A model of female breadwinnership: is she outearning him?

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Abstract

This paper investigates the determinants of female breadwinners households, defined as households where the wife is the sole or the main earner. The economic literature has so far neglected this issue. The existing economic models of household behaviour do not directly encompass the situation of female breadwinners households. Husbands will be likely to opt for participating in the labour market at almost hundred per cent, while the same may not be true for their wives. A female breadwinner household may come about either because the husband has a lower preference for work than his wife or because he is hit by adverse circumstances, for example a decline in the demand for men with his qualification or a lay off. Positive assortative mating coupled with lesser labour market discrimination of women may also play a role. Policies that discourage secondary earners participation like, for example, joint taxation and tax credits, could possibly reinforce spouses' inequality of labour market participation and earning, where husbands

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would be affected by these distortions in the cases under study here. We find that in France in 2002 in one almost every five households, out of the population of couples were both spouses are aged less than fifty-five, the wife was the sole or the main earner. It is our aim to model the occurrence of female breadwinners households. We also specify an econometric model that allows for separate labour market participation equations of the two spouses, where earnings are endogenized. We use data drawn from the French Labour Force Surveys of years 1990 to 2002 to try and disentangle the impact of macro-economic trends, the situation of the local labour market, spouses' characteristics and unobservables on the occurrence of female breadwinnership. We conclude that situations were the wife is the sole earner are quite distinct from the case of higher-earnings wives and, in particular, they are more likely to be associated with lower education level of husbands. Wife higher-earnings dual-earners households are significantly associated with higher education levels of wives. Spouses' unobservables and their correlations contribute significantly to explain the occurrence of female breadwinnership.

1 Introduction

About 24% of American dual-earners wives earned more than their husband in 2004 (Bureau of Labor, 2004). The proportion of female breadwinners was quite remarkable in Australia at about the same time(Drago et al., 2004). Stancanelli (2007) finds similar trends for France in her descriptive study of the situation of French spouses in the labour market. According to our estimates, the proportion of wives earning more than their husband was 14% of the population of French couples in 2002, while that wifes sole-earner was about 4%. We found that the proportion of male-breadwinner couples, where he works and she is out of work, had gone down from 35% in 1990 to 25% in 2002.

The economic literature on female breadwinners is very scant. There is huge literature on lone parents but, to our knowledge, no economic paper deals with the situation of female breadwinners. This is the more worrying that existing models of household behaviour do not appear to extand easily to the case of female breadwinners. In particular, in the most frequent case, husbands will be likely to opt for participating in the labour market at almost hundred per cent, while the same may not be true for their wives. A female breadwinner household may come about either because the husband has a lower preference for work than his wife or because he is hit by adverse circumstances, for example a decline in the demand for men with his qualification or a lay off. These issues are not dealt with by current models of household labour market situations. We model household decisions both in the unitary and the alternative set up, where each spouse has a separate utility function, allowing for the occurrence of a female breadwinner household. We refer generally to "female breadwinners" as couple households where the wife is the sole or the main earner. Situations of wives working while their husband is out of work would typically correspond to the case of a wife sole-earner; while wives earning higher income from work than their husband in dual-earners couples define situations where the wife is the main earner.

Only non-economists have looked into the situation of female breadwinners, to our knwoledge. In the United States, two popular best-sellers investigate the occurrence of

female breadwinners. Minetor (2002), a female-breadwinner herself, carries out a series of interviews with a number of American female breadwinners and their husbands, suggesting that sometimes female-breadwinner households are just due to the hazard but other times they come out from a deliberate choice of the two spouses to let the wife make her career first. Some of the husbands interviewed are stay home men, happy to care for their children, but some of them are unhappy and unemployed struggling to find a job. The author draws her sample by contacting some associations of female managers and career women. A similar methodological approach based on a series of interviews with female breadwinners and their husbands is taken by Pappenheim and Graves (2005), that do, however, draw their sample just using personal contacts and words of mouth. The female breawinners pictured in the book are often top career women whose husbands business failed. Both books find a high deal of stress and conflict between spouses in the female-breadwinner households interviewed, arising partly from the lack of recognition by society of the existence of households like theirs, while the stereotype remains that of men being the sole or the main earner. Some of the households interviewed do not like to talk about their situation with neighbours and relatives. Unhappy female breadwinners feel resentful to their husbands for not taken a conventional male breadwinner role and unhappy husbands feel demotivated to search for work. The happiest female-breadwinners couple look like those where female breadwinnership was chosen by the spouses.

The subject of female breadwinnership has been brought up by psichologists and sociologists. Drago et al. (2004) look at the existence and persistence of situations of female breadwinnership in Australia, using data drawn from a panel dataset. The authors conclude that when the wives earning dominance arises from economic factors, husbands tend to have low socio-economic status, a poor labour market position and low family committments; when it is associated with gender equity principles of spouses, spouses characteristics are more often positive. Brennan et al. (2001) draw a "representative" sample of female breadwinners couples to investigate the impact of earnings dominance on the quality of spouses' marital role. They conclude that there is no impact of changes in wifes earnings on marital role quality, but they find that the reverse is true for men.

However, their sample is quite small and response rate my not be independent of marriage quality.

From the point of view of economists, the policy implications of female breadwinnership may be more relevant than the happiness of spouses. Most OECD countries have developped policies to increase the participation rates of women in an attempt to limit the size of pension burden and to deal with aging population issues. While single women have similar labour market participation rates than men, married women have much lower participation rates in all OECD countries. Considerable attention has been paid to design new policies that may encourage work by married women and to remove obstacles to the labour market participation of "mothers". The litterature shows, for example, that joint taxation and tax credits discourage labour market participation of secondary earners (Apps, 2006, Apps and Rees, 2005, Stancanelli, 2007), where husbands would be affected by these distortions in the cases under study here. Individual taxation of spouses has been introduced in a number of OECD countries, but not yet France.

Now, take the case of France, according to our estimates, the proportion of married women employed has gone up from 61% in 1990 to 71% in 2002[1]. If we distinguish dual-earners couples from households where only the wife works, the proportion of the last did not vary much over this lapse of time, representing about 3-4% of the population considered, while the proportion of dual-earners increased by nine percentage points. The proportion of higher-earnings wives increased among dual-earners, passing from 16% of this population in 1990 to 21% in 2002. Pencavel (1998) relates the increasing education rates of American women to the increase in the number of dual earners couples. The same factor may contribute to explain the increase in the proportion of wives earnings more than their husbands. If all distortions to labour market participation of (married) women were removed, the proportion of female breadwinners may increase, which may perhaps further increase the overall participation rate of women.

Policy makers should also be concerned with the possible poverty risk faced by households where women are the sole earner. When this type of situation arises from adverse

[1] Our population is made of couples were both spouses are aged less than fifty-five. Stancanelli (2007) finds similar patterns looking at the population of couples aged up to 65.

circumstances that hit the husband rather than from a common decision, (low-educated) female breadwinners may not bring enough income home to satisfy the needs of their household. If female breadwinnership situations have a negative impact on husbands' psychological well-being, which could be especially true for low-educated or more traditional couples, this could lead to difficult situations, possible violent, and in any case tend to reduce husbands' search intensity and work probability. Policies targeted at publicizing the occurrence of female breadwinnership situations as "non-exceptional" cases may help turn down the stress from these couples.

From the economist point of view, given the size the phenomenon takes, it would be important to make sure that the prevailing economic models of household behaviour encompass the situation of female breadwinners. It is the aim of our paper to put forward a simple model of household behaviour that allows for the occurrence of female-breadwinner households, defined as households where the wife is the sole or the main earner. To test for the impact of different factors, such as macro-economic trends, the situation of the local labour market, spouses' characteristics and unobservables, on the occurrence of female breadwinnership, we specify an econometric model of spouses labour market decisions, whereby we model jointly the employment states of the two spouses and their earnings, allowing for random effects and for correlations of spouses unobservables. Our sample is made of 300,000 French couples drawn from the French Labour Force Surveys of years 1990 to 2002. The large size of the sample enables us to observe enough households of each type of female breadwinners: we observe 12,000 couples where the wife is the sole earner and 35,000 where she is the main earner. We exploit the rotating structure of the survey, one third of the sample is replaced each year -so that a couple can stay in the sample for at most three years- to construct an unbalanced panel.

The structure of the paper is the following. First, the data at hand are described. Next, descriptive analysis of couples characteristics and labour market behaviour is provided. In the following section, the theoretical model is layed out. The econometric model is spelled out next. Results of estimation of the model are then presented. The last section concludes the paper.

2 The French labour force surveys

The sample for analysis is drawn from the French Labor Force Surveys of years 1990 to 2002. We cannot extend our analysis to later years, as the LFS series was broken in 2003 to comply with harmonization requirements of the European Union statistical offices. The new LFS series of 2003 and later years is carried out on a continuous time basis and the structure of the questionnaire has been substantially modified. In particular, questions concerning employment and unemployment have been modified substantially. The LFS surveys up to year 2002 had a rotating sample structure which enables one to construct a longitudinal sample. Around 60,000 households were interviewed each year in March, with a third of the sample being replaced each year. All household members were interviewed and interviewes were carried out at house of the respondents -while the majority of interviews are carried out by telephone in the new LFS series, which has lowered the quality of the new survey.

For our analysis, we first select from each survey year a sample of individuals with the following characteristics:

- they reported to be household heads or spouse of the head;
- they were aged between 16 and 54;
- they were not doing their military service;
- they were not self-employed.

Records for which either the husband or the wife was not in the survey were dropped from the sample. We define here husband and wife as the partners, without distinguishing for whether they are married or not. Records for husband and wife were linked, giving a final sample of roughly 23,000 couples for each of the years considered. Observations relating to the different years were pooled together over time to construct our final sample for analysis, which contains only couples. Records for which the partner changed over time where dropped, but these were only a few obervations, about 70 for the all period considered.

