Labour Force Participation and Marital Fertility of Italian Women: The Role of Education

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Abstract

This paper uses data from the 1993 Survey of Household Income and Wealth conducted by the Bank of Italy in order to estimate a reduced form *purist* model of female marital fertility and labour force participation. It focuses in particular on the effect of formal education on both fertility and labour force participation, and accounts for the potential endogeneity of education. Our estimates show that increasing education up to the upper secondary level exerts *ceteris paribus* a positive effect on marital fertility at ages 21-39 and that highly educated women postpone fertility and have a higher labour market attachment.

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1. Introduction

One 'stylised fact' commonly observed in the developed countries is the pattern assumed by the correlation between women's education, labour force participation (LFP hereafter) and fertility. Figures 1-3 show the secular trend of average years of education in the female population, the female LFP rate and the Total Fertility Rates (TFRs) in some European countries.

[Figures1-3 about here]

Aggregated time-series data from individual countries seemingly show the existence of a negative relationship between education and fertility and a positive relationship between education and LFP. However, when different countries are compared, the pattern of negative correlation between education and fertility is no longer clear. Some countries with low average years of education in the female population in 1995, for example Spain (6.68), Italy (6.98) and Portugal (5.22), also have very low TFRs (respectively 1.19, 1.17 and 1.49), whilst countries with higher average years of education have relatively higher TFRs, such as Finland or Norway (where average years of education and TFRs are 9.50 and 1.81, 11.41 and 1.87 in 1995, respectively).

Economists attempted to explain these associations using economic models of human capital investment, fertility and labour supply.[1] These models have then been frequently tested using aggregated time series-cross country data.[2] However, such data are not ideal for testing the implications of economic models of female fertility and LFP, due to problems of aggregation and the different institutional frameworks of different countries (such as child care and contraception availability and costs, which are difficult to control for) as well as the same country over time.

In particular, the relationship between education and fertility is a complex one and the total effect of education may act through several channels. Figure 4 shows that education may influence fertility both indirectly by affecting the age at marriage, and other aspects

[1] See the literature on the *economic theory of fertility*, e.g. Becker (1981) and Cigno (1991).
[2] For some recent examples see Cigno and Rosati (1996) and Ahn and Mira (1999).

of marriage such as duration,[3] and directly through its effect on marital fertility. Moreover, marital fertility may affect marriage duration while the expectation of family dissolution may influence fertility, LFP and the investment in human capital.[4] Furthermore, education may be in part endogenous: strong preferences for market work may induce women to invest more in education and perhaps to have lower fertility (these effects operating through preferences are shown in the figure by dotted arrows). In macroeconomic studies of female fertility and LFP, it is difficult to isolate the different effects of education on marriage formation and dissolution, marriage duration and marital fertility. Hence, the estimated effect is a total effect that does not shed light on the way in which education affects both fertility and LFP.

[Figure 4 about here]

For this reason, the present paper focuses on married women's LFP and fertility decisions using household survey micro-data, i.e. it analyses the interactions shown by bold arrows in figure 4. The particular interest is in Italy, a country which has recently attracted the attention of economists and policy makers and stimulated a lively debate (see CNEL 2000) due to its exceptionally low levels of both fertility and female LFP. The study of female LFP and fertility is important for several reasons:

1. the decline in TFRs may cause a problem of labour shortage in the future. In this respect, policies which seek to increase women's LFP[5] may prove an effective way to attenuate the problem.
2. Another way to address the problem is to investigate the reasons for the low fertility of Italian women. Can the low fertility be considered the consequence of a change in women's preferences or as a rational response to economic incentives? In the latter case, policy makers can influence fertility behaviour by affecting costs and incentives related to childbearing.[6]

[3] Smith (1997), for example, finds that the rising earnings of women, which are partly due to increasing educational levels, are a significant determinant of the rising incidence of divorce in Great Britain.
[4] Lillard and Waite (1999), for instance, test the hypothesis that the risk of marital disruption affects marital fertility and that marital dissolution is affected by the presence of children in the family, while Parkman (1992, p. 672) maintains that 'the increase of married women labour force participation under unilateral divorce is due to the lack of compensation at divorce for reduced human capital based on sacrificed opportunities to acquire and maintain market skills'.
[5] Throughout the paper we sometimes refer to 'labour force participation' simply as 'participation'.
[6] In this regard, Colombino and Di Tommaso (1996) find that cohort effects, related to changes in preferences, are not significant in their analysis of fertility and LFP using Italian data for the years 1987, 1989 and 1991.

