INSTITUT NATIONAL DE LA STATISTIQUE ET DES ETUDES ECONOMIQUES
Série des Documents de Travail du CREST
(Centre de Recherche en Economie et Statistique)

n° 2010-09

Dynamic Modeling of Fertility and Labour Market Participation of Married or Cohabiting Women

C. EDON[1]
T. KAMIONKA[2]

[1] IRES (Institute for Economic and Social Research) – UCL (Université Catholique de Louvain) and IERPE (Institute for Empirical Resarch in Political Economy), Phone : (32) 10 47 39 74. Address : IRES, 3 Place Montesquieu, 1348 Louvain-la-neuve, Belgique. cyriaque.edon@uclouvain.be

[2] CNRS and CREST, Laboratoire de Microéconométrie, 15 Boulevard Gabriel Péri, 92245 Malakoff Cédex, France. Phone : (33) (0)1 41 17 35 51. kamionka@ensae.fr

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Cyriaque Edon* Thierry Kamionka†

This version : May 2010

Abstract

We jointly model fertility and participation decisions of women who live in couple using a dynamic model. In this paper we analyze the labour supply and the fertility decisions of married or cohabiting women in France, Spain, Germany, UK and Denmark. We estimate, for the period going from 1994 to 2001, a dynamic bivariate probit model with random effects using the ECHP (European Community Household Panel) and using a simulated maximum likelihood estimator. These estimates are made on an annual basis taking into account the initial conditions problem. The decisions of participation and fertility of women who live in couple depend on the individual characteristics (observed or unobserved) and are characterized by a significant state dependence. Our results suggest that the decisions of employment and fertility cannot be modeled separately. The differences in fertility across these countries are explained by individual characteristics and variations in social and fiscal policies. However, the unobserved components of heterogeneity also play a central role in the observed differences across countries. We show the importance of the permanent income component in the participation decision. Random effects are negatively correlated across the equations of the model. Consequently, women who, a priori, prefer to have a higher consumption have weaker preferences for fertility.

Keywords : Participation, Heterogeneity, Simulation based estimation, Panel data.
JEL Classification : J21, J22, C33, C35, J13.

* IRES (Institute for Economic and Social Research)-UCL (Université Catholique de Louvain) and IERPE (Institute for Empirical Research in Political Economy) (cyriaque.edon@uclouvain.be). Phone : (32) 10 47 39 74. Address: IRES. 3, Place Montesquieu. 1348 Louvain-la-Neuve. Belgique.

† CNRS and CREST (kamionka@ensae.fr). Phone : (33) (0)1 41 17 35 51. Address: CREST. Timbre J390. 15, Boulevard Gabriel Péri. 92245 Malakoff Cedex. France.

We would like to thank Georges Bresson, Guy Lacroix, David Margolis, Bruno Van der Linden, Christian Viegelahn, Sofia Pessoa e Costa and Leonard Wantchekon for helpful discussions and comments. We are also grateful to the participants at the UCL-IRES Research Seminar, at the IERPE (Institute for Empirical Research in Political Economy) Research Seminar, at the European Meeting of the Econometric Society (EEA-ESEM, Barcelone) and at the European Association of Labour Economists (EALE, Tallinn), JMA Conference (Angers) and ERUDITE Seminar for useful comments. Financial support from the Belgian Federal Government (Grant PAI P6/07 on "Economic Policy and Finance in the Global Economy: Equilibrium Analysis and Social Evaluation") is gratefully acknowledged.

1 Introduction

Most empirical studies on female labour supply behavior rely on exogeneity of fertility decisions with respect to labour supply and show a negative impact of fertility on labour participation. This negative correlation between fertility and employment or participation decreases with the age of the youngest child (e.g Mincer (1962), (1963), Heckman (1980)). However, this relation is not necessarily causal. The negative effect of fertility may be the result of a selection phenomenon where women who have higher preferences for fertility have also weaker preferences for consumption. Mroz (1987) shows, using cross section data, that conditionally on participation, fertility is exogenous with respect to women's labour supply. However, using panel data, Jakubson (1991) rejects the assumption of exogeneity of fertility.

The econometric problem associated with the endogeneity of fertility decisions with respect to female labour supply has been considered in several papers. Moffitt (1984) and Hotz, Kydland and Sedlacek (1988) treat the endogeneity problem, estimating the determinants of fertility and labour supply within a simultaneous-equation framework. Rosenzweig and Wolpin (1980), Bronars and Grogger (1994), Angrist and Evans (1998), Jacobsen, Pearce and Rosenbloom (1999), Angrist (2001) suggest to look for "natural" experiments, such as the occurrence of twins in the first birth. Another solution is to use instrumental variables to take into account the potential endogeneity of fertility. For instance Angrist (2001) exploits an exclusion restriction based on the sex of the first two children.

These studies show that the impact of fertility on labour market participation can be significantly different when the endogeneity of fertility is taken into account in the estimation. However, the results can vary a lot according to the specification used. In these studies most authors use a linear probability model to approximate non-linear relations or estimate the parameters using a two-step estimation procedure.

In addition, an extensive literature based on panel data that examines female labour supply indicates that there is persistence in the life cycle participation decisions of mothers. Heckman and Willis (1977), Nakamura and Nakamura (1985), Eckstein and Wolpin (1989) show that the majority of them work for most of their active life or do not work at all, and participation in one period has an impact on the participation probability in future periods. This persistence, usually referred to as *"true state-dependence"*, may reflect the accumulation of human capital or a change in the reservation wage due to increased search costs or a potential loss of skills when they are not employed. According to human capital theory, skills accumulated through experience raise the probability of working in the future. Similarly, fixed costs of entering the labour force (search costs, for example) make future participation more likely for individuals already working. A high persistence could imply that policies targeted at reducing the costs of participation could be effective. The presence of state dependence is very important when studying

women labour supply, in particular when we analyze the effect of fertility on participation. A long maternity leave leads to a decline in human capital investment, and possibly to a depreciation of the human capital stock. Ignoring this component is likely to bias the estimations. For example, Nakamura and Nakamura (1985, 1994) show that the mere presence of a child does not influence current labour supply when they take state dependence into account.

The persistence of participation decisions can also be the result of unobserved heterogeneity that reflects the differences in preferences for employment (called *"spurious state-dependence"*). Heterogeneity creates persistence because of self-selection of those with high preferences for employment. This creates spurious dependence of aggregate transition probabilities on previous state. True and spurious state-dependence have different implications on the design of social and economic policies. It is therefore important to disentangle the relative importance of these two causes of persistency.

Recent studies of female labour supply explore the role of true and spurious state-dependence on employment (e.g., Hyslop (1999) and Carrasco (2001), Edon and Kamionka (2008), Edon (2008), Del Boca and Sauer (2008)). Hyslop (1999) finds that participation decisions are characterized by substantial unobserved heterogeneity and positive state dependence. He also finds negative serial correlation in the transitory errors in specifications that allow for state dependence. Using the same specification as Hyslop (1999) in which he considers both state dependence forms, Edon and Kamionka (2008) show that the decision of participation of women who live in couple depends on individual characteristics and is characterized by a significant true state-dependence. In addition, the components of unobserved heterogeneity play a central role in the dynamics of labour market participation. This unobserved heterogeneity reflects differences in trade-off between consumption, leisure and domestic production. But, to our knowledge, except Del Boca and Sauer (2008) and Edon (2008), there are no studies that analyze the importance of true and spurious state-dependence across countries.

In line with Del Boca and Sauer (2008), we believe that in addition to human capital accumulation and search costs, the differences in the degree of state dependence across countries can be explained by institutional factors. In this case the difference in estimated values of state dependence in female labour supply between countries may, in large part, be the result of the differences in institutional environments, like labour market flexibility and child care. However, unlike Del Boca and Sauer (2008), we consider a dynamic framework to analyze both participation and fertility decisions. In addition, in our specification, the current participation equation depends on the current fertility decision. Unobserved heterogeneity is handled using individual random effects. These random effects can be correlated across equations. We allow the error terms of the equations to be correlated. Initial conditions are dealt using the method of Wooldridge (2005). The model is estimated by maximization of simulated likelihood (Kamionka (1998), Fougère and Kamionka

(2008)) and using data from the European ECHP for 5 countries: Denmark, France, Germany, Spain and UK.

We also show the existence of a large and negative correlation between participation decision and fertility. This correlation is captured by the individual effects (*"spurious state-dependence"*). This result suggests that women who have a strong preferences for maternity tend to have a weaker preference for consumption and employment. There is no correlation between the error terms of the equations in any country. For the model estimated for all the countries, the correlation between fertility and participation decision is large and negative and the correlation between the idiosyncratic terms is positive. The impact of the permanent component of the non-labour income on participation is negative. The impact of the transitory income on fertility is negative and positive on the participation decision.

The initial presence of a young child - at the time of the first survey - has a negative impact on fertility. The presence of a young child has a large and negative effect on employment. Consequently, the initial state is informative regarding the importance of fertility. As predicted by the classic labour supply theory, the impact of the diploma is positive and increases with the level of diploma.

The paper is organized as follows. The empirical model is presented in section 2. The data we use is described in section 3 where some descriptive statistics are discussed. We then present and comment the estimation results in section 4. The last section concludes.

2 Specification

In the labour supply literature, several authors have stressed that labour market participation and fertility decisions are the outcomes of a dynamic process where the effect of children on labour supply depends, in large part, on how previous labour supply and children are treated (e.g. Moffitt (1984), Hotz and Miller (1988), Keane and Sauer (2006)). According to the life-cycle model, in addition to variables describing observed heterogeneity, current employment decisions depend on past decisions. This allows to account for the search costs associated with labour market entry and labour market opportunities which differ with the individual's participation state (e.g Hyslop (1999)). Current employment may also depend on the number of children in the household and the new births which are respectively the result of past and current fertility decisions.