Labour market states are defined using the (subjective) answers to the relative questions. Labour market participants include employed and unemployed people. Non-participants are students, retirees and other inactive persons. We have information in the dataset on the social class of husband and wife. Two alternative definitions of social class have been used here: the narrower one is based on a two-digit classification of the social class of the respondents; the broader one relies on a one-digit classification. The relevant survey question is given in the Annex to the paper, in the original French language. Educational level variables are increasing in education level, level 6 corresponding to at most compulsory education. The basis for the education dummies is the highest level, equal to university or higher degrees. The survey collects information on monthly gross wage at the time the survey was run. Earnings information is only collected for salaried workers. No information is collected on non-labour income. We have constructed a variable giving the number of dependent children living at home and a dummy for the presence of any small children of less than three years old in the household. Almost 100% of children aged three and older are at (maternal) school in France. This is available to everyone and free of charge, so not rationed. Local labour market conditions are captured by the region of residence and the size of the 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. The base for these dummies are medium size cities with a population of 20,000 to 200,000 inhabitants.

We also construct a series of variables to account for class endogamy of spouses, defined as the positive association between socio-economic characteristics of the two spouses. These were:

- a dummy for whether the two spouses had the same level of completed education;
- the interaction of the dummy for low-education level with the dummy for the same education level, ie both spouses are low-educated;
- a dummy for whether the two spouses belong to the same socio-economic category, at two digit level (see list of categories in the Annex) ;

- a dummy for whether the husband is much older than his wife, equal to one if he is over 5 years older;

- a dummy for whether the wife is much older than her husband, equal to one if she is over 5 years older;

The age difference dummies are suppose to proxy the fact that endogamous spouses will have low age difference. The average age difference between the two spouses is 2 years.

3 A model of spouses employment states and earnings

3.1 Household labour supply: theoretical background

We characterize four household types:

- male breadwinner couples, where he works and she is out of work

- female breadwinner couples, where she works and he is out of work

- dual earners

- couples out of work

Earnings are brought in to complete the model, by singling out two further outcomes:

- dual earners with the husband as main earner

- dual earners with wives outearning their husbands

Our focus is on female breadwinner couples, and dual earners with the wife outearning her husband. These types of households emerge as the outcome of a family labour supply decision. The observed household types are the outcome of the labour supply decision of couples.

The standard family labour supply model treats the family as a single decision-making unit, with a family utility function defined over family consumption, and the amounts of

leisure of man and woman in the household. The budget constraint sets the consumption level equal to the sum of the earnings of the household members and the household's nonlabour income. The maximization of the utility function results in labour supply functions for husbands and wives that depend on hourly wage rates and household's nonlabour income. Heterogeneity in preferences and household characteristics may affect labour supply outcomes. This model has been critized and adapted in many directions. The collective approach (Chiappori, 1988) models the labour supply of individuals as the equilibrium outcome of a Pareto efficient bargaining process. Wage rates not only enter the family budget constraint but may also affect the relative bargaining power of household members through their influence on the Pareto weights. In a survey article Apps (2003) emphasizes the importance of household production and time use data. Time use data do not simply pool all non-market time into the category "leisure" but distinguish alternative time uses that may add to household production. If household production is incorporated in the family labour supply model, alternative sources of heterogeneity in the outcomes of labour supply are revealed, as different households may be differently productive in household production. As a consequence, wage rates may affect labour supply outcomes differently across households and household members.

Let us first look at female breadwinners couples where he is out of work. There can be several factors that add to the probability of observing this type of household. The main factors are (i) workers' characteristics, (ii) (relative) wage rates of household members, (iii) the added worker effect. A husband with a high marginal utility of leisure will stay home more likely. The same holds if his marginal productivity in producing home-made goods is high. Next, if the wage of the wife is so high that she can support the needs of the family alone, the husband may stay home. This situation may happen if a highly educated woman forms a couple with a lower educated man. The added worker effect can be an alternative explanation for observing a female breadwinner. If the husband has lost his job, the wife may enter the labour market to compensate for the loss of household income. However, this situation is likely to be of a temporary nature, and ends if the husband finds a job. In the empirical application we will consider a measure for the persistence of the observed labour market state of spouses.

To study dual earners where wives outearn their husbands we consider their respective earnings. Some of these wives may be highly educated: a higher wage will result in a higher price of leisure and a higher marginal cost of household production. However, lower educated families where an added worker effect may apply can also be found among households of this type.

3.2 An illustrative model

In the section we present a basic economic model that characterizes the female breadwinner household types that are the subject of this empirical study. The overview in the previous subsection has already shown that there are many delicate issues in modelling the joint labour market behaviour of male and female partners within a household. However, all models of family labour supply contain the trade-off between income out of labour on the one hand and the merits of non-work time on the other. This trade-off is the key in the decision of household members to work. In our model we do not consider bargaining processes between household members. We also do not explicitly deal with household production. The data for our empirical study only allow us to distinguish between work time and non-work time, while non-work time is the residual of work time and cannot be refined to alternative uses. But whenever we talk about the 'value of non-work time' it is clear this implicitly may include time spend on household production, and need not be pure enjoyment of leisure.

The subject of our study are households in which either the wife is the only person employed, or dual earners where she earns more than he. Therefore, the empirical model in the next section describes employment status, and in this section we will set up an economic model in which employment status is the choice variable of the household members.

3.2.1 A model with household utility

The model is as follows:

1. Employment opportunities

   The choice set of household members is determined by employment opportunities,

governed 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. If there is a job opportunity, an employment opportunity for the husband is available with probability $p_m = P(e_m = 1)$. For the wife we denote the employment opportunity by e_f which occurs with probability p_f.

2. The household's objective function

   We denote the labour market status of household member j by $d_j, j = m, f$, with $d_j = 1$ if household member j is working, $d_j = 0$ otherwise. We indicate household consumption by C. In the model we do not explicitly consider private consumption goods for individual household members. On one hand, this would not provide any additional insight into the phenomenon we are studying. On the other hand, the LFS do not contain information on consumption.[2] We assume that the household has an objective function that depends on the labour market states d_m and d_f, and on household consumption C. The objective function is:

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

   The function (1) may be interpreted as a household utility function, like in a unitary model. Alternatively, it may be interpreted as a household welfare function, a Pareto weighted average of the utility functions of individual household members. It may also be feasible to assume a cooperative framework, in which the sum of individual utility functions is being maximized. In the next subsection, we present an alternative model based on separate utility functions of household members and a noncooperative setting. However, the specification (1) is suitable for illustrating the trade-off between wage income and the value of non-work time. We do not explicitly incorporate the choice of working hours in the model. The utility function can depend on taste shifters that influence the valuation of non-work time. Moreover, the utility function may depend on random variables. Here we supress

[2] Distinguishing private consumption goods is important in intrahousehold bargaining models.

any notation for taste shifters or random effects, but the characteristics in the empirical model for employment, presented in the next section, may be interpreted as such.

3. Properties of the household objective function

   We assume that the objective function has the following properties:

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

   According to conditions (2), other things being equal, non-work time is preferred over work time.

   The marginal utility of consumption is positive:

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

   Next, we assume that the utility gain of non-work time compared to work time is larger 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 comparable to having a diminishing marginal rate of substitution between non-work time and consumption.

4. The household budget constraint

   We denote the (potential) labour income of household member j by $w_j, j = m, f$. Thus, we get the following household budget constraint:

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

   We could have added non-labour income, but the data we use do not contain non-labour income anyhow, so we do not include it explicitly in our notation.[3] In the empirical analysis we will consider alternative specifications: a specifcation with $w_j, j = m, f$ equal to earnings, and a specification with wage rates.

[3] Our empirical model allows for the presence of unobserved random effects.

5. Mazimization

   The household members set d_m and $d_f \in \{0, 1\}$ such that the objective function (1) is maximized subject to the budget constraint (6).

We will use now the model to characterize the household types that are the subject of this study. First, we consider households in which both husband and wife are working, but she earns more than him. To observe this type of household, two conditions must be met: (i). $(d_m, d_f) = (1, 1)$ is the outcome of the choice process; (ii). $w_f > w_m$. It is clear that the second condition is very much influenced by the earnings potentials of the household members, which are explained outside the model. It can be the result of investments in human capital, experience, and differences in the industrial sector where the spouses have their employment opportunities. In the empirical model, this second condition will be modelled by wage equations. The first condition, being dual earners, is the outcome of the model presented here. Being dual earners can be influenced by the second condition. For the empirical specification this implies that our model must be able to specify the joint probability of satisfying the two conditions (i) and (ii), but, more than this, it allows to decompose this joint probability into the probability that condition (ii) applies, and the conditional probability that (i) applies, conditional on (ii). The probability of satisfying condition (i), conditional on (ii), then, can be interpreted as probability of the outcome under investigation.

A necessary condition for the outcome $(d_m, d_f) = (1, 1)$ is that both household members have employment opportunities: $(e_m, e_f) = 1$. Thus, demand side factors will influence the outcome. In our empirical specification, we include gender specific time dependent unemployment rates as well as annual GDP to capture demand side influences. Given the job oppportunities available, the household members both have to choose for being employed. This happens 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 shows a trade-off between the value of the labour income w_m if the husband works and the value of non-work time. We can also write it 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 of non-work time, compared to work time, which is positive according to (2). The right hand side is the utility gain due to a higher consumption level as a results of the labour income w_m, which is positive, according to (3). Therefore, (8) shows that the utility gain due to a higher available income to the household is larger than the utility gain due to non-work time: earnings to the husband are relatively high compared to the value of non-work time.