3. The analysis of the impact of a widespread phenomenon, namely the increase in women's level of education, on LFP and marital fertility is interesting both from a positive point of view, in order to predict the possible impact of rising educational levels on female marital fertility and LFP, and from a normative point of view, since the Italian educational system has been recently undergone an extensive reform which, among other things, has increased the duration of compulsory schooling.

The outline of the paper is as follows. In the following section we review some of the insights into the effect of education offered by dynamic theoretical models of fertility and LFP. Section three summarises the findings of previous empirical work relating to Italy. Section four describes the data and the variables used in the empirical analysis, the econometric model and the main results. Section five concludes.

2. Education, labour force participation and marital fertility, insights from life-cycle theoretical models

Theoretical models of LFP and fertility can be divided into *life-time static models* and *life-cycle dynamic models*. The former are mainly concerned with the study of completed fertility while the latter enable the analysis of a greater number of issues, such as the timing and spacing of births. In the present section we illustrate the insights into the role of education offered by some theoretical *life-cycle dynamic models* of fertility and LFP, since we are interested in both completed fertility and fertility *tempo.*[7]

In a recent survey of theoretical and empirical work on the optimal age at motherhood Gustafsson (2001) describes three theoretical models in detail: Happel et al. (1984) , Cigno (1991) and Walker (1995). We focus here on the predictions of these models regarding the effect of education, while the interested reader can find their detailed description either in Gustafsson (2001) or in the original articles.

Happel et al. (1984) emphasise *consumption smoothing* as the main determinant of fertility timing. In their model, individual utility is separable into consumption and the 'effective' number of children (a combination of quantity and quality of offspring). Under the perfectly imperfect capital market (PICM) assumption, i.e. individuals cannot borrow against their future incomes, the husband's (exogenous) earnings profile matters for fertility timing since women give birth in a time interval in which the income of the

primary earner is relatively high. According to the model, the wife's earnings depend on pre-marital work experience and when she gives birth she retires from the labour market for a fixed exogenous number of periods, during which job skills are subject to depreciation or obsolescence. Happel et al. (1984) do not explicitly consider formal education; however its effect can be roughly likened to that of a higher stock of pre-marital work experience (i.e. human capital), which increases the probability of a delayed first birth. The reason is that when pre-marital work experience is high the probability of total skill loss during child rearing is less, and this is the sole case in which an early birth is preferred to a late birth in the model.

Cigno (1991) and Walker (1995), instead, emphasise the *career planning motive* as the main determinant of LFP and fertility behaviour.

In Cigno (1991) parents derive utility from consumption and 'effective' children. Parents have a positive discount rate and capital markets are perfect. In the model a higher stock of pre-marital human capital determines a lower completed fertility and early child births. This is due to the income effect, because parents discount the utility derived from offspring. As Gustafsson (2001) observes, this prediction is at odds with the Happel et al. (1984) result. The differences are due to the fact that in the latter model there was a positive rate of depreciation of human capital (and women better endowed with human capital were less at risk of losing their job skills) and no discounting was assumed. However, Cigno (1991) also maintains that women with a steeper earnings profile have a slower fertility *tempo*, i.e. they postpone child births. Cigno and Ermisch (1989), for instance, find that women in semi-skilled or manual occupations (who have a relatively flat earnings profile) have earlier child births than do women in more skilled clerical occupations. Of course, the probability of entering skilled occupations depends, among other things, on women's education. The reason for this effect is that a withdrawal from the labour market has a current opportunity cost, the wage, and a future opportunity cost, the capital loss due to the potential job experience forgone. For a steep earnings profile the current cost is relatively lower when a woman is young, while the future cost decreases with age (since there are less years of work activity left). Furthermore, the age pattern of the total opportunity cost depends on the shape of the earnings profile. Gustafsson (2001, p. 241), for instance, observes that if it is concave the capital loss due to a later birth is very much smaller than that due to an early child birth. To summarise, in Cigno's (1991) model education may have a two-fold effect. If education increases only the size of life-cycle wealth but does not alter the earnings profile, highly educated

[7] I.e. the distribution of births over the life-cycle. In particular, we use fertility *tempo* to refer to the average

women are likely to give birth early in the marriage, while if education alters only the earnings profile but not life-cycle wealth, namely makes it steeper, women have an incentive to postpone fertility. Finally, if education changes both the size of life-cycle wealth and the earnings profile, the sign of the net effect on fertility timing cannot be predicted theoretically and must be addressed empirically.