Like Carrasco (2001), we consider a dynamic equation for fertility which allows for feedback and in which the gender mix of existing children is used to identify the effect of a newborn on employment. The decision of childbearing may depend on current employment. For employed women, the perspective of incurring high costs upon returning may lead them to stay in employment and to delay birth (Garibaldi and Wasmer (2004)). Thus, we include the past employment state in the

fertility equation because current birth is the result of past fertility decisions which depend on previous participation decisions.

2.1 Modeling

Let y_{it}^* and d_{it}^* denote the latent variables associated with, respectively, participation and fertility decisions of woman i at time t.

We make the assumption that the existing relation between these variables and the characteristics of the women is the following:

$$\begin{cases} y_{it}^* = x_{it}'\beta_1 + \gamma_1\, y_{it-1} + \alpha\, d_{it} + \xi_{i1} + u_{it} \\ \\ d_{it}^* = x_{it}'\beta_2 + z_{it}'\delta + \gamma_2\, d_{it-1} + \gamma_3\, y_{it-1} + \xi_{i2} + v_{it}. \end{cases} \tag{1}$$

where y_{it} is equal to 1 if woman participates in the labour market and 0 otherwise ($t = 1, \ldots, T$ and $i = 1, \ldots, n$). Fertility at time t, namely d_{it}, is equal to 1 when a child was born during the last twelve months and 0 otherwise. x_{it} is a vector of observable characteristics which includes the marital status, partner's income, education level, age and demographic characteristics such as the existence of children in the household.

y_{it-1} and d_{it-1} represent, respectively, the indicator variables for labour market participation and fertility at time $t-1$. β_1 and β_2 are vectors of parameters. γ_1, γ_2 and α are real scalars (γ_1, γ_2, γ_3 and $\alpha \in \mathbb{R}$). ξ_{i1} and ξ_{i2} are individual effects and, consequently, are constant with time. u_{it} and v_{it} are error terms for woman i and period t.

z_{it} is a vector of instruments for fertility including a variable that indicates whether the first two children have the same gender and another variable that characterizes the gender of the eldest children. This kind of instrument was suggested by Angrist (Angrist and Evans 1998) because it is likely to be exogenous with respect to the error term of the participation equation but correlated with future births. These variables are probably good instruments since they are independent of u_{it} and are highly correlated with d_{it}. Let us remark that, in our sample, between 38.54 % and 65.34 % of women have at least two children, depending on the country.

Here, the only income taken into account for a woman who has to decide to participate or not - except the wage she receives when she is employed - is the income received by her partner. It can incorporate, according to the employment status of the partner, the unemployment benefit received by this individual. In practice, we do not consider in the specification those social benefits that depend on the total income of the household and on the number of children. This choice allows avoiding endogeneity problems associated with the non-wage income of the women.

y_{it}^* and d_{it}^* are unobservable variables. We observe the result of the choice of woman i :

$$y_{it} = \mathbb{1}[y_{it}^* > 0],$$

$$d_{it} = \mathbb{1}[d_{it}^* > 0],$$

where $t = 1, \ldots, T_i$ and $i = 1, \ldots, n$.

We make the assumption that $\xi_i = (\xi_{i1}, \xi_{i2})' \mid x_i, z_i \sim N(0, \Sigma_\xi)$ and that ξ_i is independent of x_i and z_i. The random effects ξ_i, $i = 1, \ldots, n$, are furthermore assumed to be independent across women. *A priori*, the individual effects for a given individual can be correlated across the equations.

Let $\epsilon_{it} = (u_{it}, v_{it})'$ be a vector of the error terms at time t for woman i. Let us assume that these error terms are independent across women and across periods. Moreover, $\epsilon_{it} \mid x_i, z_i \sim N(0, \Sigma_\epsilon)$, where

$$\Sigma_\epsilon = \begin{pmatrix} 1 & \rho_{uv} \\ \rho_{uv} & 1 \end{pmatrix},$$

where $\rho_{uv} = cov(u_{it}, v_{it})$ since $var(u_{it}) = var(v_{it}) = 1$.

2.2 Initial conditions

When we use a dynamic model, it is important to take into account the initial conditions when these conditions cannot reasonably be considered as exogenous. This problem has been underlined by Heckman (1981). Indeed, when the observation of a process starts after the first date of the process, the initial conditions are informative of unobserved heterogeneity. Recently, Wooldridge (2005) has proposed a simple method in order to take into account the problem of initial conditions in the context of a dynamic model with individual random effects. Let $x_i = (x_{i1}', x_{i1}', \ldots, x_{iT}')'$ and $z_i = (z_{i1}', z_{i1}', \ldots, z_{iT}')'$ be two vectors of exogenous characteristics for individual i.

Let $f(\xi_i \mid x_i, z_i, y_{i1}, d_{i1}; \Sigma_\xi)$ be the density probability function associated with the conditional distribution of the variable ξ_i given the initial conditions for participation and fertility (namely, y_{i1} and d_{i1}).

For the conditional distribution of the vector of individual effects, we assume that

$$\xi_{i1} = a_0 + a_1\, y_{i1} + (x_i', z_i')\, b_1 + e_{i1},$$
$$\xi_{i2} = c_0 + c_1\, d_{i1} + (x_i', z_i')\, b_2 + e_{i2},$$

where $e_i \sim N(0, \Sigma_\xi)$ and

$$\Sigma_\xi = \begin{pmatrix} \sigma_{\xi_1}^2 & \rho_{\xi_1\xi_2}\sigma_{\xi_1}\sigma_{\xi_2} \\ \rho_{\xi_1\xi_2}\sigma_{\xi_1}\sigma_{\xi_2} & \sigma_{\xi_2}^2 \end{pmatrix}.$$

Then, the latent model can be re-written

$$y_{it}^* = x_{it}'\beta_1 + \gamma_1\, y_{it-1} + \alpha\, d_{it} + a_0 + a_1\, y_{i1} + (x_i', z_i')\, b_1 + e_{i1} + u_{it},$$
$$d_{it}^* = x_{it}'\beta_2 + z_{it}\delta + \gamma_2\, d_{it-1} + \gamma_3\, y_{it-1} + c_0 + c_1\, d_{i1} + (x_i', z_i')\, b_2 + e_{i2} + v_{it},$$

where the variables $e_i = (e_{i1}, e_{i2})'$ are independently and identically distributed as normal random variables $N(0, \Sigma_\xi)$.

2.3 Identification

The specification corresponds to a bivariate probit model with random effects. Let r_{ijt} denote the residual for individual i at time t and for equation j ($j = 1, 2$). Let r_i denote the vector of residuals of the latent model for all the times and all the equations:

$$r_i = \begin{cases} r_{i11} = u_{i1} + e_{i1}, \\ \vdots \\ r_{i1T} = u_{iT} + e_{i1}, \\ r_{i21} = v_{i1} + e_{i2}, \\ \vdots \\ r_{i2T} = v_{iT} + e_{i2}. \end{cases}$$

Let $\Sigma_1 = \sigma_{\xi_1}^2\ \mathbb{1}_T \mathbb{1}_T'$, $\Sigma_2 = \sigma_{\xi_2}^2\ \mathbb{1}_T \mathbb{1}_T'$, $\Sigma_u = \sigma_u^2\ I_T$, $\Sigma_v = \sigma_v^2\ I_T$, $\Sigma_{12} = \rho_{\xi_1\xi_2}\sigma_{\xi_1}^2\sigma_{\xi_2}^2\ \mathbb{1}_T \mathbb{1}_T'$ and $\Sigma_{uv} = \rho_{uv}\ \sigma_u^2\sigma_v^2\ I_T$.

The variance of the error term of the latent model $V = Var(r_i)$ is given by the expression

$$V = \begin{pmatrix} \Sigma_1 + \Sigma_u & \Sigma_{uv} + \Sigma_{12} \\ \Sigma_{uv} + \Sigma_{12} & \Sigma_2 + \Sigma_v \end{pmatrix}$$

The extra diagonal elements of this symmetric matrix are identified like in a multivariate probit model.

Let us remark that $cov(r_{ijt}; r_{ijt'}) = var(e_{ij}) = \sigma_{\xi_j}^2$, for $j = 1, 2$ and $t \neq t'$. So, the variance of the random effect is identified using the panel dimension of the data. These parameters are identified using the correlations corresponding to time t and time t' for a given equation of the model.

Moreover, $cov(r_{ijt}; r_{ij't'}) = cov(e_{ij}, e_{ij'}) = \rho_{\xi_1\xi_2}\sigma_{\xi_1}\sigma_{\xi_2}$, if $j \neq j'$ and $t \neq t'$. The parameter $\rho_{\xi_1\xi_2}$ is then identified using the correlations corresponding to time t and time t' between fertility and employment.

Let us note that

$$cov(r_{ijt}; r_{ijt}) = \begin{cases} \sigma_{\xi_1}^2 + \sigma_u^2, & \text{if } j = 1, \\ \sigma_{\xi_2}^2 + \sigma_v^2, & \text{if } j = 2, \end{cases}$$

for $t = 1, \ldots, T$.

As the endogenous variables are binary variables, let us assume that $\sigma_u^2 = \sigma_v^2 = 1$.

Moreover, $cov(r_{i1t}; r_{i2t}) = cov(e_{i1}+u_{it}; e_{i2}+v_{it}) = \rho_{\xi_1\xi_2}\sigma_{\xi_1}\sigma_{\xi_2}+\rho_{uv}$. Then, ρ_{uv} is identified using the correlation corresponding to time t between fertility and employment equations.