The same holds for the wife, as described by the second condition in (10): her earnings must be high relative to the value of work time. Now, it would be too simplistic to characterize dual earners as high wage individuals. Conditions (4) and (5) indicate that the value of non-work time is higher if the consumption level of the household is higher. This means that if, say, the husband has a high wage income, the value of leisure of the wife increases, which decreases her incentives to work; but her wage income could be so high that it continues to exceed the value of non-work time. Other mechanisms may also be at work. One could think, in particular, of assortative positive mating, which might imply that people with similar preferences for work tend to form couples. In the empirical model, we allow for correlation in unobserved characteristics, and we also include some observed variables for individuals that belong to the same class or education group. In this model we do not deal with bargaining issues, but if the state of employment and the fact that someone who brings in his or her own labour income has a better bargaining position within the household, this can be an additional incentive to work, even if the spouse has a high labour income.

The second household type are households in which the wife is the sole earner. The husband does not work. The model shows different underlying explanations for observing this household type. First, the husband may not have a job opportunity: $e_m = 0$. He is out of work by restriction, and not by choice. The wife chooses to work, which implies:

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

This case shows some equivalence with what is known as the 'added worker effect'. The value of non-work time can be low to the wife, according to (5), as the husband does not bring in income to the household. Thus, wife may choose to work, even if her wage is not very high.

Next, it may be that the husband does have a job opportunity ($e_m = 1$), but the observed outcome is the result of choice. Here we have

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

The wife working leads to a higher utility than the cases in which both are working, he is working, and none of them is working. This may happen if the wife's earnings are very high, increasing the valuation of leisure of the husband, the husband's earnings are low, relative to his valuation of leisure.

So we have two alternative explanations for having a female breadwinner: the first is female breadwinnership out of poverty, while the second is likely to happen with a high-potential-earnings wife. A good indicator for the latter is the level of education. In the empirical analysis, if a high education level has a large positive effect on observing a household with a female breadwinner, the second explanation is likely to be more important. If, on the contrary, a low education level of the husband (implying poor employment opportunities) influences the probability of observing a female breadwinner, this first explanation is likely to be more important. Note that here it is important to separate the outcome of the empirical model into two steps: effect of education on wages and effect of education on employment. The effect of education on wages runs through the wage equation, whereas conditional on wages, there can be an effect on employment.

3.2.2 A noncooperative model variant

So far we have illustrated the household types in the context of a model with an objective function for the household as a whole. However, similar trade-offs between non-work time and labour income are present in a noncooperative framework based on individual utility functions. We assume that household member $j, j = m, f$ has utility function

$U_j(d_m, d_f, C)$. Each individual utility function may depend on the labour market status of the other spouse, as this can influence the valuation of the own non-work time. Again we abstain from private goods. The budget constraint remains as in (6).

In order to observe a dual earner family where she earns more than he does, the model must generate a Nash equilibrium $(d_m, d_f) = (1, 1)$ with payoffs $(U_m(1, 1, w_m + w_f), U_f(1, 1, w_m + w_f))$. For this outcome to be a Nash equilibrium the following conditions need be satisfied:

$$\begin{aligned} U_m(1, 1, w_m + w_f) &> U_m(0, 1, w_f) \\ U_f(1, 1, w_m + w_f) &> U_f(1, 0, w_m) \end{aligned} \tag{11}$$

In other words, if the other partner works, the best response is to work as well. Again, this implies that the value of the wage income exceeds the valuation of non-work time, for each individual separately. The conditions (11) do not guarantee the uniqueness of the equilibrium. A sufficient condition for uniqueness is that the choice of employment is the dominant strategy for at least one the spouses. If employment is the dominant strategy for the husband, we add

$$U_m(1, 0, w_m) > U_m(0, 0, 0) \tag{12}$$

Alternatively, if working is the dominant strategy for the wife, we have

$$U_f(0, 1, w_f) > U_f(0, 0, 0) \tag{13}$$

An implication of this uniqueness condition is that households in which both spouses are out of work are so by the lack of employment opportunities, and never by choice. Since we observe many husbands working, even when the wife is a high wage worker (see also the outcomes of the empirical model), it is more likely that working is a dominant strategy for men.

Observing a household with a sole female breadwinner, again, can be the result of her husband lacking job opportunities. For the wife to be working, we need to have:

$$U_f(0, 1, w_f) > U_f(0, 0, 0) \tag{14}$$

For this case, basically the same considerations apply as for the model with a household objective function.

If both have the opportunity to work, the husband must be out of work as a result of choice. The following conditions apply:

$$\begin{aligned} U_m(0,1,w_f) &> U_m(1,1,w_m+w_f) \\ U_f(0,1,w_f) &> U_f(0,0,0) \end{aligned} \tag{15}$$

The conditions (15) imply that $(d_m, d_f) = (0,1)$ is a Nash equilibrium. For a the uniqueness of the equilibrium we can add that working is the dominant strategy of the wife:

$$U_f(1,1,w_m+w_f) > U_f(1,0,w_m) \tag{16}$$

or that non-work is the dominant strategy for the husband:

$$U_m(0,0,0) > U_m(1,0,w_m) \tag{17}$$

The latter conditions seems the least likely to prevail. The former condition, together with conditions (15), may be more likely to happen if the wage of the wife is higher, and the wage of the husband is lower.

3.3 The empirical model

We specify employment and earnings equations for husband and wife within a household. Since we focus not only on wives "sole" workers but also on dual earner couples with wives outearning their husbands we first specify our model in terms of earnings rather than hourly wage rates. Next, as an alternative, we also specify a model with hourly wages. We specify reduced form employment equations. We exploit the panel nature of the dataset to include random effects in the employment and earnings equations. The random effects represent unobserved individual heterogeneity, such as unobserved preferences, and unobserved characteristics.

Let d_{jit} ($d_{jit} = 1$ if employed, $d_{jit} = 0$ if not) denote the labour market state of spouse $j = m, f$, where m stands for husbands and f for wives, and $i = 1, ..., N$ characterizes the couple and $t = 1, ..., T$, years. We explain the labour market state by observable characteristics $z_{jit}, j = m, f$, an unobserved random effect $\alpha_{ji}, j = m, f$, and an idiosyncratic error $\epsilon_{jit}, j = m, f$ by

$$\begin{aligned} d^*_{jit} &= \gamma_j \prime z_{jit} + \alpha_{ji} + \epsilon_{jit}, j = m, f, t = 1, ..., T, i = 1, ..., N \\ d_{jit} &= \iota(d^*_{jit} > 0) \end{aligned} \tag{18}$$

For earnings, we have the following wage equation that relates wages w_{jit} to observed characteristics x_{jit}, a random effect ω_{ji}, and an idiosyncratic error $u_{jit}, j = m, f$:

$$\ln w_{jit} = \eta_j' x_{jit} + \omega_{ji} + u_{jit}, j = m, f, t = 1, ..., T, i = 1, ..., N \tag{19}$$

We assume that the random effects in the employment equation and the earnings equation are identically and independently normally distributed across households, allowing for correlation of earnings and employment states of the two spouses:

$$\begin{pmatrix} \alpha_i \\ \omega_i \end{pmatrix} \equiv \begin{pmatrix} \alpha_{mi} \\ \alpha_{fi} \\ \omega_{mi} \\ \omega_{fi} \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2_{m,\alpha} & \sigma_{mf,\alpha} & \sigma_{m,\alpha\omega} & \sigma_{mf,\alpha\omega} \\ \sigma_{mf,\alpha} & \sigma^2_{f\alpha} & \sigma_{fm,\alpha\omega} & \sigma_{f,\alpha\omega} \\ \sigma_{m,\alpha\omega} & \sigma_{fm,\alpha\omega} & \sigma^2_{m,\omega} & \sigma_{mf,\omega} \\ \sigma_{mf,\alpha\omega} & \sigma_{f,\alpha\omega} & \sigma_{mf,\omega} & \sigma^2_{f,\omega} \end{pmatrix} \right) \tag{20}$$

For the idiosyncratic errors we make a similar assumption:

$$\begin{pmatrix} \epsilon_{it} \\ u_{it} \end{pmatrix} \equiv \begin{pmatrix} \epsilon_{m,it} \\ \epsilon_{f,it} \\ u_{m,it} \\ u_{f,it} \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \sigma_{mf,\epsilon} & \sigma_{m,\epsilon u} & \sigma_{mf,\epsilon u} \\ \sigma_{mf,\epsilon} & 1 & \sigma_{fm,\epsilon u} & \sigma_{f,\epsilon u} \\ \sigma_{m,\epsilon u} & \sigma_{fm,\epsilon u} & \tau^2_m & \tau_{mf} \\ \sigma_{mf,\epsilon u} & \sigma_{f,\epsilon u} & \tau_{mf} & \tau^2_f \end{pmatrix} \right) \tag{21}$$

In appendix A we show how we construct the likelihood contributions for different types of observations. To construct the likelihood function, we determine the joint probability of the observed labour market states of the household members in each year and the joint density of their earnings. In the appendix we show that the computation of the likelihood contributions requires up to five dimensional integration, depending on the type of observation. The dimension of the integration procedure in combination with the large number of observations in our sample, makes numerical integration too time consuming. Therefore we employ the method of simulated maximum likelihood (SML) and replace integration by simulation (see Börsch-Supan and Hajivassiliou, 1983). We use 20 replications for each observation to simulate the integrals.

4 Descriptive analysis of different types of couples

Sample descriptives are given in Table 1 together with descriptives for dual-earners households and for households where both spouses are out-of work. These last may

include households where either spouse is unemployed and looking for work or s\he is not working and not seeking employment. Descriptives for, respectively, male and female breadwinners households are shown in Table 2. Table 3 focuses on dual-earners, distinguishing between more conventional dual-earners households, where the husband earns more than his wife, and households where she earns the same or more than him. As mentioned earlier on, we look here at gross monthly earnings, before tax, and without adjusting for hours of work. We assume that each spouse contribution to total household income from work can be captured by this variable better than by net earnings or hourly earnings. The model we use does allow for endogeneity of monthly earnings, so we do not have to worry about hours. The additional advantage of disregarding hours is that we do not have to deal with measurement error in hours, which is bound to be quite important in the LFS data.

Table 4 shows summary statistics of the distribution of gross earnings of husbands and wives in different types of households. Husbands outearnings their wives are contrasted here with the reverse case of wives 'strictly' outearnings their husbands for descriptive purposes.