Walker (1995) specifies a dynamic model in which parents derive utility from children and consumption and have intertemporally and contemporaneously strongly separable preferences, and capital markets are perfect. In Walker's model parents are strongly motivated to have children early in the life-cycle since children produce a recursive flow of utility also for all periods following the birth event, which is discounted at a positive rate of time preference (unlike in Happel et al. 1984). Walker does not consider the effect of pre-marital human capital in his model, although he does consider the effect of different wage profiles and maintains that changes which make the profile steeper reduce the *tempo* of fertility (with the same level of completed fertility), while changes which flatten the earnings profile tend to delay fertility. The reason is that during a period of increasing wages, *ceteris paribus*, women have an incentive to give birth early in the life-cycle, when the opportunity cost of their time is relatively less. The difference of results with respect to Cigno (1991) is due to the recursive structure of the utility of fertility and to the different specification of the wage function, which is not linear but convex in work experience. This means that the current wage forgone by giving birth and caring for children is much lower when an individual is relatively younger. In the model an increase in wealth tends by the cumulative nature of the utility flows to reduce the *tempo* of fertility too. Therefore, since highly educated women generally experience both higher life-cycle wealth and a steeper wage profile (see Murphy and Welch 1992) the prediction of the model is that an increase in women's education induces them to give birth sooner.

Blackburn et al. (1993) study the interactions between fertility timing, wages and human capital accumulation. The authors consider a dynamic model in which women make their human capital investment decision conditional on their preferences with regard to the timing of their first birth. The model shows that if the discount rate is greater than the economy growth rate of wages for workers who do not invest in human capital, then individuals who prefer an early child birth are less likely to invest in human capital. This model therefore reverses the direction of the causality, which now runs from preferences for fertility timing to women's education, suggesting a potential endogeneity problem for women's education neglected by other models.

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time between first marriage and births.

In conclusion, different theoretical models stress different factors and motives as the main determinants of LFP and fertility behaviour and sometimes generate opposite predictions about the effect of education which rely heavily on the assumption made. Therefore, the question of the effect of education on LFP, fertility *quantum* and fertility *tempo* must be addressed empirically.

3. Fertility and labour force participation in Italy: past empirical research

Although there are many empirical studies which investigate female labour supply and labour market participation conditioning on 'child services' variables and studies analysing female fertility conditioning on LFP,[8] we review here only recent empirical work using an approach similar to ours, i.e. studies which jointly model and estimate female LFP and marital fertility behaviour in Italy.
Some recent contributions are:

[Table 1 about here]

Colombino and Di Tommaso (1996), who estimate a simultaneous model of female marital fertility and LFP using a sequence of cross-sections of micro data (Survey of Household Income and Wealth - SHIW - for the years 1987, 1989 and 1991). Their sample includes women aged between 18 and 40. They find that cohort effects are not significant whereas wage effects are strong and significant. They use a bivariate probit model, which though allowing for correlation between fertility and participation decisions, theoretically implies separability of the lifetime utility function into fertility and leisure, as shown by Weeks and Orme (1999). Colombino and Di Tommaso consider the effect of various measures of unearned income and wealth to investigate income effects. The effect of the regressors included is reported in table 1. Education has a positive impact on women's wage and therefore, indirectly, a positive effect on participation and a negative effect on fertility. Colombino and Di Tommaso do not account for the potential endogeneity of education.

Di Tommaso (1999), who estimates a trivariate model of women's participation, fertility and wages using SHIW data for the same period as Colombino and Di Tommaso (1996).

[8] For some surveys see Browning (1992), Nakamura and Nakamura (1992) and Hotz et al. (1997).

She uses a sample of women aged 18-40. The results are shown in table 1. Schooling has a positive impact on participation and a negative impact on fertility through the effect on wages. From the technical point of view Di Tommaso's econometric specification is based on the restrictive assumption of separability of the lifetime utility function into leisure and fertility. Education is considered exogenous.

Del Boca (1999), who analyses the effect of market rigidities on the participation and fertility behaviour of Italian married women. She performs cross-section and panel data analyses using data from the SHIW for the years 1991, 1993 and 1995. Her sample includes women aged 21-45. The preferred model is the fixed effects model, which does not allow estimation of the effect of education. The results are shown in table 1. In the cross-sections education has a positive impact on fertility for the 1991 and 1995 cohorts and a positive impact on participation for all three years. From a technical point of view Del Boca's panel estimation procedure rests upon the assumption of independence of fertility and LFP decisions. In that case, once the unobserved heterogeneity has been eliminated using a fixed effects model, the two logit models for participation and fertility can be estimated separately. However, the author uses two separate logit models for estimation of the cross-sections without accounting for the possible correlation between the two decisions (unlike Colombino and Di Tommaso 1996). This study does not account for the possible endogeneity of education.