2.4 Likelihood function

Let us consider an independent and identically distributed sample with size n. Under our assumptions, the likelihood function is

$$L(\theta) = \prod_{i=1}^{n} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \prod_{t=2}^{T} \Phi_2(z_{it}(e_{i1}), w_{it}(e_{i2}); \rho_{it})\ \phi_2(e_{i1}, e_{i2}, \Sigma_\xi)\, d\, e_{i1}\, d\, e_{i2}, \quad (2)$$

where $\phi_2(e_1, e_2, \Sigma_\xi) = \frac{1}{2\pi\,|\Sigma_\xi|^{1/2}} \exp(-\frac{1}{2}(e_1, e_2)\Sigma_\xi^{-1}(e_1, e_2)')$ and

$$z_{it}(e_{i1}) = (2y_{it}-1)\,(x'_{it}\beta_1+\gamma_1\, y_{it-1}+\alpha\, d_{it}+a_0+a_1\, y_{i1}+(x'_i, z'_i)\, b_1+e_{i1}),$$
$$w_{it}(e_{i2}) = (2d_{it}-1)\,(x'_{it}\beta_2+z_{it}\delta+\gamma_2\, d_{it-1}+\gamma_3\, y_{it-1}+c_0+c_1\, d_{i1}+(x'_i, z'_i)\, b_2+e_{i2}),$$
$$\rho_{it} = (2\, y_{it} - 1)\,(2\, d_{it} - 1)\,\rho_{uv}.$$

As the contribution (2) of a given individual to the likelihood function has no closed form, we simulate this function using random drawings e_{ij}^h, $h = 1, \ldots, H$, for each individual i and equation j, $j = 1, 2$.

We can then obtain an estimation of the vector θ of parameters maximizing the logarithm of the simulated likelihood function:

$$\hat{\ell}_{N,H}(\theta) = \sum_{i=1}^{N} \ln(\frac{1}{H} \sum_{h=1}^{H} \prod_{t=2}^{T} \Phi_2(z_{it}^h; w_{it}^h; \rho_{it})) \quad (3)$$

where $z_{it}^h = z_{it}(e_{i1}^h)$ et $w_{it}^h = w_{it}(e_{i2}^h)$. The drawings e_{ij}^h are specific to the individual i, and independent and identically distributed ($i = 1, \ldots, n$).

Indeed, the individual contribution (2) to the likelihood function can be estimated using (cf. Gouriéroux and Monfort (1997)):

$$\hat{p}_i^H = \frac{1}{H} \sum_{h=1}^{H} \prod_{t=2}^{T} \Phi_2(z_{it}^h; w_{it}^h; \rho_{it}) \quad (4)$$

where $z_{it}^h = z_{it}(e_{i1}^h)$ and $w_{it}^h = w_{it}(e_{i2}^h)$. $e_{ij}^h = (e_{i1}^h, e_{i2}^h)'$ are random drawings obtained from the distribution $N(0, \Sigma_\xi)$. These drawings allow to generate error terms from the equations of the model. H is the total number of drawings used for each individual. $\hat{p}_i^H$ is an estimation of the contribution i to the conditional likelihood function. $j = 1, 2$ is the index, respectively, for participation and fertility equations.

Let us remark that the drawing $e_{ij}^h = (e_{i1}^h, e_{i2}^h)'$ is obtained from the distribution $N(0, \Sigma_\xi)$. In order to obtain one of these drawings let $\eta_{ij}^h \sim N(0, 1)$ for $j = 1, 2$ and $\eta_i^h = (\eta_{i1}^h, \eta_{i2}^h)'$. Let $\Sigma_\xi = C\, C'$ where C is a lower triangular matrix. Then, let us assume that $e_i^h = C\, \eta_i^h$, where the drawings e_i^h are specific to individual i and independent.

3 Data

3.1 Sample selection

The data used in this study are from the European Community Household Panel (ECHP). The ECHP is a community survey launched by the Statistical Office of the European Communities (EUROSTAT) in 1993 in the 12 countries of the European Union[1]. In the first wave of 1994 a sample of some $60,500$ households- approximately $130,000$ adults aged 16 years and over - were interviewed in the 12 member States. The ECHP is a longitudinal survey based on a standardized questionnaire that involves the annual interview of a representative panel of households and individuals, covering a wide range of topics including demographics, employment characteristics, education. The aim of the ECHP is to obtain a unique and coherent community source in the field of households' and individuals incomes, before and after the implementation of the domestic market. Even if the income represents the central information, this survey covers diverse domains such as employment, education, accommodation, health and social relationships. It allows studying, in a dynamic way, the links between income and these various terms. It also authorizes a comparative analysis between individuals and across countries because data collection method and questionnaires are standardized. This will allow the distinction between institutional and individual specificities.

The survey began in 1994. It was originally decided to conduct this survey for three years but it was then prolonged until 2001. Our study is based on the eight calendar years $1994 - 2001$ corresponding to waves 1 to 8. The working sample is restricted to women, aged between 20 and 56 years old in 1994, continuously living in couple (married or not) during the period. The restriction on age allows to cover the activity period. The condition imposed on the marital situation is not very strong. Indeed, the women in our sample are in couple during all of the follow up period, but it is possible for them to change spouse. There is not, to our knowledge, in the ECHP, any variable allowing to notice the household changes following a separation. However, if a woman changes partner between 1994 and 2001, the effect of this change on the employment or fertility can be observed through the effect of spouse's income which can vary over the time.

We consider five countries: Denmark, France, Germany, Spain and UK. We focus our analysis on these countries because they differ in terms of institutions related to employment and childcare. Furthermore, each of these countries represents one of five regimes of welfare state which prevail in Europe according to the typology established by Esping-Andersen (Esping (1990)). According to them,

[1] At the beginning, in 1994, the ECHP data were collected in the 12 Member States (Germany, Belgium, Denmark, Spain, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and the UK) by "National Data Collection Units", either National Statistical Institutes (NSIs) or research centers depending on the country. They were joined by Austria in 1995, by Finland in 1996, then by Sweden in 1997.

Table 1: **Sample characteristics**

	France	**Germany**	**Spain**	**UK**	**Denmark**
Education level$^{(a)}$					
Low educ.	46.36	21.97	71.53	51.04	20.52
	(0.498)	(0.414)	(0.451)	(0.500)	(0.404)
Middle educ.	28.88	58.57	13.74	13.06	44.42
	(0.453)	(0.493)	(0.344)	(0.337)	(0.497)
Higher educ.	23.13	18.83	14.73	35.14	34.98
	(0.421)	(0.391)	(0.354)	(0.477)	(0.477)
Fecundity$^{(a)}$					
Number of children$^{(b)}$	1.53 (1.172)	1.29 (1.075)	1.85 (1.088)	1.17 (1.039)	1.23 (1.128)
Number of children aged 0-2 y.o$^{(c)}$	15.03 (0.357)	9.40 (0.292)	10.81 (0.311)	11.65 (0.321)	15.44 (0.361)
Number of children aged 3-5 y.o$^{(c)}$	12.59 (0.332)	8.26 (0.275)	10.05 (0.301)	9.98 (0.299)	12.19 (0.327)
Number of children aged 6-11 y.o$^{(c)}$	32.51 (0.468)	25.48 (0.436)	31.16 (0.463)	24.23 (0.428)	28.60 (0.452)
Number of children aged 12-16 y.o$^{(c)}$	24.15 (0.428)	21.22 (0.409)	25.19 (0.434)	16.55 (0.372)	19.25 (0.394)
Number of children aged 17 y.o and more$^{(c)}$	34.55 (0.476)	37.16 (0.483)	51.91 (0.500)	28.56 (0.451)	24.73 (0.431)
Partner's income$^{(b)}$ (in KE 2001)	25.47 (25.52)	23.02 (14.07)	14.57 (11.97)	22.31 (16.60)	25.75 (13.43)
Elements of biography					
Age$^{(b)}$	42.22 (9.32)	42.97 (9.918)	43.58 (9.29)	42.73 (9.80)	42.74 (9.642)
Capital$^{(a)}$	20.33	2.86	9.65	7.62	8.17
	(0.402)	(0.170)	(0.295)	(0.265)	(0.274)
Married$^{(a)}$	89.91	94.85	99.16	94.68	86.29
	(0.301)	(0.221)	(0.091)	(0.224)	(0.344)
Citizenship$^{(a)}$					
Nationals	95.70	85.21	99.35	98.17	98.69
	(0.203)	(0.355)	(0.080)	(0.134)	(0.114)
Immigrant	7.68	14.79	1.43	1.83	2.46
	(0.266)	(0.355)	(0.119)	(0.134)	(0.155)
Unemployed partner	3.15	7.01	7.84	2.88	2.37
	(0.175)	(0.255)	(0.269)	(0.167)	(0.152)
Number of observations	1641	1929	1638	712	650

Note : ECHP 1994 - 2001. Standard error in parentheses.

$^{(a)}$ Column percentages

$^{(b)}$ Sample Averages. $^{(c)}$ Sample Averages ($\times 100$).

Denmark belongs to the *"social universalist democratic regime"* which is characterized by flexible labour markets and generous welfare policies. These policies are financed by relatively high taxes on labour income and/or social security contributions. This regime is in general observed in the Nordic countries. The *"conservative regime"* represented by Germany is characterized by a family policy less generous than the Nordic regime and likely to vary according to parent's employment status. Social transfers are related to previous earnings, and means-tested social transfers act as a residual safety net. In the UK, qualified as a *"liberal regime"*, children are supposed to pertain to the privacy domain. The State plays a guiding role and intervenes only in poor families. In this regime, social transfers, often means-tested, are less generous than in other regimes. The labour market is relatively flexible. Family policies are financed with lower income taxes and lower social security contributions, when compared to the universalist and the conservative welfare regimes. In the *"Mediterranean regime"* characterized by Spain, the prevailing institutional regime relies on family ties rather than on social insurance. As in the liberal regime, social transfers are given less generously than in the universalist and the conservative regimes. But unlike the Anglo-Saxon system, this policy is motivated only by the economic situation of countries and not by an ideologic concept. The French regime is a mix of the universalist and conservative regimes. Public policy encourages women to work. Like in the universalist regime, social transfers are relatively generous in France.