Table 5 provides some information on the evolution over time of the different types of households considered here. It shows that the proportion of male breadwinners households has declined over time, falling from 35% in 1990 to 25% in 2002, amounting to a reduction of ten percentage points. Dual-earners households have increased by 9 percentage points, passing from 58% in 1990 to 67% in 2002. Among these households, the proportion of wives outearning their husbands has increased by four percentage points over the thirteen years period that we consider, from 10% to 14% of the sample. In 2002, in one every ten households in the population, wives earn the same or more than their husbands, on the basis of their gross monthly earnings. In the same year, in one out of five dual-earners households, wives were outearnings their husbands. Male breadwinners households are still quite important: but they have gone from accounting for a third of the population of households in 1990 to representing just a fourth of all households in 2002. The vast majority of households are throughout the period considered dual-earners and their proportion has been increasing over time.

The sample cut at below 55 of age for both partners is meant to drop all households with retirees and early-retirees from the population for the analysis.

The average age difference for spouses in the sample is about two years. Men in wife outearning household are one year younger on average than men in other household types. Husbands are much older than wives (more than five years older) in households where either one or both spouses are out-of-work relative to dual earners households: the relative proportions are 20-28% of the sample for the first and 13% for the second. And this in spite of having cut the sample at below age 55 for both partners.

Men in "conventional" dual earners households -where the husband earns more than his wife- have higher gross earnings than male breadwinners, although taxation may cancel these differences out.[4] Men in "unconventional" dual-earners households, that are outearned by their wives, have gross earnings below husbands' sample averages, while their outearning wives earn much more than other wives in the population. "Outearning" wives have earnings distribution similar to that of "outearning" men in the sample.

Dual earners spouses and outearning wives belong much more often to the same socio-occupational class as their husbands (respectively, 12% and 16% of them are in this situation) than wives of male breadwinners (2%). Wives outearning their husbands are overly higher educated.

Marriage is more frequent among couples where the man is a male breadwinner (84%) than for female breadwinners households (68%). Husband outearning households are more likely to be married (80% of them are so) than wife outeranings ones (74%).

Female breadwinners and wife outeranings households and are much more likely to live in inner Paris (19% and 17%, respectively) than male breadwinners ones (12%) and couples where both spouses are out of work (12%). Husband outearning household are somewhat in the middle, with 15% of them living in inner Paris.

[4] The French tax system is more favourable to households where only one spouse works and the other has no income, conditional on the spouses being formally married. Joint taxation is compulsory for married couples and not allowed for unmarried ones. Exceptions are couples that subscribed a "pax", but this concerns only very marginally unmarried couples in our sample. As pax was only introduced in 1999 and at that time couples had to be "paxed" for three years, before they could file joint tax declarations, if they wished to do so. Furthermore, only very few couples paxed in the first years since the pax was created, and most of paxed couples are not heterosexual and therefore not covered by our study.

As far as nationality goes, it is striking that only just above 70% of spouses are of French nationality in both-out-of-work households against largely over 90% for dual earners and 87% for male breadwinners couples. Husbands are about 3 percentage points less likely to be French than their wives in both-out-of-work households, female breadwinners and wive outearning couples.

As far as fertility goes, the number of children present in the household is the largest for spouses both-out-of-work and male breadwinners households, where it averages two children per household. It is the lowest in the case of wives outearning their husband, equal to just over one child per couple. The proportion of small children, aged below three years, is also the highest for the both-out-of-work and male breadwinners cases.

Finally, we look at mobility in and out of employment for husbands and wives, in Tables 6 and 7, respectively. Given that observations can stay in the sample for at most three years, transition rates are computed over two and three years intervals, respectively for those staying on in the sample two an three years. We consider transitions from 1990 to 1991, and 1992 and, ten years later, from 2001 to 2001, and 2002, for comparison purposes. In Table 6, transitions out of employment are examined. The table shows that the well over 90% of employed spouses remain employed over two and three years intervals, respectively. Mobility increases over time and it is stronger for women. Table 7 looks at the reverse transitions from non-employment into employment. It is shown that husbands move much more frequently out of non-employment and into employment than wives do. The proportion of movers among husbands varies between 38% and 45% depending on the year considered, as a function of the business cycle, and on the length of the time interval taken as a reference, with mobility increasing over time. The same figure for wives is much lower and varies between 15% and 25%. All these transitions rates are computed only for couples that stay on in the sample and, therefore, may be underestimated as finding or losing jobs is bound to be associated with moving houses -which would, in turn, result in dropping out of the sample, given the way the LFS survey sample is drawn.[5] However, couples are likely to be less mobile than single people would,

[5] The sample is drawn on the basis of housing location and individuals moving houses are not followed.

so that attrition may be less of a problem, at least over a relatively short time interval.

5 Results of estimation

Table 8 shows the estimation results of the parameters γ_m and γ_f of the employment equations (18). Table 9 gives the parameter estimates of the earnings equations (19). Table 10 contains the estimates of the parameters of the covariance matrices in (21) and (20). For ease of interpretation, we have reparametrized the covariance matrices in terms of correlation coefficients.

The impact of the covariates considered on the employment probabilities of husbands and wives follow standard patterns: age has a non linear impact; higher education levels have a positive impact -the highest education level, university degree and higher, is the basis for these dummies; the presence of small children has a negative impact, stronger for women; while the number of children has a positive effect for men, but negative for women; French nationality increases the employment probability. Men living in a couple but not married have lower employment probabilities while effect is smaller for women. We see overall that the region of residence affects the employment probability, and for some regions the impact is opposite for men and women. Living in a small community has a positive impact on employment for men but negative for women. Class endogamy, the fact of belonging to the same socio economic profession, increases employment of both spouses with a stronger impact for women. Having the same education level but low for both spouses has a negative effect for men, and a negative but insignificant one for women. Husbands enjoying the same education level as their wives and above compulsory education for both spouses have higher employment rates while the opposite is true for their spouses. Larger age difference between the spouses lower significantly the employment probabilities.

The model in section 3.2 spelled out that employment opportunities play a role in identifying different types of female breadwinner households. We can have households with the woman as the sole breadwinner if the husband is out of work because there are no employment opportunities, or if we have higher a educated women with high

earnings, whose the husband is out of work by choice. To capture the impact pf demand side factors on employment opportunities, we have included yearly information on GDP growth and gender specific unemployment rates. In addition, we have included year dummies to measure other year specific effects. We have data for the years 1990-1992, and we chose 1990 as base. Note that for every year specific series included, we have to normalize a year dummy to zero. We chose to normalize 1991 and 1992 to zero. The results for growth and unemployment rates are damn interesting. We see that growth hardly effects the husbands employment probability: the coefficient is very small and not significant. The yearly male unemployment rate, though, has a negative influence on the husband's employment probability, capturing the impact of poorer employment opportunities in times of higher unemployment. For the women, we spot an entirely different pattern. Here we see that in times of poor economic growth, the employment probabilities of women are higher. The female unemployment effect, though, does not have a significant impact on the employment probabilities, and its coefficient estimate is even positive. The negative impact of growth on female employment may very well capture the added worker effect.

In the earnings equation (table 9) we have included experience, defined as the number of years since completion of education. Since the age of completion of education level varies by education level, we have also included cross effects of education and experience.

Adding together the coefficients of experience, we see that for men earnings increase with experience for all but the lowest education level. The growth rate, though, differs by education level. For women earnings also grow with experience but the rate of growth is lower than for men (following from the negative coefficient of the log-linear experience effect). The wave dummies are positive for both spouses. Earnings increase with the level of education for both spouses. Salaries are higher in the region of Ile de France as expected.

The estimates of the covariance matrix can be used to compute the correlation across time in the unobservables. For instance, the correlation coefficient of the unobservables in the employment equation across different time periods is $\sigma^2_{\alpha,j}/(\sigma^2_{\alpha,j}+1), j = m, f$. The value is 0.38 for husbands and 0.51 for wives. The interpretation in that especially for

women we see a much higher persistence in the labour market state than can be explained on basis of the observable covariates, like for instance education, only. For the earnings equation the correlation across time can be measured by $\sigma^2_{\omega,j}/(\sigma^2_{\omega,j}+\tau^2_j), j = m, f$, which is 0.79 for men and 0.92 for women, suggesting that there is quite some persistence in salaries that cannot be attributed to observable covariates in the earnings equation.

Furthermore, we see that various correlation coefficients are significantly different from zero. Especially the coefficients $\rho_{m,\alpha\omega}$ and $\rho_{f,\alpha\omega}$ are quite high, showing strong persistent correlation between earnings and labour market status for both husband and wife. We expect a lower correlation if we use wage rates instead of earnings. At present, an alternative model including wage rates is being prepared.

6 Probabilities for the different household types

With the estimates, we can evaluate the probabilities of different household types, distinguished by the employment status of the household members. We can determine the marginal effects of various background characteristics on these probabilities and explore the role of persistence in unobservables in the determination of these household states. In particular, we are interested in the probability of finding a female breadwinner family $P(d_{m,it} = 0, d_{f,it} = 1)$. According to the theoretical model, this probability can be affected by demand side factors (the husband who is involuntarily employed, female breadwinnership out of poverty), or to a relatively high educated wife (the husband chooses not to work, the income effect plays a role here). The other probability of interest is the probability of a dual-earners household where she is outearning him $P(d_{m,it} = 1, d_{f,it} = 1, w_{f,it} > w_{m,it})$. According to the theoretical model in section 3.2, it makes sense to decompose the latter probability in the conditional probability $P(d_{m,it} = 1, d_{f,it} = 1|w_{f,it} > w_{m,it})$ and the marginal probability $P(w_{f,it} > w_{m,it})$. The latter probability shows the probability that the wife has the larger earnings capacity, which is explained outside the theoretical model, but is likely to be affected by the level of education. The first probability is the probability that we have a dual earner couple, conditional on the wife having a larger earnings capacity.