With respect to the above studies:

1. we use 1993 SHIW data. The choice of the cohort depends on the availability of the variables used in the econometric specification (in particular data on child care availability by province of residence).[9]
2. we consider a flow-fertility variable (a precise definition is given in section 4.3) and by including some interaction terms between years of education and age, we also analyse issues related to the effect of education on fertility timing.[10] Moreover, we use a spline function (with 'knots' at the different educational levels: compulsory, upper secondary and tertiary education) which allows the effect of additional years of

[9] Del Boca (1999) uses data on child care availability at the regional level.

[10] Due to the cross-sectional nature of our study, in principle it should not be possible to distinguish between age and cohort effects. This problem is overcome by including in the empirical work some proxies for the individual preferences towards 'taste for market work', which proxy for cohort effects or secular trends. Accordingly, we interpret the effect of the interaction terms between education and age as the impact of education on the timing of fertility and LFP. A likelihood-ratio test for the equality of the effect of education across age-classes in the MNL model with control for heterogeneity (see section 4.4) was rejected ($\chi^2(21)=38.99$, p-value=0.01).

education on LFP and fertility to differ across educational levels. This formulation is more general than that which imposes an equal coefficient for all years of education (usually adopted in the literature). In particular, a test for the equality of coefficients across educational levels is rejected.[11]

3. we explicitly control for family background variables that might affect a woman's, or her husband's, preferences towards fertility and LFP, often neglected in past empirical work.
4. we use a multinomial model. A multinomial model is more general than a bivariate one since it accounts for the possible non-separability of the life-cycle utility function into leisure and fertility, as shown in Weeks and Orme (1999). Di Tommaso and Weeks (2000), for instance, in an application of Weeks and Orme (1999) to LFP and fertility decisions on UK data, find that the bivariate probit and logit models, which imply a restrictive form of additive separability across the decisions, are rejected in favour of their multinomial counterparts.
5. we estimate a reduced form-*purist* model, in the language of Browning (1992). In particular, we are interested in the effect of education upon fertility and LFP. Therefore, in the empirical specification we do not include 'child services' variables, which are endogenous, but only their determinants, such as a woman's level of education.[12]
6. we account for the potential endogeneity of female education by including several possible controls for the 'taste for market work' and testing for the weak exogeneity of education.

4. The empirical analysis

In the following sub-sections we describe the methodology and the results of the empirical analysis.

[11] The outcome of the likelihood-ratio test for the 'parsimonious' MNL model (see section 4.4) was $\chi^2(24)=70.20$, p-value=0.00.

[12] This means, for instance, that the probability that a woman will give birth in a specific year depends on her desired level of completed fertility and fertility timing (hence on her realised fertility), whose effects are picked up in the empirical specification by their 'first determinants', such as her level of education.

4.1 The econometric model

Under standard regularity conditions the dynamic life-cycle models described in section 2 can be solved giving an optimal solution for the choice variables, in particular life-cycle fertility and labour force participation.

We code participation in period t as $L_t=1$ (i.e. $l_t > 0$), non-participation as $L_t=0$, the decision to give birth in period t as $B_t=1$ and the decision not to give birth as $B_t=0$ and focus here only on marital fertility. Therefore, we assume that women have already made their maximising choices in their pre-marital period and we condition on those optimal choices.

Focusing on L_t and B_t only and omitting in the notation the other choice variables, the optimal life-cycle plan concerning LFP and fertility can be stated as:

$$P^*=\{(L^*_1, B^*_1),(L^*_2,B^*_2),...,(L^*_T,B^*_T)\}. \quad (1)$$

where T is the end of the planning horizon.

