71	0.45
Same socio-economic class	0.09	0.28	0.12	0.32	0.24	0.43
Same education level	0.41	0.48	0.39	0.49	0.58	0.49
F cohort born after 1964	0.29	0.45	0.28	0.45	0.34	0.47
M cohort born after 1964	0.22	0.41	0.22	0.41	0.23	0.42
F cohort born 1955-1964	0.38	0.48	0.38	0.49	0.34	0.47
M cohort born 1955-1964	0.36	0.48	0.36	0.48	0.32	0.47
F Monthly gross W, Euros	1062	967	1062	927		
M Monthly gross W, Euros	1506	1219	1512	1132		

These are unweighted figures, averaged over the thirteen-year period 1990-2002.

Current wages are averaged only over positive values. They are measured in Euros

Table 3: Summary Statistics: male and female breadwinners

Variable	Male breadwinners $N = 91600$		Female breadwinners $N = 12315$	
	Mean	Std Dev	Mean	Std Dev
F Age	36.76	8.28	37.10	8.70
M Age	39.29	8.15	39.49	8.98
M is > 5 years older	0.19	0.39	0.21	0.40
F is > 5 years older	0.03	0.16	0.04	0.20
F Education level 1 (lowest)	0.43	0.49	0.34	0.47
F Education level 2	0.09	0.29	0.09	0.28
F Education level 3	0.26	0.44	0.26	0.44
F Education level 4	0.10	0.31	0.12	0.33
F Education level 5	0.06	0.24	0.11	0.32
M Education level 1 (lowest)	0.34	0.47	0.39	0.49
M Education level 2	0.06	0.24	0.07	0.25
M Education level 3	0.35	0.48	0.32	0.47
M Education level 4	0.09	0.29	0.09	0.29
M Education level 5	0.06	0.25	0.06	0.24
Married	0.84	0.37	0.68	0.46
Number of children	1.97	1.34	1.27	1.16
Children, age < 3	0.23	0.42	0.12	0.32
Ile de France	0.14	0.35	0.21	0.41
Paris	0.12	0.32	0.19	0.39
F French nationality	0.87	0.34	0.88	0.33
M French nationality	0.87	0.34	0.83	0.37
Same socio-economic class	0.02	0.15	0.06	0.25
Same education level	0.43	0.49	0.41	0.49
F cohort born after 1964	0.30	0.46	0.30	0.46
M cohort born after 1964	0.20	0.40	0.24	0.42
F cohort born 1955-1964	0.38	0.48	0.35	0.48
M cohort born 1955-1964	0.37	0.48	0.32	0.47
F Monthly gross W, Euros			975	1423
M Monthly gross W, Euros	1494	1383		

These are unweighted figures, averaged over the thirteen-year period 1990-2002.
Male (female) breadwinners are defined as husband(wife)-sole-earner couples.
Current wages are averaged only over positive values and measured in Euros.

Table 4: Summary Statistics: dual-earners by outearning relationship

Variable	Dual-earners, Wm>Wf $N = 116720$		Dual-earners, Wm≤Wf $N =35662$	
	Mean	Std Dev	Mean	Std Dev
F Age	37.09	8.15	36.93	8.16
M Age	39.21	8.12	38.22	8.36
M is > 5 years older	0.14	0.35	0.11	0.31
F is > 5 years older	0.02	0.15	0.04	0.20
F Education level 1 (lowest)	0.26	0.44	0.13	0.33
F Education level 2	0.09	0.29	0.07	0.26
F Education level 3	0.30	0.46	0.24	0.43
F Education level 4	0.15	0.36	0.17	0.38
F Education level 5	0.13	0.33	0.23	0.42
M Education level 1 (lowest)	0.23	0.42	0.24	0.43
M Education level 2	0.07	0.25	0.07	0.26
M Education level 3	0.37	0.48	0.38	0.48
M Education level 4	0.12	0.32	0.12	0.32
M Education level 5	0.10	0.30	0.10	0.29
Married	0.80	0.40	0.74	0.44
Number of children	1.39	1.04	1.19	0.98
Children, age < 3	0.12	0.33	0.14	0.35
Ile de France	0.18	0.38	0.20	0.40
Paris	0.15	0.36	0.17	0.38
F French nationality	0.94	0.24	0.96	0.19
M French nationality	0.93	0.25	0.94	0.24
Same socio-economic class	0.11	0.31	0.16	0.37
Same education level	0.40	0.49	0.35	0.48
F cohort born after 1964	0.28	0.45	0.31	0.46
M cohort born after 1964	0.21	0.40	0.27	0.44
F cohort born 1955-1964	0.38	0.49	0.38	0.49
M cohort born 1955-1964	0.36	0.48	0.37	0.48
F Monthly gross W, Euros	927	555	1534	1661
M Monthly gross W, Euros	1615	1227	1155	496