It may also make sense to look at the reverse factorization, where we look at the probability of a wife who outearns the husband, conditional on being a dual-earners family $P(w_{f,it} > w_{m,it}|d_{m,it} = 1, d_{f,it} = 1)$: this probability corresponds to the event that is observable. We only observe wages of both household members of dual earners couples and therefore for these couple we can determine this event directly by looking at the data.

In table 11 we show the effect of education. We chose a base vector of observable characteristics, with all the background variables set at their sample means. The time effects (growth, unemployment rates, and time dummies) have been set at their year 2002 values. The first column shows various probabilities. Next we vary the levels of education. We first set the education levels of husbands and wife to its lowest level. Next we subsequently set the education levels of the wife to its lowest level and that of the husband to its highest level, the education level of the wife to the highest and that of the husband to the lowest, and finally both education levels to the highest level. These may sometimes seem to be extreme case, but they set the limits to what variation in education can do to household employment probabilities. The effects by educations are found in subsequent columns. The rows of the table show the different household types. The first four rows show the different household types by employment state. The second row corresponds to the household type where the wife is the sole breadwinner. The with row shows the joint probability of observing a dual earner couple where the wife outearns the husband. The sixth shows the probability that the wife earns more than the husband, conditional on being a dual earner couple. Then we get the marginal probality that the wife earns more than him, and finally, the conditional probaility that we have a dual earner couple, conditional on having a wife that earns more than her husband.

Note that table 12 displays the same probabilities, but expressed in deviation from the base. This table also shows standard errors, such that we can easily spot whether a deviation from the base is significant. This is true in almost all cases.

First let us look ar couples where the wife is the sole breadwinner. We see that this probaility actually is higher than the base if both household members have a low

education level. This may correspond to female breadwinnership out of poverty. This interpretation becomes more support if we look at the marginal probability that she earns more than him: this probability is lower than the base, but nevertheless the probability that she is the sole breadwinner rises. We see that the probability of having a sole breadwinners is highest if the wife's education level is high, and the husband's is low. The theoretical model predicted that in this case the probability of observing a female breadwinnership gets higher, as the husband may withdraw from the labour market. However, a low education still also may proxy low employment opportunities of the husband. The probability of observing the wife as the sole breadwinner is lowest if the husband has the highest level of education and the wife the lowest. This result is not surprising because the valutation of the husband's leisure time compared to his wage is likely to be low, whereas the valuation of teh wife's leisure time compares to her wage is likely to be high. More surprising may be the result that the probability of having the wife as a sole breadwinner is lower if the wife has a high education level but the husband has a high education level as well. Having a high income wife apparently does not motivate the husband to withdraw from the labour force: he has a high education level as well and therefore his wage-value of leisure ratio is high, even though this ratio may be decreased by the higher income of his wife.

The other household type that is focussed upon in this paper, are dual earner couples where she earns more than him. Looking at the marginal probability that she earns more than him, we see that this probability is stronly affected by differences in education level. Therefore this probability is highest if she has the highest level of education and he the lowest, and lowest if she has the lowest level of education and he the highest. If both have the highest level of education, we see that the probability that she earns a higher wage is hardly any larger than the base. However, inequality between men and women seems to be higher at low education levels. We see that the joint probability of observing a dual earner family where she earns the most is highest if she has the highest education level and he has the lowest. Note that for this case, also the unconditional probability that we have a dual earner couple is higher than the base: it is not the case that many men stop working if the wife has a high education level. It is more that the wife starts working

as well, in addition to the husband. In this respect there is an asymmetry between men and women: if he has a high education level and she a low, we have less dual earner couple and more traditional male breadwinner households. The reason for this asymmetry may be the wages: if the husband has a higher education level than the wife, he has asymmetrically higher wage than if the wife has a higher education level than the husband, as can be seen from the marginal probability that she has a higher wage than he. Further, the probability of having a dual earner couple where she earns more than him is also somewhat higher than the base for highly educated couples, but the impact is relatively small. Overall we can say that this households where she earns more than him still is a minority among the dual earner couples, but for several education levels, it is now more common than the traditional male breadwinner household type. Asymmetry in wages between men and women plays an important role, but we should not forget that the present analysis is in earnings, so female part-time work may boost figures on wage inequality. Should this asymmetry become more equal in future then there the consequences may be that there may come more dual earner households where she earns more than him, but also more households where the husband chooses to withdraw from the labour market.

We have also computed probabilties for households without children. We do not have it in a table but we will mention the results. The presence of children is likely to affect the value of non-work time, especially of the wife. Therefore we see among household without children a higher proportion of household where the wife is the sole breadwinner, more dual earner families, less male breadwinner families, and also less families where both are out of work. The probability that we have a dual earner couple slightly decreases, though. This is because women with lower wages start working sooner if no children in the household are present, due to the trade of between wages and the value of non-work time that is made.

To see the impact of the business cycle variables we have done the following analysis. For the base we have set the values of growth, and male and female unemployment rates to their 2002 values, which are 0.75, 7.9, and 10.1. This shows a low growth, but still low unemployment rates due to high growth the year before. The womens' unemployment

rate is historically low. Next we have set the value to 1994 values (0.87, 10.8, 14.2) with low growth and high unemployment. Then to the 1990 value with high growth and low unemployment (3.67, 6.7, 11.8). In that year the overall unemployment rate was comparable to 2002, but more favourable to men. Then we have chosen the year with the highest growth of the sample period and moderate unemployment rates (4.61, 8.3, 11.6). Finally the year with the lowest growth and higher unemployment rates (-1.01, 9.5, 13.3). The results are in tables 13 and 14.

The values of 1994 (second column) show high unemployment rates for men and women, and low growth. The estimation results showed a negative impact of unemployment rates on the husband's employment probability and a negative impact of growth on the wife's employment probability. Here we see a decrease in male breadwinner couples and an increase in female breadwinner couples. This should capture the added worker effect. We see that the probability of a female breadwinner couple is lower in case of high economic growth and low male unemployment rates (3rd column). Also the negative growth case shows more female breadwinner couples. The order of magnitude of the variation in the probability of observing a female breadwinner couple is somewhat lower than the variation in wages, although comparable to the effect where we put the education to the lowest level for both household members. This means that business cycle variation can still be an important determinant of the probability of observing a female breadwinner couple, especially for the lower educated. The other probability of interest, the probability of observing a dual earner couple where she earns more than him, seem not ot be much effect by the business cycle effects. First, in our model the earnings equation does not depend on the business cycle effects, although this equation contains time dummies, but these dummies mainly showed an increasing wages throughout the years. We do not vary the values of the time dummies in the computations. The probability of observing dual earner couples seems to be mostly affected by the larger unemployment rates for males in columns 2 and 5. This means that dual earnership to temparory poor economic conditions is not a big issue, and the education effects in determining our second household type of interest seem to be much more important. This is also in accordance with the prediction of our theoretical model.

7 Conclusions

In this paper, we have investigated the determinants of the occurrence of households where the wife is the sole or the main earner. These represent almost 2 every household in France. We have specified a reduced form model of employment and earnings equations for husband and wife within a household including random effects.

We find that the probability of a female breadwinners defined strictly as a wife working while her husband is out of work, is significantly lower for high-educated spouses and for high-educated husbands with a low educated wife. The probability of wives outearning their husband is higher for couples where the wife is high educated and the husband is low educated as well as for spouses both high-educated; it is also higher for both low-educated spouses than for the baseline case.

A Likelihood contributions

The model equations (18) and (19) and the distributional assumptions (20) and (21) are used to construct the likelihood contributions for different types of observations.

First we consider a couple i with both spouses employed in year t, $(d_{mit} = 1, d_{fit} = 1)$, with earnings w_{mit} and w_{fit} observed for both spouses, and with unobserved characteristics $(\alpha_i, \omega_i)'$. We first construct the probability that both spouses are employed, conditional on the unobservables $(\alpha_i, \omega_i)'$

Define the covariance matrix of the idiosyncratic errors (21) as

$$\begin{pmatrix} \Sigma_\epsilon & \Sigma_{\epsilon u}\prime \\ \Sigma_{\epsilon u} & \Sigma_u \end{pmatrix} \equiv \begin{pmatrix} 1 & \sigma_{mf,\epsilon} & \sigma_{m,\epsilon u} & \sigma_{mf,\epsilon u} \\ \sigma_{mf,\epsilon} & 1 & \sigma_{fm,\epsilon u} & \sigma_{f,\epsilon u} \\ \sigma_{m,\epsilon u} & \sigma_{fm,\epsilon u} & \tau_m^2 & \tau_{mf} \\ \sigma_{mf,\epsilon u} & \sigma_{f,\epsilon u} & \tau_{mf} & \tau_f^2 \end{pmatrix} \tag{22}$$

The density 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:

$$\epsilon_{it}|u_{it} \sim N(\Sigma'_{\epsilon u}\Sigma_u^{-1}u_{it}, \Sigma_\epsilon - \Sigma'_{\epsilon u}\Sigma_u^{-1}\Sigma_{\epsilon u}) \tag{23}$$

$$\Sigma_{\epsilon|u} := \Sigma_\epsilon - \Sigma'_{\epsilon u}\Sigma_u^{-1}\Sigma_{\epsilon u} := \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix} \text{ and } \begin{pmatrix} \mu_1(u_{it}) \\ \mu_2(u_{it}) \end{pmatrix} = \Sigma'_{\epsilon u}\Sigma_u^{-1}u_{it} \tag{24}$$

We determine $P(d_{m,it} = 1, d_{f,it} = 1|w_{m,it}, w_{f,it}, \alpha_i, \omega_i)$. Employment of spouse j follows from (18) as

$$d_{jit} = 1 \text{ if } d^*_{jit} = \gamma'_j z_{jit} + \alpha_{ji} + \epsilon_{jit} > 0 \text{ or } \epsilon_{jit} > -\gamma'_j z_{jit} - \alpha_{ji} \tag{25}$$