We use a balanced version of the ECHP panel in order to have the same temporal dimension for all individuals. This means that we retain in our study only women who are present during the eight years of survey. This choice is guided by the analysis of the income effect on employment. It is necessary to have an identical time length for all individuals in order for the effect of permanent non-labour income which is estimated by the sample average of the spouse income to be comparable. It is possible to use a balanced panel data without consequence for the estimations because the individuals are followed in their geographical and professional mobility: this limits attrition rates.

Finally, we retained in our sample the trajectories of women for which individuals' explanatory variables values are available in this panel. We have a sample of 1641 women for France, 1929 for Germany, 712 for UK, 1638 for Spain and 650 for Denmark (see. Table 1). The average age varies between 42 and 44 years, depending on the country.

The education levels in our sample correspond to the International Standard Classification of Education (ISCED). Low education includes pre-primary, primary and lower secondary education. Middle education represents upper secondary education. High education represents tertiary education. The distribution of diplomas analyzed for the full sample during the period indicates a significant difference within countries on the one hand, and between countries on the other hand. Denmark is the country where women are the most educated. In particular, 20.52% of the Danish women living in couple have a low level of education (ISCED $0-2$),

44.42% have a middle level (ISCED 3) and 34.98% have a high level (ISCED 5-7). Among the countries of our study, the lowest education levels are observed most frequently in Spain. We observe that 71.53% of Spanish women who live in couple have a low education level and 14.73% a high level.

Annual spouse's income (non-labour income) are expressed in constant 2001 Euro. The average non-labour income over the sample period is the lowest in Spain (14570 euros) and the highest in Denmark (25750 Euro). Of course, European women living in couple are often married. According to countries, the percentage of married women in our sample varies between 86.29% and 99.16%. The lowest average number of children is observed in UK (1.17) and the highest in Spain (1.85). A priori, there is no significant difference in the global fertility rate across countries. However, the observed distribution of the age of children shows a disparity between countries. Women who live in couple in Denmark, in France and in UK have more frequently infants and young children than those living in Germany and in Spain. But, children stay longer in household in Spain compared to other countries. For illustration, in our sample 51.91% of Spanish women have in their household a child aged of 17 years old or more while they are 24.73% in Denmark.

3.2 Female employment rates

Figure 1 presents the annual participation rates of women who live in couple in the sample. Participation is defined by the individual employment status. Nevertheless, we have shown, in an other study (Edon and Kamionka (2008), Edon (2008)), that the estimation outcomes when our specification is based on employment *versus* non employment or activity *versus* inactivity are generally similar in accordance with Jones and Riddell (1999).

The employment rates over the sample period are high in all countries except in Spain. The lowest rates are observed in Spain (between 28.82% and 35.47%) and the highest in Denmark (between 78% and 82.46%) followed by the UK (between 59.13% and 65.44%), France (between 58.13% and 64.41%) and Germany (between 56.35% and 60.29%).

We identify, using the employment evolution during the study period, two groups of countries:

- Spain : characterized by a strong and continuous growth of participation rate over the study period, from 29.54% in 1994 to 35.47% in 2001.
- Denmark, France, Germany, UK: characterized by a cyclic evolution of participation but no trend. The employment rate of women in couple is positively correlated with economic situation.

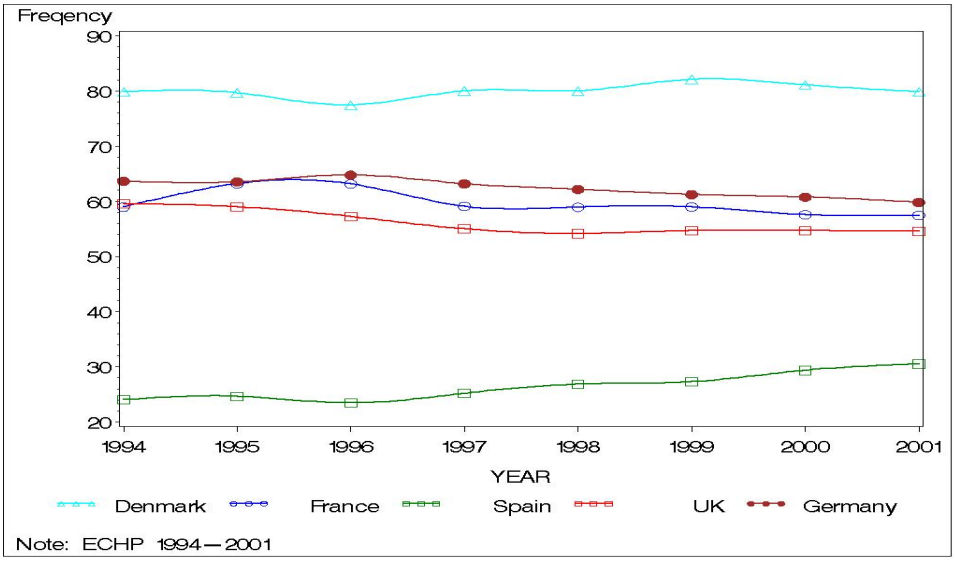

Figure 1: *Female Employment Rates by Country*

3.3 Evolution of female participation

To describe the dynamics of the participation of women who live in couple during a life cycle, we analyze the number of years worked during the period going from 1994 to 2001. The observed frequency distribution of years of participation (Table 2) suggests that there is significant persistence in the annual working decision of women in couple. Thus, in our data, 59.54% of women who live in couple in Denmark were continuously employed during eight years. These rates are respectively 41.19%, 37.78% and 35.56% in France, in U.K and in Germany. The low persistence of employment rate observed in Spain where only 17.7% of the women continuously worked during eight years may be explained by a weak global labour market participation.

The distribution of the number of employment years is different across countries. We can distinguish, in our data, two types of countries according to the female labour market characteristics:

- Countries with a high mobility represented by U.K and Germany where, respectively, 44.24% and 42.57 of women move, at least one time, from nonemployment to employment or from nonemployment to employment.
- Countries with a medium mobility represented by France, Denmark and Spain where, respectively, 35.71, 33.84% and 33.58% of women move, at least one time, from nonemployment to employment or from nonemployment to employment.

Table 2: **Employment Evolution**

	Number of employed years									Total
	0	1	2	3	4	5	6	7	8	
France	379	67	68	73	68	90	95	125	676	1641
	(23.10)	(4.08)	(4.14)	(4.45)	(4.14)	(5.48)	(5.79)	(7.62)	(41.19)	(100)
Germany	423	120	105	110	90	112	114	169	686	1929
	(21.93)	(6.22)	(5.44)	(5.70)	(4.67)	(5.81)	(5.91)	(8.76)	(35.56)	(100)
Spain	798	150	93	78	66	48	46	69	290	1638
	(48.72)	(9.16)	(5.68)	(4.76)	(4.03)	(2.93)	(2.81)	(4.21)	(17.70)	(100)
U.-K.	128	38	30	37	43	39	41	87	269	712
	(17.98)	(5.34)	(4.21)	(5.20)	(6.04)	(5.48)	(5.76)	(12.22)	(37.78)	(100)
Denmark	43	12	18	23	22	39	45	61	387	650
	(6.62)	(1.85)	(2.77)	(3.54)	(3.38)	(6.00)	(6.92)	(9.38)	(59.54)	(100)

Note : ECHP 1994 - 2001, Eurostat. Frequencies in parentheses.

3.4 Average number of children

Consider the observed average number of children of women aged at most 50 years old (see Figure 2). This Graph shows the cumulative average number of children in the household. If there are no births during our study period, the curve will be represented by a straight line. We can see that, according to our sample, the average number of children has increased overall but at a decreasing rate. The curve slope is higher in France and Denmark and lower in Spain and Germany. This indicates that there were more births in France and Denmark than in Spain and Germany between 1994 and 2001.

The evolution of the average number of children seems to be similar in Germany and in Denmark. The average number of children increased between 1994 and 1999, then decreased between 1999 and 2000 and, then, increased again. Nevertheless, the average number of children and the fertility growth are significantly higher in Denmark than Germany.

Furthermore, fertility has continuously increased in France over the sample period. Finally, the highest average number of children is observed in France followed by Spain, Denmark, Germany and UK. In order to better understand these differences between countries, we analyze the distribution of the average number of children conditionally on employment.

The relationship between the number of children and employment is shown in Figure 3. Women without employment have more children than working women in all the countries except Denmark. Fertility does not seem to penalize employment of women in Denmark.

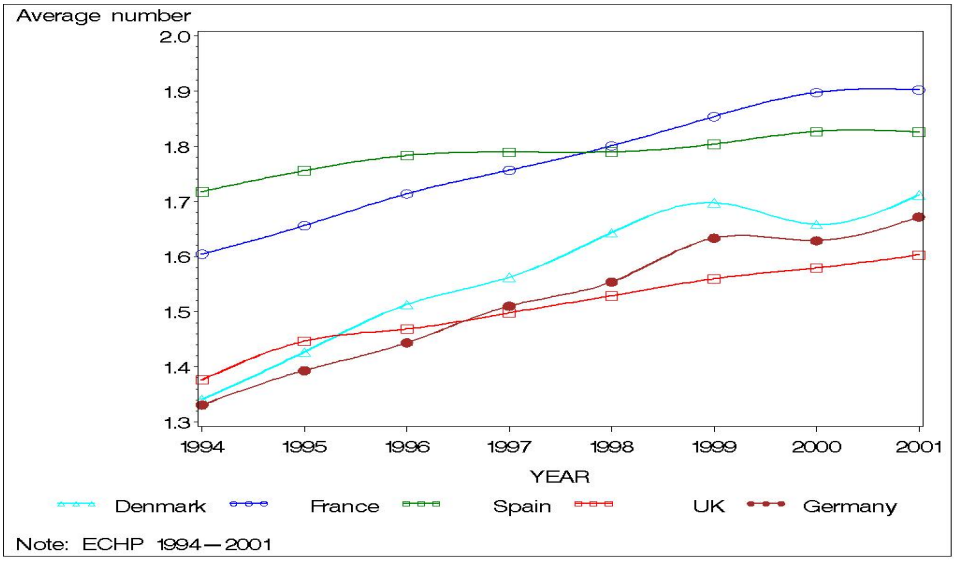

Figure 2: *Average number of children (women aged at most* 50 *yo.)*

Except for Denmark, the average number of children drops when women are employed. The difference between the average number of children in the household when the woman is employed and when she is not is maximal for Germany and Spain (see Figure 3). This difference is minimal for Denmark. The situation in Denmark is singular since the average number of children is generally greater in this country when women are employed.