These are unweighted sample figures, averaged over the thirteen-year period 1990-2002.
Current wages are averaged only over positive values. They are measured in Euros.

Table 5: Sample distribution of gross monthly earnings

Variable	Dual earn. Wm>Wf $N =116720$	Dual earn. Wm≤Wf $N = 31572$	Male breadw. $N = 75022$	Female breadw. $N = 1110$
Q1 F (25%)	610	1118		610
Median F (50%)	885	1372		893
Q3 F (75%)	1159	1692		1212
Mean F	927	1534		975
Standard deviation F	555	1661		1422
Q1 M (25%)	1112	915	978	
Median M (50%)	1387	1082	1220	
Q3 M (75%)	1829	1334	1651	
Mean M	1615	1155	1493	
Standard deviation M	1227	496	1383	

These are unweighted sample figures, averaged over the thirteen-year period 1990-2002.
Current wages are averaged only over positive values. They are measured in Euros.

Table 6: Fitted probabilities (averaged over all observations)

Both out of work	0.037
Only wife works	0.043
Only husband works	0.32
Dual-earners	0.60
Dual-earners $wf > wm$	0.26

Table 7: Marginal effects on the probability of employment

	Both out of work	Only wife works	Only husband works	Dual earners	joint prob dual earn. $w_f > w_m$
Education and socio-economic status (reference: education level 6)					
Education level 1, wife	0.020	-0.020	0.221	-0.221	-0.314
Education level 2, wife	0.011	-0.011	0.113	-0.113	-0.302
Education level 3, wife	0.009	-0.009	0.090	-0.090	-0.301
Education level 4, wife	0.005	-0.005	0.047	-0.047	-0.262
Education level 5, wife	0.0003	-0.0003	0.003	-0.003	-0.167
Education level 1, husband	0.011	0.062	-0.011	-0.062	0.408
Education level 2, husband	0.007	0.037	-0.007	-0.037	0.364
Education level 3, husband	0.006	0.035	-0.006	-0.035	0.397
Education level 4, husband	0.003	0.016	-0.003	-0.016	0.308
Education level 5, husband	0.002	0.008	-0.002	-0.008	0.201
Spouses same education level	-0.001	-0.006	0.007	-0.0002/	0.002
Same educ. lev * low education	0.007	0.040	-0.006	-0.041	-0.015
Same socio-economic category	-0.009	-0.014	-0.069	0.092	0.012
Age and cohort effects (age + 1 year, reference cohort: 1965+)					
Age of wife	-0.0001	0.0001	-0.001	0.001	0.0001
Age of husband	0.0001	0.001	-0.0001	-0.001	-0.0002
Husband older by >5 years	0.006	0.021	0.011	-0.038	-0.010
Wife older by >3 years	0.006	0.019	0.012	-0.036	-0.009
Husband's cohort post-1964	-0.0002/	-0.001	0.0002/	0.001 /	0.001
Husband's cohort 1955-1964	-0.001	-0.004	0.001	0.004	0.001
Wife's cohort post-1964	0.002	-0.002	0.020	-0.020	-0.002
Wife's cohort 1955-1964	-0.0001/	0.0001/	-0.001 /	0.001 /	0.0001/
Family characteristics (reference, married, no children under 3)					
Cohabiting couple	0.008	0.048	-0.009	-0.047	-0.018
Number of children	0.003	-0.004	0.035	-0.035	-0.004
Any children under 3	0.008	-0.003	0.072	-0.077	-0.010
Nationality and community (reference: non-French)					
French nationality husband	-0.007	-0.035	0.007	0.035	0.013
French nationality wife	-0.004	0.004	-0.035	0.035	0.003
Small community	-0.003	-0.012	-0.004	0.019	0.005
Unemployment rates (+ 1 percentage point)					
Unemployment rate men	-0.004	0.005 /	-0.038	0.037	0.003 /
Unemployment rate women	0.008	0.005 /	0.050	-0.063	-0.010