With (25), (23) and (24) we can write

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

$$\int_{-(z'_{fit}\gamma_f + \mu_2(u_{it}) + \alpha_{fi})/\sigma_2}^{\infty} \Phi\left(\frac{z'_{mit}\gamma_m + \alpha_{mi} + \mu_1(u_{it}) + \frac{\sigma_{12}}{\sigma_2}\nu}{\sqrt{\sigma_1^2 - \frac{\sigma_{12}^2}{\sigma_2^2}}}\right) \frac{1}{\sqrt{2\pi}} \exp\left\{-\frac{1}{2}\nu^2\right\} d\nu \tag{26}$$

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

$$f(w_{mit}, w_{fit}|\omega_i, \alpha_i) = \frac{1}{w_{mit}, w_{fit} 2\pi|\Sigma_u|^{1/2}} \exp\{-\frac{1}{2}(\ln w_{it} - \eta' x_{it} - \omega_i)'\Sigma_u^{-1}(\ln w_{it} - \eta' x_{it} - \omega_i)\} \tag{27}$$

with $\eta' x_{it} \equiv (\eta'_m x_{mit}, \eta'_f x_{fit})'$ and $\ln w_{it} \equiv (\ln w_{mit}, \ln w_{fit})'$. Now the joint probability density of the observation $(d_{mit} = 1, d_{fit} = 1, w_{mit}, w_{fit})$ is $l_{it}(\alpha_i, \omega_i)$ with

$$l_{it}(\alpha_i, \omega_i) = P(d_{mit} = 1, d_{fit} = 1 | w_{mit}, w_{fit}, \alpha_i, \omega_i) \times f(w_{mit}, w_{fit} | \omega_i, \alpha_i) \tag{28}$$

For some observations we know the employment status but the earnings are not observed. Suppose we have an observation $(d_{mit} = 1, d_{fit} = 1, w_{fit})$ with the wage of the husband missing. From (21) we know the joint distribution of the idiosyncratic errors of the employment equation and the error of the wage equation of the wife:

$$\begin{pmatrix} \epsilon_{m,it} \\ \epsilon_{f,it} \\ u_{f,it} \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \sigma_{mf,\epsilon} & \sigma_{mf,\epsilon u} \\ \sigma_{mf,\epsilon} & 1 & \sigma_{f,\epsilon u} \\ \sigma_{mf,\epsilon u} & \sigma_{f,\epsilon u} & \tau_f^2 \end{pmatrix} \right) \tag{29}$$

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

$$\begin{pmatrix} \epsilon_{mit} \\ \epsilon_{fit} \end{pmatrix} | u_{fit} \sim N \left(\begin{pmatrix} \mu_1(u_{it}) \\ \mu_2(u_{it}) \end{pmatrix}, \begin{pmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{pmatrix} \right) \tag{30}$$

with

$$\begin{aligned} \mu_1(u_{it}) &= \tfrac{\sigma_{mf,\epsilon u}}{\tau_f^2} u_{fit} \\ \mu_2(u_{it}) &= \tfrac{\sigma_{f,\epsilon u}}{\tau_f^2} u_{fit} \\ \sigma_1^2 &= 1 - \tfrac{\sigma_{mf,\epsilon u}^2}{\tau_f^2} \\ \sigma_{12} &= \sigma_{mf,\epsilon u} - \tfrac{\sigma_{mf,\epsilon u}\sigma_{f,\epsilon u}}{\tau_f^2} \\ \sigma_2^2 &= 1 - \tfrac{\sigma_{f,\epsilon u}^2}{\tau_f^2} \end{aligned} \tag{31}$$

Now we can compute $P(d_{mit} = 1, d_{fit} = 1 | w_{fit}, \alpha_i, \omega_i)$ in the same way as (26) using the conditional means and variances in (31). We can complete the likelihood contribution $l(\alpha_{it}, \omega_{it})'$ for this household in year t by multiplying this probability by the marginal density of the wife wage, conditional on the unobservables.

Dual earner households for which the earnings of the husband are observed but the wife's earnings not can be treated in the same way. The relevant condtional means and variances become

$$\begin{aligned} \mu_1(u_{it}) &= \tfrac{\sigma_{m,\epsilon u}}{\tau_m^2} u_{mit} \\ \mu_2(u_{it}) &= \tfrac{\sigma_{fm,\epsilon u}}{\tau_m^2} u_{fit} \\ \sigma_1^2 &= 1 - \tfrac{\sigma_{m,\epsilon u}^2}{\tau_m^2} \\ \sigma_{12} &= \sigma_{mf,\epsilon u} - \tfrac{\sigma_{fm,\epsilon u}\sigma_{m,\epsilon u}}{\tau_m^2} \\ \sigma_2^2 &= 1 - \tfrac{\sigma_{fm,\epsilon u}^2}{\tau_m^2} \end{aligned} \tag{32}$$

For dual earner households with missing information on earnings for both spouses we have

$$P(d_{m,it}=1, d_{f,it}=1|\alpha_i,\omega_i) =$$
$$\int_{-(z'_{fit}\gamma_f+\alpha_{fi})}^{\infty} \Phi\left(\frac{z'_{mit}\gamma_m+\alpha_{mi}+\sigma_{mf,\epsilon}\nu}{\sqrt{1-\sigma^2_{mf,\epsilon}}}\right)\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\nu^2\right\}d\nu \tag{33}$$

To determine the likelihood contribution for an employed wife, with the earnings observed, with a nonemployed spouse, we take

$$P(d_{m,it}=0, d_{f,it}=1|w_{f,it},\alpha_i,\omega_i) =$$
$$\int_{-(z'_{fit}\gamma_f+\mu_2(u_{it})+\alpha_{fi})/\sigma_2}^{\infty}\left[1-\Phi\left(\frac{z'_{mit}\gamma_m+\alpha_{mi}+\mu_1(u_{it})+\frac{\sigma_{12}}{\sigma_2}\nu}{\sqrt{\sigma_1^2-\frac{\sigma_{12}^2}{\sigma_2^2}}}\right)\right]\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\nu^2\right\}d\nu \tag{34}$$

where the conditional means and variances are defined by (31). Multiplying the probability by the marginal distribution of earnings of the wife gives the likelihood contribution $l_{it}(\alpha_i,\omega_i)$ for this household in year t, conditional on random effects.

If information on the earnings w_{fit} is missing, we get

$$P(d_{m,it}=0, d_{f,it}=1|\alpha_i) =$$
$$\int_{-(z'_{fit}\gamma_f+\alpha_{fi})}^{\infty}\left[1-\Phi\left(\frac{z'_{mit}\gamma_m+\alpha_{mi}+\sigma_{mf,\epsilon}\nu}{\sqrt{1-\sigma^2_{mf,\epsilon}}}\right)\right]\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\nu^2\right\}d\nu \tag{35}$$

For the likelihood contribution for an employed husband, with the earnings observed, with a nonemployed spouse, the required probability becomes

$$P(d_{m,it}=1, d_{f,it}=0|w_{m,it},\alpha_i,\omega_i) =$$
$$\int_{-\infty}^{-(z'_{fit}\gamma_f+\mu_2(u_{it})+\alpha_{fi})/\sigma_2}\Phi\left(\frac{z'_{mit}\gamma_m+\alpha_{mi}+\mu_1(u_{it})+\frac{\sigma_{12}}{\sigma_2}\nu}{\sqrt{\sigma_1^2-\frac{\sigma_{12}^2}{\sigma_2^2}}}\right)\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\nu^2\right\}d\nu \tag{36}$$

where the conditional means and variances are defined by (32). Multiplying the probability by the marginal distribution of earnings of the husband gives the likelihood contribution $l_{it}(\alpha_i,\omega_i)$ for this household in year t, conditional on random effects.

If the earnings of the husband are not observed, the likelihood contribution becomes

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

$$\int_{-\infty}^{-(z'_{fit}\gamma_f+\alpha_{fi})} \Phi\left(\frac{z'_{mit}\gamma_m+\alpha_{mi}+\sigma_{mf,\epsilon}\nu}{\sqrt{1-\sigma^2_{mf,\epsilon}}}\right)\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\nu^2\right\}d\nu \tag{37}$$

Finally, the likelihood contribution for a household with both spouses out of work is

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

$$\int_{-\infty}^{-(z'_{fit}\gamma_f+\alpha_{fi})}\left[1-\Phi\left(\frac{z'_{mit}\gamma_m+\alpha_{mi}+\sigma_{mf,\epsilon}\nu}{\sqrt{1-\sigma^2_{mf,\epsilon}}}\right)\right]\frac{1}{\sqrt{2\pi}}\exp\left\{-\frac{1}{2}\nu^2\right\}d\nu \tag{38}$$

So far we have only determined likelihood contributions for a given year, conditional on random effects (α_i, ω_i), which we denote by $l_{it}(\alpha_i, \omega_i)$. Suppose that household i is observed for the years T_{i1} through T_{i2}. Then the likelihood contribution of household i over all periods of observation, conditional on random effects is

$$l_i(\alpha_i, \omega_i) = \prod_{t=T_{i1}}^{T_{i2}} l_{it}(\alpha_i, \omega_i) \tag{39}$$

The likelihood function is completed by integrating over the random effects. Let $f(\alpha_i, \omega_i)$ denote the joint normal density of random effects, following from (20). The complete likelihood contribution for household i becomes

$$l_i = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} l_i(\alpha_i, \omega_i) f(\alpha_i, \omega_i) d\alpha_i d\omega_i \tag{40}$$

where it should be noted that the dimension of both α_i and ω_i is 2.

The computation of the likelihood contributions requires up to five dimensional integration, depending on the type of observation. We use the method of simulated maximum likelihood (SML) and replace integration by simulation (see Börsch-Supan and Hajivassiliou, 1983). We use 20 replications for each observation to simulated the integrals.