These differences in fertility rates for employed and nonemployed women can be due to several factors, including state-dependence in fertility, financial factors or the difficulty to combine maternity and employment.

4 Results

We have estimated the model for each country separately. These results allow to compare, in particular, the structure of the covariance matrix across countries or the impact of the presence of a young child on the employment equation. However, the exercise is limited by the size of each subsample (see Table 1). Section 4.2 presents the results of the estimation of the model on the whole sample.

4.1 Estimation results by country

The estimation results are presented in Tables (3) and (4).

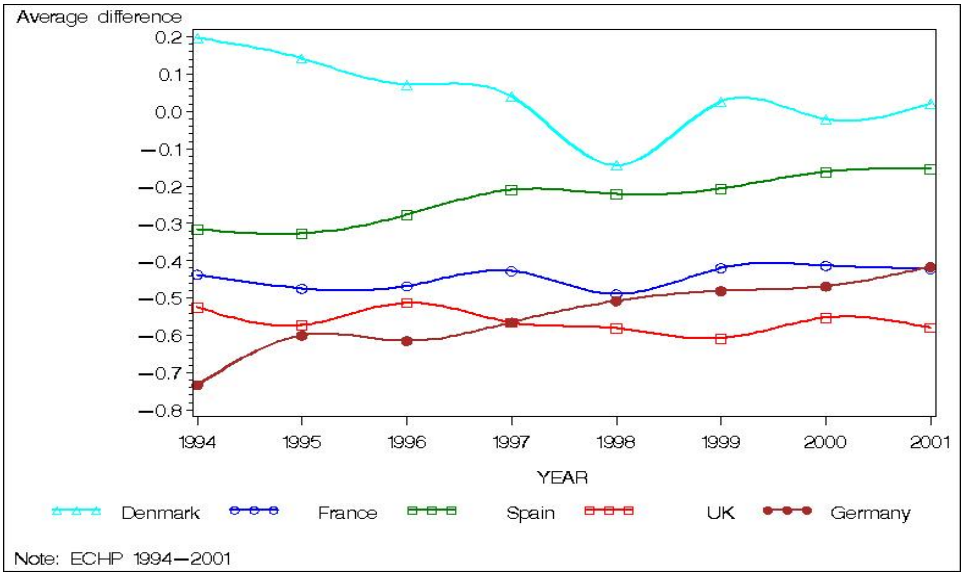

Figure 3: *Average difference in the number of children between employed and nonemployed women (women aged at most* 50 *years old.)*

4.1.1 Impact of age

The conditional probability of employment is weak for young women (aged from 20 to 29 years old) comparatively to the reference group (women aged from 30 to 39 years old) in all countries. The low probabilities of employment observed for the first age group can be the result of late arrival on the labour market of young women due to the continuation of studies and/or a greater fertility for this age group. For example, in Germany women frequently decide to delay their entry in the labour market in order to have children (in this country women have usually less children. Indeed, in 2008, the birth rate is equal to 8.18 for 1000 in Germany and to 12.73 for 1000 in France[2]). Furthermore, women are frequently employed on the 30 to 50 age group in all countries. This indicates that women who live in couple enter and stay into the labour market at ages where births are less frequent.

We observe a quadratic effect of age on employment behavior: the conditional employment probability is first increasing with age then decreasing (except for Denmark). For Germany, women with age greater or equal to 50 years old are significantly less likely to be employed. The employment behavior of this group is the consequence of local practices in terms of withdrawal from the labour market.

4.1.2 Impact of the diploma

The effect of the diploma on the conditional probability of employment is positive. Our estimations show that employment probabilities increase with the degree of

[2]see http://www.statistiques-mondiales.com.

diploma, whatever the country. All things being equal, this results is consistent with the Neoclassic labour supply theory predictions. According to this theory, there is a positive correlation between diploma and the opportunity cost associated with leisure. Thus, women who are more educated are also more likely to be employed.

Compared to women who have low education, only women who have higher diplomas are more frequently employed in the UK and in Germany. There is no significant difference in employment probabilities between women with elementary (low) and secondary (middle) education levels in these countries. This result suggests that the expected wage of women who have secondary education level is not higher than those who have elementary education.

However, the effect of diploma varies across countries. The difference in employment rates across education levels is higher in Spain, country where participation of women is low. This difference is lower in the UK, a country where participation of women is high and where the labour market is more flexible.

The impact of diploma on fertility is generally weak. Women who have a secondary education are less likely to give birth to a child than those who have an elementary education level in all countries, particularly in Germany and in France. This result could be explained by the difficulty for women who have a middle education level to conciliate family life and employment. In the presence of a young child in the household, employment generates new participation costs such as childcare costs. However, the expected wages of women who have middle education level are not large enough to compensate these costs. Therefore, women in this social group postpone birth for professional reasons.

Particularly in Spain, women with a higher diploma have a greater probability to have a child. This result can be associated with a large impact of diploma on the conditional probability of being employed in this country. The lack of sufficient support for families with young children makes it difficult for mothers to conciliate a professional and a family life (see Table 6). A high level of education ensures, to some extent, higher wages allowing women to cope with high costs associated with the presence of young children when they are employed. Thus, it is easier for mothers with higher diploma to support the participation costs due to the newborn.

The diploma has no significant impact on fertility for Denmark and U.K. The sample sizes are probably not large enough for these countries (respectively, 650 and 712 individuals). For Germany, the estimated impact of the diploma on fertility is negative for women with a middle or higher diploma. Consequently, for Germany, we can consider that educated women choose more frequently to be employed rather than to have children.

Table 3: **Bivariate Dynamic Probit (employed or non employed)**

	France		**Germany**		**Spain**	
	Fertility equation	Employment equation	Fertility equation	Employment equation	Fertility equation	Employment equation
Fertility						
Newborn	-	-0.9002**	-	0.5685**	-	-0.8993
		(0.3108)		(0.2383)		(0.5508)
Initial child	-0.0813	-	-0.7941	-	-0.4332**	-
	(0.0870)		(0.5062))		(0.1387)	
Children of the same sex	0.4867***	-	0.2179***	-	0.3607***	-
	(0.0673)		(0.0842)		(0.0722)	
First child is a boy	0.1589***	-	0.2537***	-	0.1502**	-
	(0.0559)		(0.0752)		(0.0667)	
Number of children aged 1-3 y.o	0.0716 (0.0589)	-0.3913*** (0 (0.0717)	1.6214*** (0.0597)	-1.1130*** (0.0988)	0.0812 (0.0648)	-0.2147** (0.0928)
Number of children aged 4-6 y.o	-0.2008*** (0.0581)	-0.2598*** (0.0580)	0.0264 (0.0785)	-0.4320*** (0.0641)	-0.0621 (0.0620)	-0.1741** (0.0731)
Number of children aged 7-12 y.o	-0.3920*** (0.0444)	-0.0634 (0.0424)	-0.2237*** (0.0640)	-0.2412*** (0.0461)	-0.3867*** (0.0418)	-0.0463 (0.0485)
Number of children aged 18y.o or more	-0.3846*** (0.0562)	0.0101 (0.0408)	-0.1916** (0.0693)	-0.0278 (0.0391)	-0.3058*** (0.0477)	0.0619 (0.0458)
Diploma						
Low educ	Ref	Ref	Ref	Ref	Ref	Ref
Middle educ.	-0.1556**	0.1135**	-0.2113**	0.0497	-0.1421	0.5575***
	(0.0780)	(0.0550)	(0.1045)	(0.0713)	(0.1023)	(0.0820)
High educ.	0.0959	0.3763***	-0.2082	0.5332***	0.2253**	1.0475***
	(0.0829)	(0.0714)	(0.1334)	(0.0872)	(0.1002)	(0.0985)
Income of partner or cohabitant						
y_{mit}	-0.0186	0.0059	-0.0842	-0.0726*	0.0099	0.0073
	(0.0429)	(0.0303)	(0.0578)	(0.0383)	(0.0545)	(0.0385)
y_{pit}	0.0030	-0.0191*	0.0303	-0.0994***	-0.0165	-0.1533***
	(0.0321)	(0.0113)	(0.0353)	(0.0219)	(0.0514)	(0.0367)
Unemployed partner	0.2266	-0.0825	0.0448	-0.1447*	-0.0744	-0.0038
	(0.1453)	(0.1105)	(0.1299)	(0.0748)	(0.1210)	(0.0843)

(*) Significant at 10%. (**) Significant at 5%. (***) Significant at 1%.

(a): y_{mit} is the transitory non-labour income (partner income) of woman i in year t, that is measured as deviations from the sample average.

(b): y_{pit} is the permanent non-labour income (partner income) of woman i in year t, that is estimated by the sample average.