In period t the probability of observing $L_t=z$ and $B_t=j$, where $z,j=\{0,1\}$ is the probability that the couple of decisions ($L_t=z$, $B_t=j$) will be included in the optimal life-cycle plan, i.e. $\Pr[(L_t=z, B_t=j)\in P^*]$. If we define as V_t the life-cycle utility function evaluated at time t, this probability can be expressed as:

$$\Pr[V_t\{(L^*_1,B^*_1),(L^*_2,B^*_2),...,(L_t=z\ , B_t=j),...,(L^*_T,B^*_T)\} > V_t\{(L^*_1,B^*_1),(L^*_2,B^*_2),...,(L_t=h, B_t=k),...,(L^*_T,B^*_T)\}] \quad (2)$$

$\forall (h,k)\neq(z,j)$. The four different outcomes for (L_t,B_t) can be recoded to obtain a single dependent outcome variable Y_{it}, where the subscript i refers to the individual:

$$Y_{it}=\begin{cases}1 \text{ if } L_{it}=0, B_{it}=0 \text{ (NP, NF)}\\ 2 \text{ if } L_{it}=1, B_{it}=0 \text{ (P, NF)}\\ 3 \text{ if } L_{it}=0, B_{it}=1 \text{ (NP, F)}\\ 4 \text{ if } L_{it}=1, B_{it}=1 \text{ (P, F)}\end{cases} \quad (3)$$

(NP,NF) stands for 'non participation-non fertility', (P,NF) for 'participation-non fertility', (NP,F) for 'non participation-fertility' and (P,F) for 'participation-fertility'.

Now we can define the life-cycle expected utility function as V_{yit} , where *t* is the current period which we are analysing (since we use in the empirical work cross-section data) and *y* is one of the four possible outcomes of Y_{it} for the individual *i*. Adopting a linear specification we have:

$$V_{yit} = X_{it}' \boldsymbol{b}_y + \boldsymbol{e}_{yit} \tag{4}$$

where X_{it} is a vector of exogenous explanatory variables and $\boldsymbol{e}_{yit}$ is a random variable unobservable to the econometrician (e.g. differences in tastes). By assuming a Type I extreme-value distribution for $\boldsymbol{e}_{yit}$ and independence across the $\boldsymbol{e}_y$'s, the multinomial logit model (MNL) can be derived from utility maximisation (result originally due to McFadden 1974). In this case the probability of observing Y_{it}=1, for instance, is:

$$\Pr[Y_{it} = 1] = \Pr[V_{1it} = \arg\max_y V_{yit}] = \frac{\exp(X_{it}' \boldsymbol{b}_1)}{\sum_{y=1}^{4} \exp(X_{it}' \boldsymbol{b}_y)} \quad . \tag{5}$$

As equation (2) shows, the value of life-cycle utility at time *t* is a function of past, current and future choice variables. In the empirical specification we should include only exogenous variables among the regressors if we want to estimate unconditional effects (as in the *purist* approach described in Browning 1992).

Moreover, we have seen in section 2 that when empirical study is made of married women's LFP and fertility behaviour education cannot be considered an exogenous variable. In fact, it is likely that the form of a woman's preferences, i.e. the relative weights of consumption, offspring and leisure in her life-cycle utility, affect her optimal human capital investment.[13]

4.2 Some possible determinants of female labour force participation and fertility

In the empirical model we include the exogenous or predetermined variables that, acting through preferences or the budget constraint, affect women's marital fertility and LFP.

The relevant factors are well summarised in Lehrer and Nerlove (1986) and Dex and Joshi (1999). Here we consider:

Role of the partner. The husband[14] affects a woman's fertility and participation decisions in several ways. If we adopt a unitary model of family, LFP decisions are jointly made by the spouses, as are fertility decisions. This suggests that the husband's labour incomes are endogenous in that setting (in the sense that they are jointly determined with female labour supply). If we adopt a collective model of family (see Chiappori 1992) labour force and fertility decisions are individually made by each spouse who takes into account her/his non-labour income and the income of her/his partner (since family incomes are shared according to a certain 'sharing rule'). Unfortunately, in this case past non-labour incomes depend on past LFP, fertility and saving behaviour and are likely to be endogenous. We believe that, because of the strong institutional rigidities existing in the Italian labour market (see Del Boca 1999 and Del Boca and Pasqua 2002) where part-time jobs are scarce[15] and women have primary responsibility in child rearing, the hypothesis that family labour supply is jointly determined by the spouses is not adequate: Italian men generally work and have limited degrees of freedom regarding the number of hours worked so that their incomes can be considered as exogenous with respect to female labour supply and fertility decisions.[16] Therefore, a *traditional family model* (see Del Boca 1997) is probably more suitable to the Italian case:[17] a woman makes her participation and fertility decisions taking into account the fact that she can share some family resources with her partner (and therefore also her partner's incomes). The sign of the impact of husband's income on female fertility cannot be determined theoretically. In models that only account for the quantity of children the expected effect is positive. In contrast, in models accounting also for the demand for quality the effect is generally expected to be negative (see De Tray 1973 and Becker and Lewis 1973). Then the question must be addressed empirically.