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Table 1: Sample descriptives: dual earners and out-of-work couples

Variable	Sample		Dual earners		Both out of work	
	N =306571		N = 189506		N = 13150	
	mean	st dev	mean	st dev	mean	st dev
W Age	37.11	8.26	37.33	8.15	36.36	9.02
H Age	39.29	8.24	39.27	8.18	39.60	8.99
H is >5 years older	0.16	0.37	0.13	0.34	0.28	0.45
W is >5 years older	0.03	0.16	0.03	0.16	0.04	0.21
W Education level 1(lowest)	0.31	0.46	0.23	0.42	0.65	0.48
W Education level 2	0.09	0.28	0.09	0.28	0.07	0.25
W Education level 3	0.27	0.44	0.28	0.45	0.17	0.38
W Education level 4	0.135	0.34	0.16	0.36	0.06	0.24
W Education level 5	0.12	0.32	0.15	0.36	0.03	0.17
H Education level 1(lowest)	0.28	0.45	0.23	0.42	0.58	0.49
H Education level 2	0.07	0.25	0.07	0.25	0.05	0.22
H Education level 3	0.36	0.48	0.37	0.48	0.25	0.43
H Education level 4	0.11	0.31	0.12	0.32	0.05	0.22
H 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
# 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
W French nationality	0.91	0.28	0.95	0.22	0.74	0.44
H French nationality	0.90	0.30	0.94	0.24	0.71	0.45
Same social 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
W Monthly gross W, FF	6929.76	6344.94	6965.88	6089.34		
H Monthly gross W, FF	9880.64	7995.33	9920.60	7424.68		

These are unweighted sample statistics, averaged over the thirteen years period, 1990-2002.

Wages are summarized only over positive values. They are measured in French Francs

(equal to 1/ 6.55957 euros).

Table 2: Sample descriptives: male and female breadwinners

Variable	Male breadwinners $N = 91600$		Female breadwinners $N = 12315$	
	mean	std dev	mean	std dev
W Age	36.76	8.28	37.10	8.70
H Age	39.29	8.15	39.49	8.98
H is > 5 years older	0.19	0.39	0.21	0.40
W is > 5 years older	0.03	0.16	0.04	0.20
W Education level 1 (lowest)	0.43	0.49	0.34	0.47
W Education level 2	0.09	0.29	0.09	0.28
W Education level 3	0.26	0.44	0.26	0.44
W Education level 4	0.10	0.31	0.12	0.33
W Education level 5	0.06	0.24	0.11	0.32
H Education level 1 (lowest)	0.34	0.47	0.39	0.49
H Education level 2	0.06	0.24	0.07	0.25
H Education level 3	0.35	0.48	0.32	0.47
H Education level 4	0.09	0.29	0.09	0.29
H Education level 5	0.06	0.25	0.06	0.24
Married	0.84	0.37	0.68	0.46
# 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
W French nationality	0.87	0.34	0.88	0.33
H French nationality	0.87	0.34	0.83	0.37
Same social class	0.02	0.15	0.06	0.25
Same education level	0.43	0.49	0.41	0.49
W Monthly gross W, French Francs			6394.18	9331.43
H Monthly gross W, French Francs	9797.19	9071.39		

These are unweighted sample statistics, averaged over the thirteen years period, 1990-2002.
Wages are summarized only over positive values and measured in French Francs
(equal to 1/ 6.55957 euros).

Table 3: Sample descriptives: dual-earners by outearnings relationships

Variable	Dual earners, WM>WF $N = 116720$		Dual earners, WM≤WF N =35662	
	mean	std dev	mean	std dev
W Age	37.09	8.15	36.93	8.16
H Age	39.21	8.12	38.22	8.36
H is > 5 years older	0.14	0.35	0.11	0.31
W is > 5 years older	0.02	0.15	0.04	0.20
W Education level 1 (lowest)	0.26	0.44	0.13	0.33
W Education level 2	0.09	0.29	0.07	0.26
W Education level 3	0.30	0.46	0.24	0.43
W Education level 4	0.15	0.36	0.17	0.38
W Education level 5	0.13	0.33	0.23	0.42
H Education level 1 (lowest)	0.23	0.42	0.24	0.43
H Education level 2	0.07	0.25	0.07	0.26
H Education level 3	0.37	0.48	0.38	0.48
H Education level 4	0.12	0.32	0.12	0.32
H Education level 5	0.10	0.30	0.10	0.29
Married	0.80	0.40	0.74	0.44
# 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
W French nationality	0.94	0.24	0.96	0.19
H French nationality	0.93	0.25	0.94	0.24
Same social class	0.11	0.31	0.16	0.37
Same education level	0.40	0.49	0.35	0.48
W Monthly gross W, French Francs	6078.47	3641.9	10061.09	10895.53
H Monthly gross W, French Francs	10596.6	8047.44	7579.11	3251.85

These are unweighted sample statistics, averaged over the thirteen years period, 1990-2002.

These are unweighted sample statistics, averaged over the thirteen years period, 1990-2002.

Wages are summarized only over positive values. They are measured in French Francs (equal to 1/ 6.55957 euros).

Table 4: Distribution of gross earnings

Variable	Dual earn. WM>WF N =116720	Dual earn. WF>WM N = 31572	Male breadw. N = 75022	Female breadw. N = 1110
Q1 W (25%)	4000	7333.33		4000
Median W (50%)	5808.33	9000		5860.67
Q3 W (75%)	7600	11100		7950
Mean W	6078.47	10061.09		6394.18
Standard deviation W	3641.9	10895.53		9331.43
Q1 M (25%)	7300	6000	6416.67	
Median M (50%)	9100	7100	8000	
Q3 M (75%)	12000	8750	10833.33	
Mean M	10596.6	7579.11	9797.19	
Standard deviation M	8047.44	3251.85	9071.39	

These are unweighted sample statistics, averaged over the thirteen years period, 1990-2002.
Wages are summarized only over positive values. They are measured in French Francs
(equal to 1/ 6.55957 euros).
Notice that in column 2, wives earn strictly more than their husbands.

Table 5: The evolution of labour market states over time

Years	Male breadw.	Female breadw.	dual earners	Out-of-work	WM≤WF(*)	WM≤WF(**)
1990	0.35	0.03	0.58	0.04	0.17	0.10
1991	0.33	0.03	0.60	0.04	0.16	0.10
1992	0.32	0.03	0.60	0.04	0.17	0.10
1993	0.31	0.05	0.59	0.05	0.19	0.11
1994	0.31	0.05	0.59	0.05	0.20	0.12
1995	0.30	0.04	0.61	0.04	0.20	0.12
1996	0.30	0.04	0.61	0.04	0.18	0.11
1997	0.30	0.04	0.61	0.04	0.20	0.11
1998	0.29	0.04	0.62	0.04	0.18	0.11
1999	0.28	0.04	0.63	0.04	0.18	0.11
2000	0.27	0.04	0.64	0.04	0.20	0.13
2001	0.26	0.03	0.66	0.04	0.20	0.13
2002	0.25	0.04	0.67	0.04	0.21	0.14

These are unweighted sample statistics.
(*) Couples where WM≤WF are a subsample of dual earners,
and their percentage is calculated over the population of dual earners.
(*) Couples where WM≤WF are a subsample of dual earners,
but their percentage is here calculated over the population of households in the sample.
Each line sum up to one, if the cases of WM≤WF are excluded.

Table 6: Spouses' transitions from employment into non-employment, over one and two years intervals

Years intervals	Wives		Husbands	
	Stayers	Movers	Stayers	Movers
1990 to 1991	93.13	6.87	97.14	2.86
1990 to 1992	91.49	8.51	96.17	3.83
2000 to 2001	93.51	6.49	97.75	2.25
2001 to 2002	91.93	8.07	96.28	3.72

These are unweighted sample statistics.
The base for comparison, are the employed in the starting year,
that are set equal to 100%.
We consider two time periods, 1990 to 1992 and 2000 to 2002,
Transitions are computed over observations that remained in the sample,
respectively, for two and three years periods, for comparison purposes.

Table 7: Spouses' transitions from non-employment into employment, over one and two years intervals

Years intervals	Wives		Husbands	
	Stayers	Movers	Stayers	Movers
1990 to 1991	84.97	15.03	60.74	39.26
1990 to 1992	81.08	18.72	54.05	45.95
2000 to 2001	81.24	18.76	61.36	38.64
2001 to 2002	74.72	25.28	58.82	41.18

These are unweighted sample statistics.
The base for comparison, are the employed in the starting year,
that are set equal to 100%.
We consider two time periods, 1990 to 1992 and 2000 to 2002,
Transitions are computed over observations that remained in the sample,
respectively, for two and three years periods, for comparison purposes.