Table 3: **Bivariate Dynamic Probit (employed or non employed)(Cont.)**

	France		**Germany**		**Spain**	
	Fertility equation	Employment equation	Fertility equation	Employment equation	Fertility equation	Employment equation
Age						
From 20 to 29 y.o.	0.2064**	-0.2240**	0.2080**	-0.3046***	0.1526	-0.2170
	(0.0789)	(0.0985)	(0.1051)	(0.0872)	(0.1047)	(0.1484)
From 30 to 39 y.o.	Ref	Ref	Ref	Ref	Ref	Ref
From 40 to 50 y.o.	-0.8496***	0.2844***	-0.3065*	0.0726	-0.5029***	0.2931**
	(0.1231)	(0.0809)	(0.1815)	(0.0754)	(0.1302)	(0.0976)
50 y.o. or more	-	0.1915	-	-0.2521**	-	0.2161
		(0.1344)		(0.1216)		(0.1581)
Elements of biography						
Married	1.5263***	2.1566***	0.5568*	1.3068***	0.9977**	1.6860***
	(0.2575)	(0.2727)	(0.3444)	(0.2936)	(0.3376)	(0.4648)
Age*wedding	-0.0461***	-0.0578***	-0.0107	-0.0407***	-0.0457***	-0.0325***
	(0.0076)	(0.0072)	(0.0095)	(0.0061)	(0.0079)	(0.0084)
Foreign	0.2712**	-0.2509**	0.0630	-0.1908**	0.3640**	-0.1881
	(0.0988)	(0.0974)	(0.1091)	(0.0924)	(0.1807)	(0.2303)
Other parameters						
Constant	-1.2345***	-1.2553***	-2.5158***	-0.3762**	-0.8350***	-2.2238***
	(0.1229)	(0.1050)	(0.2629)	(0.1475)	(0.2109)	(0.3517)
y_{t-1}	0.0735	1.8785***	0.2627**	1.3358***	-0.0537	1.2224***
	(0.0707	(0.0545)	(0.0847)	(0.0426)	(0.0839)	(0.0551)
d_{t-1}	-1.0955***	-	-1.8860***	-	-0.6712***	-
	((0.1280)		(0.1720)		(0.1895)	
y_1	-	1.3374***	-	1.4374***	-	2.0323***
		(0.1000)		(0.0782)		(0.1161)
Variance of effects (Σ_ξ)						
σ_1	-	0.6507***	-	0.9036***	-	1.0529***
		(0.0558)	-	(0.0458)		(0.0582)
σ_2	0.0318	-	0.1259	-	0.0576	-
	(0.1281)		(0.157)		(0.1317)	
ρ_{12}	-0.9312*		-0.9965***		-0.0708	
	(0.5426)		(0.0589)		(0.0698)	
Correlation of idiosyncratic terms (Σ_ϵ)						
ρ_{uv}	-0.0179		0.1642		0.1877	
	(0.0048)		(0.1405)		(0.2859)	

(*) Significant at 10%. (**) Significant at 5%. (***) Significant at 1%.

Table 4: **Bivariate Dynamic Probit (employed or non employed)**

	UK		Denmark	
	Fertility equation	Employment equation	Fertility equation	Employment equation
Fertility				
Newborn	-	-0.6331	-	-1.1277**
		(0.6125)		(0.4220)
Initial child	-0.3254	-	-0.5865*	-
	(0.2330)		(0.3362)	
Children of the same sex	0.2203	-	0.3454**	-
	(0.1422)		(0.1157)	
First child is a boy	-0.1289	-	0.1661	
	(0.3023)		(0.1085)	-
Number of children aged 1-3 y.o	0.5748*** (0.0823)	-0.4301** (0.1313)	0.7828*** (0.0792)	-0.0673 (0.1230)
Number of children aged 4-6 y.o	0.0200 (0.0846)	-0.2704** (0.0925)	0.0004 (0.0952)	-0.0530 (0.0957)
Number of children aged 7-12 y.o	-0.5775*** (0.0910)	-0.0907 (0.0664)	-0.2837*** (0.0718)	0.0328 (0.0717)
Number of children aged 18y.o or more	-0.5433*** (0.1580)	0.1039 (0.0692)	-0.3053* (0.1623)	0.0460 (0.0816)
Diploma				
Low educ	Ref	Ref	Ref	Ref
Middle educ.	-0.1351	-0.0876	-0.1132	0.4020***
	(0.1629)	(0.1228)	(0.1845)	(0.0951)
High educ.	-0.0212	0.2781**	0.0824	0.6790***
	(0.1277)	(0.0864)	(0.1927)	(0.1080)
Income of partner or cohabitant				
y_{mit}	0.0134	-0.0481	0.0208	0.0119
	(0.0540)	(0.0320)	(0.0610)	(0.0317)
y_{pit}	-0.0274	-0.0282	0.0413	-0.0227
	(0.0535)	(0.0357)	(0.0799)	(0.0378)
Unemployed partner	0.1427	-0.2868	-0.0497	-0.0971
	(0.3457)	(0.2274)	(0.4469)	(0.2142)

(*) Significant at 10%. (**) Significant at 5%. (***) Significant at 1%.

(a): y_{mit} is the transitory non-labour income (partner income) of woman i in year t, that is measured as deviations from the sample average.

(b): y_{pit} is the permanent non-labour income (partner income) of woman i in year t, that is estimated by the sample average.

Table 4: **Bivariate Dynamic Probit (employed versus non employed)(Cont.)**

	UK		Denmark	
	Fertility equation	Employment equation	Fertility equation	Employment equation
Elements of biography				
Age				
From 20 to 29 y.o.	-0.0498	-0.2516	0.2360	-0.2346
	(0.1501)	(0.1796)	(0.1583)	(0.1583)
From 30 to 39 y.o.	Ref	Ref	Ref	Ref
From 40 to 50 y.o.	-0.6366**	0.3312**	-1.0254***	0.1000
	(0.2245)	(0.1332)	(0.2474)	(0.1365)
50 y.o. or more	-	0.2317	-	-0.0240
		(0.2009)		(0.1999)
Other parameters				
Married	1.4986**	2.0102***	1.4574**	1.6841***
	(0.4872)	(0.4632)	(0.7115)	(0.3733)
Age*wedding	-0.0349**	-0.0503***	-0.0448**	-0.0401***
	(0.0137)	(0.0104)	(0.0216)	(0.0091)
Foreign	-0.7295	-0.2335	0.3054	-0.0109
	(0.5737)	(0.3819)	(0.4599)	(0.2201)
Other parameters				
Constant	-1.5066***	-1.0839**	-1.5770***	-0.9932***
	(0.2177)	(0.2270)	(0.3104)	(0.1735)
y_{t-1}	0.0093	1.5836***	0.1039	1.6451***
	(0.1315)	(0.0743)	(0.1456)	(0.0939)
d_{t-1}	-1.0014***	-	-1.5827***	-
	(0.2140)		(0.2711)	
y_1	-	1.1999***	-	0.9686***
		(0.1305)		(0.1303)
Variance of effects (Σ_ξ)				
σ_1	-	0.8014***	-	0.4805***
		(0.0761)		(0.0858)
σ_2	0.15036	-	0.0344	-
	(0.2194)		(0.2838)	
ρ_{12}	-0.9894***		-0.6600	
	(0.11730)		(1.9159)	
Correlation of idiosyncratic terms (Σ_ϵ)				
ρ_{uv}	-0.0778		0.2494	
	(0.3297)		(0.2950)	

(*) Significant at 10%. (**) Significant at 5%. (***) Significant at 1%.

4.1.3 Direct and dynamic effects of fertility on employment

Our empirical specification allows to analyze both direct (short-run) and dynamic (long-run) effects of fertility on employment probabilities. The direct effect of fertility on labour supply decisions can be evaluated by the impact of current birth on employment probabilities. According to our estimations, giving birth to a child affects differently women labour force participation across countries. Indeed, the arrival of a newborn in the household reduces the employment probabilities in all countries except in Germany. But this effect is significantly different from zero and higher in France and in Denmark, two countries where maternity and paid parental leave are longer (see Table 7).

Even if the current effect of a birth is not significant in the UK and in Spain, the effect of the number of young children (aged 1-3) is strong in the first country and low in the second. For the UK and Spain, these results indicate that, frequently, women do not interrupt their activity for childbearing. But mothers often stop temporally to work during the first year after child's birth, especially if they have other young children. However, this effect is more important in the UK than in Spain, despite a larger childcare availability in the UK (see Table 6). The family ties which provide informal childcare in Spain could explain this result.

For Germany, we observe both a strong positive effect of motherhood and a high negative impact of the number of young children on participation behavior. German women frequently stay employed after childbirth but they reduce the time spent in the labour market because of low childcare availability (Voicu and Buddelmeyer (2003)). Another possible explanation of this reliance is that women are considered employed during the first year of their maternity leave in Germany. In addition, mothers more often withdraw from the labour market during the years following childbirth, particulary in presence of other young children in the household.

It is particularly noticeable that there is no effect of the number of young children in Denmark, the country where the direct effect of fertility is the strongest . A large availability of childcare (see Tab 6) makes it easier to conciliate employment with maternity in this country. Moreover, the relative labour market flexibility reduces the penalty for interrupting employment for childbirth. Hence, it is easier to return to the labour market in Denmark after post-birth work interruptions. Finally, the effect of fertility on employment decreases with the age of children in all countries. Beyond 12 years, the child ceases to be a barrier to activity in all countries.

The dynamic effect of fertility on labour supply cannot be analyzed without considering the employment persistence which might be a consequence of either true or spurious state-dependence (Heckman and Willis (1977), Nakamura and Nakamura (1985), Eckstein and Wolpin (1989)). Thus, persistence of employment could be the result of the institutional environment, such as labour market rigidities which are potential sources of true state-dependence. Existence of high

search costs or human capital depreciation, which could be regarded as indicators of labour market rigidities, may lead women to stay employed after childbearing and induce a persistence of work. Indeed, a long career interruption in order to give birth to a child might depreciate the human capital and make the return to employment more difficult, particularly in countries where labour market is less flexible. In these countries, a high state-dependence of labour supply behavior might be associated with a strong effect of fertility on employment probabilities when there exists a generous childcare policy. In some countries like Germany, we can observe a high persistence of employment - due to a weaker flexibility of labour market - and a weak effect of fertility on employment because of a less generous childcare system. Finally, the unobserved heterogeneity may also create persistence in employment because women who have a strong preference for maternity may also be those who have weaker preferences for employment. It is therefore important to disentangle the two potential sources of persistence if we want to understand the role of fertility and its sensitivity to social and economic policies across countries.