All effects are significant at the 5% level, except
* = significant at the 10% level, and / = p-value greater than 0.10
Marginal effects are computed with reference to deviations from sample means.

Table A: Employment Equations

variable	Husbands		Wives	
	Coefficient estimate	Standard error	Coefficient estimate	Standard error
Intercept	-8.201	0.980	-13.714	0.827
Ln age	6.312	0.504	9.548	0.431
Square of ln age	-0.885	0.070	-1.290	0.061
Education level 1 (lowest)	-0.463	0.015	-1.334	0.014
Education level 2	-0.303	0.017	-0.789	0.014
Education level 3	-0.291	0.013	-0.655	0.012
Education level 4	-0.142	0.016	-0.374	0.013
Education level 5	-0.079	0.017	-0.029	0.013
Cohabiting couple	-0.373	0.008	0.004	0.008
Number of children	0.001	0.003	-0.289	0.003
Any children under 3	-0.044	0.010	-0.549	0.009
Champagne Ardenne	-0.049	0.019	-0.418	0.016
Haute Normandie	-0.128	0.017	-0.330	0.016
Basse Normandie	-0.094	0.021	-0.101	0.018
Picardie	-0.107	0.017	-0.364	0.016
Centre	0.010	0.018	-0.160	0.016
Bourgogne	0.003	0.019	-0.239	0.017
Calais	-0.257	0.013	-0.555	0.012
Lorraine	0.029	0.019	-0.378	0.015
Alsace	0.124	0.020	-0.205	0.016
Franche Comte	0.139	0.020	-0.255	0.017
Loire	-0.019	0.017	-0.137	0.014
Bretagne	-0.086	0.017	-0.210	0.015
Poitou Charente	-0.116	0.019	-0.259	0.017
Aquitaine	-0.118	0.017	-0.388	0.014
Midi Pyrenees	-0.123	0.019	-0.294	0.016
Limousin	0.044	0.022	-0.124	0.020
Rhones Alpes	0.013	0.013	-0.261	0.012
Auvergne	-0.007	0.021	-0.353	0.018
Languedoc Roussillon	-0.414	0.017	-0.635	0.017
Provence	-0.288	0.013	-0.617	0.013
French nationality	0.496	0.009	0.369	0.009
Small community	0.136	0.007	0.061	0.006

Table A: Employment Equations (ctd.)

variable	Husbands		Wives	
	Coefficient estimate	Standard error	Coefficient estimate	Standard error
Spouses same education level	0.061	0.009	-0.054	0.007
Same socio-economic class	0.225	0.009	0.973	0.008
Same educ. lev * low education	-0.324	0.014	-0.013	0.012
Husband older by >5 years	-0.200	0.008	-0.138	0.008
Wife older by >3 years	-0.184	0.011	-0.137	0.010
Unemployment rate men	-0.008	0.045	0.409	0.039
Unemployment rate women	-0.102	0.054	-0.416	0.048
1993	-0.017	0.051	-0.348	0.045
1994	0.035	0.070	-0.532	0.062
1995	0.065	0.046	-0.213	0.041
1996	0.140	0.059	-0.319	0.052
1997	0.102	0.072	-0.549	0.063
1998	0.089	0.059	-0.407	0.052
1999	0.008	0.067	-0.547	0.058
2000	-0.109	0.071	-0.487	0.063
2001	-0.176	0.075	-0.381	0.066
2002	-0.297	0.133	-0.867	0.118
Cohort born after 1964	0.013	0.020	-0.173	0.018
Cohort born 1955-1964	0.039	0.012	0.012	0.011