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[13] There is also a literature showing that women may increase their level of formal education and LFP as a form of insurance against the risk of separation and divorce. In this case the optimal levels of education and LFP depend also on the characteristics of the marriage (see for instance Parkman 1992, 1998).

[14] Hereafter, we use the nouns spouse, husband and partner exchangeably.

[15] As discussed in Del Boca (1999) the lack of part-time jobs may be endogenous if determined on the supply side. In this regard using SHIW 1989 data Giannelli (1997) finds that about 13% of employed women worked longer hours than they wish.

[16] According to the 1987-1991 Multiscopo Survey (ISTAT) data on intra-household time allocation, working Italian men spend on average only 0.6 hours on housework and child care during working days. The corresponding figure for non-working men is 1.2 hours per day (see ISTAT 1993a, p. 24).

[17] Del Boca (1997, p. 76), for instance, finds that the *traditional family model* cannot be rejected using SHIW 1993 data.

Besides the role of husband's income, we consider other husband-related variables that may affect a woman's LFP and fertility decisions, namely job qualification, branch of activity, education and age. The first three variables are proxies for the husband's permanent income and income profile while the fourth is a proxy for a woman's probability of conception. Moreover, the last two variables may also affect the husband's attitude towards his wife's LFP.

Preferences and cultural factors. We consider the effect of the *gender role model* inherited by a woman from her mother and the attitude of the husband towards his wife's LFP. Namely, we include among the explanatory variables the job qualification and branch of activity of a woman's mother and the fact that her mother in law worked.[18]

Child care. Women have to decide which form of child care to use and how many hours of child rearing to allocate to the market. For this reason we include in the econometric specification some variables related to the availability of external child care, in particular public and informal child care (i.e. child care provided by a woman's parents or parents in law).

Female education. In this paper we focus on the role of formal education in shaping the participation and fertility decisions of married women. Women's stock of formal education at time *t* is a predetermined variable. This does not rule out that it could be endogenous: women with a more marked 'taste for market work' could simultaneously invest more in education, and have a higher LFP and a lower fertility.[19] The observed correlation between education, LFP and fertility would in this case be only spurious and driven by a fourth factor: the 'taste for market work'. For this reason in the empirical work we shall account for the possible endogeneity of education by including a wide range of family variables which control for heterogeneity in the 'taste for market work', in the spirit of the *proxying and matching method* (see Blundell et al. 1997), and testing for the weak exogeneity of education.

[18] Some researchers in Italy have matched Bank of Italy data with data on hours spent in domestic activities coming from other sources (such as the ISTAT Multiscopo Survey 1987-91 on time use, see ISTAT 1993a) in order to obtain a proxy for the gender role model prevailing in a specific geographic region. However, I think that such measures are likely to be endogenous, especially for women (this applies also if data on intra-household allocation of time were available at the individual level), since the time devoted to child bearing, for instance, it is likely to be affected by the fact that a woman participate in the labour market. I preferred to use the fact that a woman's mother worked, since I think that the family (especially in Italy) is the primary social unit that transfers values (such as the 'taste for market work') to an individual and that the parents are the first source of gender role models for individuals.

Easterlin model. Although in section 4.1 we considered LFP and fertility decisions to be the outcomes of maximising behaviour, as observed in Gustafsson (2001), for some time the main rival theory to neoclassical models of fertility was the so called Easterlin model (Easterlin, 1980). For this reason and to avoid a possible model misspecification (due to omitted variables) we also include some variables related to the Easterlin *relative income hypothesis.* In the Easterlin model 'the driving force behind both increased LFP and reduced fertility, is the desire of a large cohort to improve relative economic status, with parental income as a measure of that cohort's material aspirations.' (Macunovich 1996 p. 95). A survey of the results of works attempting to test the Easterlin *relative income hypothesis* is provided in Macunovich (1996). These studies have usually employed proxies for relative incomes, such as parental occupational status, and the empirical evidence on the validity of the hypothesis is 'mixed'.