As usual with this type of data, we observe a strong persistence of employment (see, for instance, Edon and Kamionka (2008)). This result is similar to the one obtained for participation by Hyslop (1999). We found that the state-dependence is highest in France followed by Denmark, the UK and Germany. The lowest state-dependence is observed in Spain. These estimations show that the countries where we observe the largest effects of birth or of young children are also those that have the highest employment persistence.

Refereing to the institutional differences that we discussed in Section 3, we can distinguish five typologies of countries :

- Countries that belong to the "nordic regime", such as Denmark, where we find a higher but not persistent effect of fertility on employment. In Denmark, women stop their activity for childbearing more frequently. But they return to the labour market before the first year of the child, even if there are other young children in the household. Large childcare availability makes it easier to conciliate family life and employment. In addition, the relative labour market flexibility reduces the penalty for exiting the labour market for childbirth. This explains why the state-dependence is lower in Denmark than in France. Large childcare availability associated with relative labour market flexibility may explain why the fertility effect does not persist over time.

- Anglo-Saxon countries are represented by the UK and characterized by means-tested benefits and limited childcare provision and by a flexibile labour market. Indeed, we observe one of the largest effect of young children on employment probabilities. Frequently, women do not stop working if they give birth because the maternity leave is unpaid in the UK. However, mothers frequently leave the labour market during the next year following childbirth,

in particular if they have other young children. After the age of 6 years old, the number of children ceases to penalize employment. These results suggest that the flexibility of the labour market reduces the long-run effect of fertility.

- Countries belonging to the "conservative regime", such as Germany, where we observed the highest effect of the number of young children on employment probabilities. This effect persists over time. In Germany, children reduce the employment probabilities until they are 12 years old. The low childcare availability associated with labour market rigidities can explain the observed high true state-dependence.

- The French regime, which can be placed between the nordic and the conservative regimes, where we find both a large direct birth effect and strong persistence over time. The strong true state-dependence observed in France may be, in large part, explained by labour market rigidities that make the return to employment more difficult if women stop their activity for childbearing.

- For mediterranean countries such as Spain, the observed birth effect is the lowest among all these countries and not persistent over time (lowest true state-dependance). The family ties help women conciliate employment and family life. However, this help is not sufficient to compensate the characteristics of public policy and, particularly, an insufficient childcare provision. Consequently, we observe a relatively low participation to the labour market and relatively weak fertility of women in this country.

For all countries, we find a positive effect of the number of young children on the probabilities to give birth. This effect is significant and highest for Germany followed by Denmark and U.K. These results show that women frequently seem to use their maternity leave in order to complete their family. In all countries, the number of children aged more than 3 years old reduces the probabilities to give birth to a child.

4.1.4 Impact of non-labour income

The transitory part of non-labour income (y_{mit}) has no impact on employment probabilities, except for Germany. The impact of the permanent part of non-labour income on employment probabilities is negative in all countries except for Denmark and U.K. This result is consistent with the empirical implications of the classical labour supply model (Becker (1965), Becker (1981)). For Denmark and U.K, the effect is negative but not significant possibly due to the size of the sample. This impact is weak for France, greater for Germany and large for Spain. Consequently, the impact of the permanent part of non-labour income is particularly important

for countries where it is difficult to conciliate family life with young children and employment like Spain or Germany. There is no impact of partner income on the conditional probability to have a child.

The existence of an unemployed partner has a negative impact on the employment probability but is significant only for Germany. This can be the consequence of social and tax legislation when they condition the reception of public benefits on household's income (Laroque and Salanié (2004)). However, generally, there is no significant impact of the presence of an unemployed partner on fertility.

4.1.5 Fertility persistence

Recall that the model also incorporates state-dependance in the fertility equation in order to analyze the dynamic of births. We find a negative and strong state dependance on fertility behavior. The higher coefficient is found in Germany followed by France, Denmark and UK. The lowest state-dependence is observed for Spain. The gap between two births is minimal for Spain, country where the negative effect of a young child on employment probabilities is the smallest. In absence of large childcare availability or labour market flexibility, women postpone birth except if they can rely on family ties in order to provide childcare.

In order to evaluate the impact of employment on fertility decisions, we have included the past employment state in the fertility equation. We assume that a current birth may be the result of past participation decision. Except for Germany, the past employment state doest not affect the current fertility decision. For Germany, past employment has a positive impact of fertility. The fact that women are considered as employed during the first year of their maternity leave in Germany may explain this result. This reflects too the insufficiency of childcare provision that would allow women to conciliate family and professional life. For instance, in 2000, childcare outside households for children less than 3 y.o. hosted 64% of the children in Denmark, 7% in Germany and only 5% in Spain (see Table 6).

4.1.6 Initial conditions

The effect of the initial conditions for employment (y_1) is positive and significant for all countries. The effect comes from the treatment of the initial conditions using the method proposed by Wooldridge (2005). This parameter gives the impact of initial employment on the conditional mean of the random effect specific to the employment equation. The effect of the initial conditions on employment probabilities is highest for Spain followed by UK, Germany and France. The lowest effect is observed for Denmark. Hence, the largest effect is found in countries where it is difficult to conciliate family life with young children and employment (Spain, U.K and Germany). Consequently, women who are employed in the first period (1994) have stronger preferences for employment.

The parameters associated with the initial conditions for fertility - initial child - is always negative but is significant only for Denmark and U.K. Indeed, for these countries, women who have a young child in 1994 have a weak probability to give birth to a child for all the other years of observation. This phenomenon can reveal a preference of women for employment. Consequently, initial conditions are informative of the distribution of unobserved heterogeneity terms. This result can also be the consequence of the timing of births and the average number of children per women.

4.1.7 Other variables

In our sample, married women are more often employed than women who live in couple without being married. Similarly, married women give more birth to a child than cohabitating women. The effect of marriage on probabilities to give birth to a child is higher in France, followed by Denmark and U.K. The lowest impact of marriage is observed in Spain and in Germany. Thus, the countries with the strongest effect of marriage on fertility are also the countries where married women are more often employed. These countries are where it is easier to conciliate employment and maternity due to generous welfare policies (France and Denmark) or flexibility of labour market (UK).

Foreign women are less often employed in France and in Germany compared to national women. The impact of nationality is not significant in the other countries. We also find that foreign women give birth more often in France and Spain compared to national women.

We use for our estimations two instruments for the fertility. The first instrument is an indicator of whether the first two children have the same gender. The other instrument is an indicator of whether the eldest children is a boy. For all countries, the probability to give birth to a child in the future increases if the eldest child is a boy or if the first two children have the same gender. This result indicates that women and couples want more frequently to have at least two children with distinct genders.

4.1.8 Variance-covariance matrix

The correlation between the idiosyncratic terms of the two equations, i.e. employment and fertility, is not significant whatever the country. This means that a shock on the participation decision has no impact on fertility for the same period and a shock to fertility decisions has no significant impact on employment probabilities.

However, the employment and fertility equations are correlated through the individual effects specific to the employment decision (namely ξ_{i1}) and through the random term specific to the fertility decision (namely ξ_{i2}). Indeed, the estimated correlation (ρ_{12}) between the two random effects is negative for all countries but significantly different from zero only for Germany, France and U.K. This result

suggests that in these countries, women who have a strong preference for maternity tend to have a weaker preference for consumption and employment.

The variance of unobserved heterogeneity in the employment equation (σ_1^2) is always significantly different from zero. This variance is higher in Spain followed by Germany, UK and France. The smallest value is observed in Denmark. It is noticeable that countries with higher unobserved heterogeneity dispersion (spurious state-dependence) are also those where we observe the lower employment persistence. These results show that the difference in employment rates across countries is mainly due to true state-dependence rather than spurious state-dependence. For instance, Danish and French mothers do not participate more in the labour market than German or Spanish mothers because they have undisclosed preferences for employment but because there are, in France and in Denmark, some institutional factors that make it easier to conciliate employment and maternity. Thus, the difference in estimated values of state dependence in female labour supply may, in large part, be the result of differences in institutional environments, like labour market flexibility and childcare.

The variance of the random term specific to the employment equation is larger than the variance of the unobserved heterogeneity specific to the fertility decision indicating that a large part of the heterogeneity in the decision to have a child has been integrated via observable variables (like age, diploma and previous realizations of fertility).

4.2 Estimation on the whole sample

In order to increase the size of the sample, we have estimated the model using a single specification for all countries. The heterogeneity across countries is taken into account adding dummy variables, one for each country. As a constant is included in each equation, the dummy variable for Germany is dropped from the specification. The estimation results are presented in Table 5.

4.2.1 Impact of age

The effect of age on the conditional employment probability is negative for the first age group (20-29 years old) and positive for the second age group (40-50 years old) compared to the reference group in (30-39 years old). Based on the arguments developed in section 4.1, participation the labour market is weak for ages where fertility is high and large for low fertility ages. Indeed, the conditional fertility probability is decreasing with age. Births occur more frequently for the 20 to 29 years old group and are, of course, much less frequent after 40 years old.