Table 8: Parameter estimates of the employment equations

variable	Men		Women	
	Parameter estimate	Standard error	Parameter estimate	Standard error
Intercept	-17.611	0.833	-28.486	0.636
Ln age	11.255	0.456	16.159	0.338
Square of ln age	-1.569	0.063	-2.209	0.047
Education level 1 (lowest)	-0.605	0.016	-0.877	0.013
Education level 2	-0.312	0.018	-0.483	0.014
Education level 3	-0.319	0.014	-0.340	0.012
Education level 4	-0.159	0.017	-0.158	0.013
Education level 5	-0.099	0.018	0.165	0.014
Cohabiting couple	-0.288	0.009	-0.030	0.008
Number of children	0.006	0.003	-0.234	0.002
Any children younger than 3	-0.033	0.011	-0.524	0.009
Champagne Ardenne	-0.047	0.020	-0.347	0.015
Haute Normandie	-0.171	0.018	-0.260	0.014
Basse Normandie	-0.085	0.021	-0.090	0.016
Picardie	-0.125	0.019	-0.352	0.014
Centre	-0.002	0.019	-0.140	0.014
Bourgogne	-0.022	0.020	-0.206	0.015
Calais	-0.202	0.014	-0.490	0.011
Lorraine	-0.027	0.020	-0.313	0.014
Alsace	0.012	0.021	-0.132	0.014
Franche Comte	0.094	0.022	-0.175	0.015
Loire	0.008	0.017	-0.074	0.013
Bretagne	-0.072	0.018	-0.167	0.014
Poitou Charente	-0.034	0.020	-0.201	0.015
Aquitanie	-0.094	0.018	-0.354	0.013
Midi Pyrenes	-0.085	0.019	-0.268	0.015
Limousin	0.061	0.023	-0.099	0.018
Rhones Alpes	-0.054	0.014	-0.220	0.011
Auvergne	0.039	0.022	-0.265	0.016
Languedoc Roussillon	-0.348	0.017	-0.548	0.015
Provence	-0.320	0.014	-0.562	0.012
French nationality	0.339	0.009	0.345	0.008
Small community	0.150	0.007	0.069	0.005

Table 8: Parameter estimates of the employment equations (ctd.)

variable	Men		Women	
	Parameter estimate	Standard error	Parameter estimate	Standard error
Spouses same education level	0.039	0.009	-0.035	0.007
same socio-economic category	0.248	0.009	0.863	0.007
Same educ. lev * low education	-0.167	0.014	-0.016	0.011
He is >5 years older than she	-0.119	0.008	-0.115	0.007
She is >3 years older than he	-0.156	0.012	-0.138	0.009
Growth	0.000011	0.009003	-0.027	0.007
Gender specific unemployment rate	-0.074	0.020	0.027	0.018
1993	-0.017	0.047	-0.081	0.036
1994	0.032	0.069	-0.077	0.043
1995	0.037	0.056	0.028	0.036
1996	0.125	0.062	-0.025	0.042
1997	0.126	0.067	-0.038	0.039
1998	0.102	0.067	0.075	0.036
1999	0.078	0.054	0.061	0.023
2000	0.001	0.041	0.197	0.023
2001	-0.035	0.019	0.203	0.031
2002	-0.064	0.023	0.193	0.039

Table 9: Parameter estimates of the earnings

variable	Men		Women	
	Parameter estimate	Standard error	Parameter estimate	Standard error
Intercept	-0.245	0.008	-0.465	0.011
Ln (1+exp)	0.049	0.007	-0.107	0.010
Square of ln (1+exp)	0.045	0.001	0.051	0.002
Education level 1 (lowest)	-1.185	0.023	-1.095	0.014
Education level 2	-0.507	0.028	-0.799	0.025
Education level 3	-0.775	0.016	-0.742	0.017
Education level 4	-0.582	0.015	-0.615	0.016
Education level 5	-0.469	0.014	-0.219	0.016
Education level 1xln(1+exp)	0.391	0.016	0.241	0.012
Education level 2xln(1+exp)	-0.098	0.020	0.0086	0.019
Education level 3xln(1+exp)	0.180	0.012	0.069	0.014
Education level 4xln(1+exp)	0.076	0.012	0.082	0.014
Education level 5xln(1+exp)	0.164	0.012	0.064	0.014
Education level 1xln$(1+\exp)^2$	-0.088	0.003	-0.067	0.002
Education level 2xln$(1+\exp)^2$	0.026	0.004	0.010	0.004
Education level 3xln$(1+\exp)^2$	-0.045	0.002	-0.012	0.003
Education level 4xln$(1+\exp)^2$	-0.006	0.002	-0.0033	0.0030
Education level 5xln$(1+\exp)^2$	-0.031	0.002	-0.011	0.003
Ile de France	0.169	0.001	0.312	0.001
1991	0.042	0.002	0.041	0.002
1992	0.070	0.002	0.067	0.002
1993	0.090	0.002	0.086	0.002
1994	0.077	0.002	0.081	0.002
1995	0.089	0.002	0.090	0.002
1996	0.098	0.002	0.100	0.002
1997	0.098	0.002	0.097	0.002
1998	0.109	0.002	0.103	0.002
1999	0.112	0.002	0.119	0.002
2000	0.129	0.002	0.148	0.002
2001	0.148	0.002	0.186	0.002
2002	0.179	0.002	0.229	0.002

Table 10: Parameter estimates of the covariance matricess

Paremeter	Parameter estimate	Standard error
The covariance matrix of the idiosyncratic errors		
$\sigma_{mf,\epsilon}$ (labour market states spouses)	0.071	0.005
$\sigma_{m,\epsilon u}$ (lab. market state and earnings man)	-0.053	0.014
$\sigma_{mf,\epsilon u}$ (lab. market state husb, earnings wife)	-0.029	0.004
$\sigma_{fm,\epsilon u}$ (lab. market state wife, earnings husb.)	-0.017	0.003
$\sigma_{f,\epsilon u}$ (lab. market state and earnings wife)	-0.124	0.006
τ_m (std dev. earnings husband)	0.178	0.000
τ_{mf} (cov. earnings husband and wife)	0.154	0.001
τ_f (std dev. earnings wife)	0.190	0.000
The covariance matrix of the random effects		
$\sigma_{m,\alpha}$ (std. dev. random effect lab. market state husband)	0.776	0.005
$\rho_{mf,\alpha}$ (corr. labour market states husband and wife)	0.066	0.003
$\rho_{m,\alpha\omega}$ (labour market state and earnings husband)	0.983	0.000
$\rho_{mf,\alpha\omega}$ (labour market state husband, earnings wife)	0.183	0.001
$\sigma_{f,\alpha}$ (std. dev. random effect lab. market state wife)	1.027	0.003
$\rho_{fm,\alpha\omega}$ (labour market state wife, earnings husband)	-0.038	0.003
$\rho_{f,\alpha\omega}$ (labour market state and earnings wife)	0.977	0.000
$\sigma_{\omega,m}$ (std. dev. random effect earnings husband)	0.342	0.000
$\rho_{\omega,mf}$ (corr. random effects earnings husband and wife)	0.054	0.001
$\sigma_{\omega,f}$ (std. dev. random effect earnings wife)	0.662	0.001

Table 11: Probabilities of different household types

Household	Base	M, F low ed.	F high M low	M high F low	M, F high
Both out of work	0.027	0.066	0.026	0.023	0.011
Female breadwinner	0.070	0.098	0.113	0.035	0.044
Male breadwinner	0.219	0.303	0.136	0.333	0.157
Dual earners	0.684	0.533	0.725	0.609	0.788
Dual earners and Wf>Wm	0.187	0.133	0.505	0.018	0.215
Wf>Wm|on dual-earners	0.274	0.250	0.697	0.029	0.272
Wf>Wm	0.225	0.184	0.641	0.020	0.238
Dual earners|on Wf>Wm	0.831	0.724	0.788	0.866	0.901

The baseline case sets all covariates equal to the mean. Ed. stands for education level.

Table 12: Probabilities expressed as a difference reative to the base, standard errors below.				
Household	M, F low ed.	F high M low	M high F low	M, F high
Both out of work	0.039	-0.001	-0.004	-0.016
	0.00094	0.00041	0.00048	0.00046
Female breadwinner	0.028	0.043	-0.035	-0.026
	0.00097	0.00144	0.00103	0.00105
Male breadwinner	0.084	-0.083	0.114	-0.062
	0.00156	0.00186	0.00158	0.00191
Dual earners	-0.151	0.041	-0.075	0.104
	0.00156	0.00232	0.00183	0.00213
Dual earners and Wf>Wm	-0.054	0.318	-0.170	0.027
	0.00038	0.00191	0.00076	0.00069
Wf>Wm conditional on dual-earners	-0.024	0.423	-0.245	-0.001
	0.00065	0.00117	0.00102	0.00091
Wf>Wm	-0.042	0.415	-0.205	0.013
	0.00032	0.00095	0.00057	0.00062
Dual earners|on Wf>Wm	-0.107	-0.043	0.035	0.070
	0.00179	0.00181	0.00226	0.00178
The baseline case sets all covariates equal to the mean. Ed. stands for education level.				

Table 13: Probabilities of different household types					
growth	0.56	0.87	3.67	4.61	-1.01
urate men	7.9	10.8	6.7	8.3	9.5
urate women	10.1	14.2	11.8	11.6	13.3
Both out of work	0.027	0.033	0.025	0.030	0.029
Female breadwinner	0.070	0.097	0.061	0.071	0.086
Male breadwinner	0.219	0.191	0.230	0.232	0.190
Dual earners	0.684	0.679	0.685	0.667	0.696
Dual earners and Wf>Wm	0.187	0.179	0.190	0.185	0.184
Wf>Wm|on dual-earners	0.274	0.264	0.278	0.278	0.264
Wf>Wm	0.225	0.225	0.225	0.225	0.225
Dual earners|on Wf>Wm	0.831	0.795	0.843	0.822	0.815
All other all covariates set equal to the mean.					

Table 14: Probabilities expressed as a difference reative to the base, standard errors below.				
growth	0.87	3.67	4.61	-1.01
urate men	10.8	6.7	8.3	9.5
urate women	14.2	11.8	11.6	13.3
Both out of work	0.006	-0.002	0.003	0.001
	0.00328	0.00128	0.00193	0.00184
Female breadwinner	0.027	-0.009	0.001	0.016
	0.00773	0.00269	0.00416	0.00371
Male breadwinner	-0.028	0.011	0.013	-0.029
	0.01367	0.00786	0.00817	0.01068
Dual earners	-0.005	0.001	-0.017	0.012
	0.01552	0.00824	0.00909	0.01123
Dual earners and Wf>Wm	-0.008	0.003	-0.002	-0.004
	0.00274	0.00112	0.00165	0.00134
Wf>Wm conditional on dual-earners	-0.010	0.004	0.004	-0.010
	0.00438	0.00252	0.00269	0.00334
Wf>Wm	0.000	0.000	0.000	0.000
	0	0	0	0
Dual earners|on Wf>Wm	-0.036	0.013	-0.009	-0.016
	0.01218	0.00495	0.00732	0.00596
All other covariates set equal to the mean.				