4.3 Data Description

The data used are drawn from the 1993 Survey of Household Income and Wealth (SHIW) of the Bank of Italy. The SHIW is the most popular source of micro-data for Italy. For a detailed description the interested reader may consult Banca d'Italia (1995) and Filippin (1997). The nature of the SHIW, which does not include data on fertility and LFP histories, does not allow us to estimate a complete life-cycle model. Hence, we have to rely on cross-sectional data; in particular we use 1993 data. We consider women aged between 21 and 39 cohabiting with their husband or partner, for whom we have information in the data set, and exclude from the sample self-employed women.[20] The sample includes 1,467 women. We choose the same age interval as Del Boca (1999), which is the study closest to ours among those listed in section 3 for the definition of fertility, but discard women in the age class 40-44. This we do since our 'economic model' of participation and fertility can explain only desired fertility, and we want to focus on the ages at which women have a high *fecundability*.[21]

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[19] For a discussion of the endogeneity of education see also Macunovich (1996, pp. 118-119).
[20] Like all the studies reviewed in section 3.
[21] We observe only realised fertility. Although in our economic model realised and observed fertility are equal, in reality they may differ because of problems of infecundity and the effectiveness of contraception. Therefore, we included in the analysis only the ages at which a woman's degree of *fecundability* is relatively high and for which an 'economic model' of fertility and participation, which explains only desired fertility, makes sense.

As already emphasised, our main focus is on the effect of formal education. Since the SHIW contains information only on the highest educational qualification obtained, we computed the total number of years of education using the years of legal duration of the different educational grades, as follows: primary school (*scuola elementare*) – 5 years; lower secondary school (*scuola media inferiore*) – 8 years; upper secondary school (*scuola media superiore*) – 13 years; tertiary education (*laurea*) – 17 years.[22] Years of education are interacted with four age dummies (21-24, 25-29, 30-34, 35-39) which enables us to study the effect of education on the timing of fertility and LFP, and we use a spline function to account for possible non-linear effects of education (i.e. the effect of the years of education is not constrained to be equal across the different levels of education).

As to the dependent variables, we define participation as employment or unemployment and consider as non-participating women those who replied to the SHIW that they were housewives.[23] We consider a birth event to be the presence in the family of a child more than one and less than two years old. Our choice depends on the fact that we want to analyse the effect of education and other variables on the decision to give birth and to participate in the labour market. For this reason we consider a flow fertility variable rather than a stock fertility variable. We consider children more than one and less than two years old since we do not know the exact age (number of months) of children aged less than one and we want to avoid considering periods when participation in the labour market is not possible, e.g. in the first months immediately after a child birth.[24] Therefore, we study the issue of fertility and LFP in the period surrounding a birth event. This provides nonetheless useful information on future labour market participation.[25]

In the model we explicitly control for the geographic area of residence, municipality size, husband's income, Easterlin's variables, parents' education, parents' job qualification, parents' branch of activity, husband's education, husband's job qualification and economic branch, husband's age, public child care availability and potential informal

[22] We dropped individuals without formal education and those with post-graduate qualifications, whose number is very low, in order to avoid spurious results.

[23] Hence, we drop students. Although in the theoretical models it is usually assumed that individuals invest in education at the beginning of the life cycle, as observed by an anonymous referee, especially for women education might happen in slots during life to combine work, children and requalification. This seems not to be a frequent phenomenon in Italy. In fact, in the 1993 SHIW data only the 0.32% of married or cohabiting women in the age group 21-39 declared to be students. However, this figure might underestimate the true number of women who are engaged in education, since some of them might be involved in part-time education and consider market work or child rearing as their primary activities.

[24] For the same reason we exclude from the sample women with a child aged less than one, since for them giving birth may not be possible.

[25] Previous studies focusing on first birth (Mott and Shapiro 1979, 1983) showed that women who did not enter the labour market within two years after a birth event have a high probability of staying out of the labour market for the rest of their life.

child care availability (parents' availability). The rationale for the inclusion of these variables along with their description is given in Appendix A.

When it was possible we preferred to use missing-value dummies rather than discarding observations for which some variables had missing information. Unfortunately, this was not always possible. In fact, for women for whom data on father's or mother's education was missing not all the four MNL outcomes were observed, which caused major problems in the model estimation. Hence, we decided to drop observations with missing data on parents' education (47 observations, 3.2% of the sample).[26] Therefore, the final sample includes 1,420 women (for some descriptive statistics see table B.1 in Appendix B). Table 2 shows the distribution of the four MNL outcomes by level of women's education: the positive correlation between education and participation is evident, although the data also show a positive correlation between education and fertility for participating women.