4.2.2 Impact of diploma

The impact of diploma on the conditional employment probability is positive. The effect increases with the level of the diploma. This result is consistent with the

Table 5: **Bivariate Dynamic Probit for all countries (employed vs. non employed)**

	Fertility equation	Employment equation
Fertility		
Newborn	-	-0.4230**
		(0.1519)
Initial child	-0.3819***	
	(0.0657)	
Children of the same sex	0.3382***	-
	(0.0361)	
First child is a boy	0.1763***	
	(0.0329)	
Number of children aged 1-3 y.o	0.6331*** (0.0259)	-0.4415*** (0.0390)
Number of children aged 4-6 y.o	-0.0365 (0.0284)	-0.2282*** (0.0304)
Number of children aged 7-12 y.o	-0.3484*** (0.0215)	-0.0682** (0.0218)
Number of children aged 18 y.o. or more	-0.3181*** (0.0263)	0.0462** (0.0206)
Diploma		
Low educ	Ref	Ref
Middle educ.	-0.1281**	0.1864***
	(0.0423)	(0.0315)
High educ.	0.0386	0.5682***
	(0.0432)	(0.0366)
Income of partner or the cohabitant		
y^a_{mit}	-0.0038	-0.0114
	(0.0218)	(0.0129)
y^b_{pit}	0.0179	-0.0564**
	(0.0158)	(0.0078)
Unemployed partner	0.0465	-0.0703
	(0.0613)	(0.0455)
Age		
From 20 to 29 y.o.	0.1986***	-0.2562***
	(0.0448)	(0.0511)
From 30 to 39 y.o.	Ref	Ref
From 40 to 50 y.o.	-0.6393***	0.2287***
	(0.0654)	(0.0416)
50 y.o. or more	-	0.0715
		(0.0659)

(*) Significant at 10%. (**) Significant at 5%. (***) Significant at 1%. (a): y_{mit} is the transitory non-labour income (partner income) of woman i in year t, that is measured as deviations from the sample average. (b): y_{pit} is the permanent non-labour income (partner income) of woman i in year t, that is estimated by the sample average.

Table 5: **Bivariate Dynamic Probit for all countries (employed or non employed)(Cont.)**

	Fertility equation	Employment equation
Country		
France	0.1286**	0.0819**
	(0.0490)	(0.0393)
Germany	Ref	Ref
Spain	0.0541	-0.2569***
	(0.0541)	(0.0411)
UK	0.2133***	0.0763
	(0.0604)	(0.0485)
Denmark	0.2200***	0.5387***
	(0.0615)	(0.0551)
Elements of biography		
Married	1.1169***	1.6053***
	(0.1318)	(0.1380)
Age*wedding	-0.0324***	-0.0428***
	(0.0038)	(0.0033)
Foreign	0.1638**	-0.1582**
	(0.0542)	(0.0557)
Other parameters		
Constant	-1.6921***	-1.2106***
	(0.0878)	(0.0693)
y_{t-1}	0.0754**	1.4930***
	(0.0372)	(0.0247)
d_{t-1}	-1.2700***	-
	(0.0672)	
y_1	-	1.4887***
		(0.0459)
Variance of effects (Σ_ξ)		
σ_1	-	0.8301***
		(0.0255)
σ_2	0.0628	-
	(0.0609)	
ρ_{12}	-0.9457***	
	(0.1294)	
Correlation of idiosyncratic terms (Σ_ϵ)		
ρ_{uv}	-0.0045	
	(0.0831)	

(*) Significant at 10%. (**) Significant at 5%. (***) Significant at 1%.

empirical implications of the labour supply theory. The impact of the diploma on fertility is only significant and negative for the secondary education level. Women who have secondary education level give less birth to a child but participate more frequently to the labour market than women who have an elementary school degree. These results confirm that employment penalizes fertility, especially for women who have secondary education diploma. The policies designed to help mothers conciliate family and professional life must target this category of women.

4.2.3 Direct and dynamic effects of fertility on employment

Overall, giving birth reduces female labour supply. The presence of a young child has a strong and negative impact on employment. This result is consistent with the empirical implications of labour supply theory because the presence of young children is associated with large care costs. However, the direct effect of fertility on employment probabilities decreases with children's age. The presence of a child older than 18 years old no longer penalizes employment.

The initial number of children has a negative and significant impact on the conditional fertility probability. On average, women who gave birth to a child in 1994, are less likely to give birth in the following years. However, this effect is weak. In accordance with previous estimations, having one or more children aged 1 to 3 years old increases the probability of giving birth to a newborn. This result indicates that, frequently, women do not like to space births. On the contrary, the number of children aged 3 years old or more reduces the probability of giving birth in the future. The conditional probability to have an additional child is decreasing with the number of children older than 3 years old present in the household.

When the household has only children of the same sex, the conditional probability to have an additional child is significantly higher. Frequently, households prefer to have at least one child of each gender. Similarly, if women give birth to a boy first, they are more likely to have a newborn in the future.

4.2.4 Impact of non-labour income

The permanent component of non-labour income (y_{pit}) has a negative impact on the conditional employment probability. This is consistent with the empirical implications of labour supply theory. The transitory component of the non-labour income has no effect on the conditional employment probability (y_{mit}).

There is no impact of non-labour income on fertility probabilities. Consequently, even when women anticipate some modifications in non-labour income, they do not change their fertility behavior.

4.2.5 Fertility persistence

We find a negative state dependance of fertility behavior. This non-persistence of fertility indicates that births are spaced frequently more than one year. In addition,

we observe a positive impact of previous employment on fertility probabilities. Being employed does not penalize the probabilities to give birth.

However, the positive effect of past employment on fertility behavior is weak. In some countries, public policies and labour market flexibility make more frequently possible the combination of employment and maternity (Denmark for instance).

4.2.6 Initial conditions

The initial condition for employment (y_1) has a large and positive impact on the conditional employment probability. Women who are employed in 1994 have then higher probabilities to be employed in the following years. Thus, the initial employment situation is informative about the distribution of the individual effect specific to the employment equation.

The impact of the initial condition for fertility is negative and significant. Women who have a young child in 1994 have then lower probabilities to have an additional child. Consequently, the initial fertility is also informative about the distribution of the random effect specific to the fertility equation.

4.2.7 Other variables

The employment probability is largest for Denmark and smallest for Spain (see Figure 1). The differences in employment behavior are very important among these European countries. Fertility is maximum for Denmark and France and minimum for Germany. The estimated impacts are partly different of what we observe in the graphics that depict the marginal distribution of the average number of children by country (see Figure 2). This result is at first sight surprising for Denmark. Let us notice that the estimations are made conditionally on unobserved heterogeneity. Moreover, for Denmark, the fertility is relatively constant with respect to the situation on the labour market (see Figure 3). This implies that, when individuals are initially employed, the unobserved component for fertility is frequently negative and large (see ρ_{12}, Table 5), which explains why the effect of the dummy variable Denmark in the specification is positive and large.

Marriage has a positive impact on fertility and employment. But the effect of age on employment probability is negative for married women indicating that married women have children earlier.

4.2.8 Variance-covariance matrices

The correlation between the idiosyncratic terms is not significantly different from zero. This means that a positive or negative shock on preferences for fertility does not affect preferences for consumption and, finally, for employment.

The correlation between random effects is negative and large. This means that individuals who prefer, a priori, to have more children have frequently lower preferences for consumption and employment. We find a positive variance of unobserved heterogeneity for employment. There is more heterogeneity in participation decisions than in fertility behavior.

5 Conclusion

In this paper we jointly model employment and fertility decisions. We use a dynamic model and take into account the presence of unobserved heterogeneity specific to the individual and to the category of decision. The model allows distinguishing between state and spurious dependence. As the observation starts after the starting time of the process, we also model initial conditions. We find that these initial conditions are very informative of the distribution of the random effect in the sample.

The estimation results show that the main empirical implications of classic labour supply model are verified : the level of diploma has a positive impact on employment and the permanent component of the non-labour income has a negative impact on employment. We observe two effects of fertility on female labour supply: a direct effect which is higher in countries where mean duration of maternity leave is larger - for Denmark and France - and a dynamic effect for which the degree of intensity depends on the institutional environment, such as childcare availability - for Denmark and France - and labour markets flexibility - for example Denmark and UK , or cultural parameters such as family ties - for Spain.

Our results suggest that in the absence of flexible labour markets, women exit employment less frequently once they have given birth (higher true state dependance), especially if there is large childcare availability. Mothers employment is thus based on the provision of childcare. The total fertility rate might be lower especially when the delivery of childcare is not important enough or not adapted to working hours - for Germany. Generous family policies based on long maternity leaves and high child benefits increase the direct effect of fertility on participation which reduces highly employment probabilities. This effect might persist over time if the provision of childcare is not accompanied by a flexibility of labour market which facilitates movements in and out of unemployment.

We find a large heterogeneity of the both decisions across European countries: employment of women is maximal in Denmark and minimal in Spain whereas fertility is maximal in France and minimal in Germany. Germany and Spain are two countries where, in practice, it is more difficult for women to conciliate family life and an active participation in the labour market. These two countries have, however, two different profiles : employment rates of women in Germany are similar to that of other European countries like France but fertility is lower in Germany; employment rates of women is minimal in Spain but fertility is similar to that of

France. The situation of Denmark is very particular : in this country the labour market is very flexible and childcare spending is large. This explains why women's employment and fertility are important.

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Appendix

Table 6: **childcare systems and market flexibility**

	childcare outside household (%) < 3 years old (2000)	childcare spending as % of GDP (2005)	enrollment rate† (3 years old) (2000)	Pre-primary spending as % of GDP (2005)	Part Time work 1999
France	30	0.4	99	0.6	23.5
Germany	7	0.1	78	0.3	34.3
Spain	5	0.4	84	0	15.17
UK	34	0.4	60	0.2	38.6
Denmark	64	0.7	91	0.5	15.1

Source : Périvier (2004) and OECD database : www.oecd.org/els/social/family/database. †: percentage of children going to school.

Table 7: **Maternity leave and Parental leave in Europe**

	Maternity leave			**parental leave**	
	Duration (weeks)	Average replacement rate (%)	Total leave duration (months)	Paid period (% of the total leave)	Child age limit (years)
France	16	100	36	100	3
Germany	14	100	36	67	3
Spain	16	100	36	0	8
UK	18	43	8	0	5
Denmark	18	62	11	70	9

Source : De Henau, Meulders and O' Dorchai (2006), Drew (2004)