Table B: Wage Equations

variable	Husbands		Wives	
	Coefficient estimate	Standard error	Coefficient estimate	Standard error
Intercept	-2.968	0.006	-3.076	0.006
Ln (1+exp)	0.013	0.006	-0.011	0.005
Square of ln (1+exp)	0.046	0.001	0.047	0.001
Education level 1 (lowest)	-0.668	0.022	-0.655	0.009
Education level 2	-0.443	0.037	-0.392	0.023
Education level 3	-0.716	0.015	-0.516	0.013
Education level 4	-0.314	0.014	-0.447	0.012
Education level 5	-0.408	0.013	-0.226	0.010
Education level 1xln(1+exp)	0.061	0.016	0.015	0.007
Education level 2xln(1+exp)	-0.126	0.026	-0.202	0.017
Education level 3xln(1+exp)	0.111	0.011	-0.091	0.010
Education level 4xln(1+exp)	-0.159	0.011	-0.091	0.010
Education level 5xln(1+exp)	0.074	0.011	-0.064	0.009
Education level 1xln(1+exp)^2	-0.031	0.003	-0.034	0.002
Education level 2xln(1+exp)^2	0.027	0.004	0.029	0.003
Education level 3xln(1+exp)^2	-0.029	0.002	0.006	0.002
Education level 4xln(1+exp)^2	0.039	0.002	0.023	0.002
Education level 5xln(1+exp)^2	-0.009	0.002	0.016	0.002
Ile de France	0.128	0.001	0.144	0.001
1991	0.024	0.002	0.008	0.002
1992	0.077	0.002	0.073	0.002
1993	0.097	0.002	0.096	0.002
1994	0.088	0.002	0.091	0.002
1995	0.100	0.002	0.105	0.002
1996	0.106	0.002	0.081	0.002
1997	0.113	0.002	0.120	0.002
1998	0.127	0.002	0.131	0.002
1999	0.132	0.002	0.139	0.002
2000	0.167	0.002	0.167	0.002
2001	0.173	0.002	0.165	0.002
2002	0.221	0.002	0.214	0.002

Table C: Parameter estimates of the covariance matrices

Parameter	Parameter estimate	Standard error
The covariance matrix of the idiosyncratic errors		
$\sigma_{mf,\epsilon}$ (labour market status spouses)	-0.016	0.005
$\sigma_{m,\epsilon u}$ (lab. market status and wage rate husband)	-0.035	0.019
$\sigma_{mf,\epsilon u}$ (lab. market status husb, wage rate wife)	-0.011	0.005
$\sigma_{fm,\epsilon u}$ (lab. market status wife, wage rate husband)	-0.025	0.003
$\sigma_{f,\epsilon u}$ (lab. market status and wage rate wife)	-0.069	0.009
τ_m (std dev. wage rate husband)	0.149	0.000
τ_{mf} (cov. wage rates husband and wife)	0.323	0.001
τ_f (std dev. wage rate wife)	0.134	0.000
The covariance matrix of the random effects		
$\sigma_{m,\alpha}$ (std. dev. random effect lab. market status husband)	0.540	0.005
$\rho_{mf,\alpha}$ (corr. labour market status husband and wife)	0.427	0.003
$\rho_{m,\alpha\omega}$ (labour market status and wage rate husband)	0.161	0.001
$\rho_{mf,\alpha\omega}$ (labour market status husband, wage rate wife)	0.266	0.001
$\sigma_{f,\alpha}$ (std. dev. random effect lab. market status wife)	1.305	0.005
$\rho_{fm,\alpha\omega}$ (labour market status wife, wage rate husband)	-0.033	0.001
$\rho_{f,\alpha\omega}$ (labour market status and wage rate wife)	0.965	0.001
$\sigma_{\omega,m}$ (std. dev. random effect wage rate husband)	0.298	0.000
$\rho_{\omega,mf}$ (corr. random effects wage rate husband and wife)	0.121	0.001
$\sigma_{\omega,f}$ (std. dev. random effect wage rate wife)	0.338	0.000