[Table 2 about here]

4.4 Econometric strategy

In order to assess the effect of education we adopt the following empirical strategy:

1. We include in the model specification a wide range of controls for a woman's family background that may proxy for unobserved heterogeneity in the 'taste for market work' (in the spirit of *the proxy and matching method*, see Blundell et al. 1997);
2. We test for the weak exogeneity of education. In the case of endogeneity of women's education we plan to apply a Non Linear Instrumental Variables (NLIV) estimation strategy, by 'instrumenting' education.

The estimated effect of education in models of women's marital fertility and LFP may be partly spurious. It may be the unobserved individual heterogeneity (e.g. unobserved preferences for market work) which induces some women to invest more in education and also affects their LFP and fertility decisions later on.[27] One way of controlling for the

[26] The rate of non-response for other parental variables (such as parents' jobs) is of the same order of magnitude. All regressions use a weight computed by the Bank of Italy which is the inverse of the probability that an individual is included in the sample.

[27] In the model of Blackburn et al. (1993), for example, it is the preference for late childbearing which induces women to invest more in human capital.

presence of unobserved heterogeneity (which may affect our estimates) is to include a wide range of family background variables, which are likely to shape a woman's preferences, in the model.[28] We included father's and mother's education, job qualification and branch of activity, which could affect a woman's 'taste for market work'. The full set of estimates of this model are reported in table B.2 in Appendix B while the coefficients of the educational variables are listed in table 3.

[Table 3 about here]

Since the MNL model uses the maintained assumption of the Independence of Irrelevant Alternatives (IIA), we performed some specification tests to assess the validity of this assumption (see Hausman and McFadden 1984). All tests (see table 4) concluded that the IIA could not be rejected by our data.

[Table 4 about here]

Clearly, even after controlling for possible taste heterogeneity, women's education retains its significance. In order to obtain a 'parsimonious' model we performed some likelihood ratio (LR hereafter) tests for the different groups of regressors (see table B.3 in Appendix B). The groups of regressors that were not significant at the 10% level, when individually tested, were the variables related to the wife's parental wealth, father's job qualification and branch of activity and husband's education, job qualification and branch of activity. However, when jointly tested the restrictions were not valid, while the model omitting only wife's parental wealth variables, father's job qualification and branch of activity was an admissible reduction of the general model.[29] The estimates of the 'parsimonious' model are shown in table B.4 in Appendix B.

Although the introduction of a wide range of controls to account for unobserved heterogeneity helps to obtain consistent estimates, it does not exclude that the left-out heterogeneity may still be important. For this reason, in the case of the endogeneity of education, a Non Linear Instrumental Variables Estimator[30] may be more appropriate.

[28] This information is provided by the SHIW at the respondent's age. The same procedure is applied, for instance, by Blackburn et al. (1993).
[29] At the 5% statistical level of significance ($\chi^2(33)=36.34$, p-value=0.32).
[30] See Grogger (1990). For some recent developments on its consistency see also Dageneais (1999) and Lucchetti (2002).

We use as identifying instruments the variables related to a woman's parental wealth and father's job qualification and branch of activity, which the first part of the analysis suggested do not affect women's LFP and fertility, but which might affect their education. Table B.5 in Appendix B shows the estimate of the education equation. The instruments turn out to be highly significant in explanation of the number of years of education achieved. Following the suggestions of Bound et al. (1995) we computed a LR test for the joint significance of the identifying instruments. The value is $\chi^2(11)=52.46$ (p-value: 0.00), which confirms that the instruments are quite good.

In order to test for the endogeneity of education we performed Smith and Blundell's (1986) weak exogeneity test, including the predicted residual from the education equation in our 'parsimonious' MNL model. The predicted residual included in the 'artificial regression' turned out not to be significant ($\chi^2(3)=0.82$, p-value=0.84). Hence, we conclude that our data do not allow rejection of the null hypothesis of weak exogeneity of women's education with fertility and LFP (once we control for a number of family background characteristics which might affect women's decision to invest in human capital). This is not an unusual result. Sander (1992), for instance, obtains similar results in his study of the effect of women's schooling on fertility in the United States. For this reason we focus on the estimates of the 'parsimonious' MNL model.

In the light of these results, table 5 shows the predicted probabilities of the four MNL outcomes by level of education and age group computed at the sample average of all the remaining variables using the 'parsimonious' MNL model. Since no married woman in our sample has a university degree at age 21-24 we do not simulate the LFP and fertility behaviour of women with a tertiary education for this age group and consider their probability to give birth and participate as null.

[Table 5 about here]

4.5 The effect of education

From table 5, it is clear that education raises the labour force attachment of women, who continue to participate in the labour market even in the period surrounding a birth event.

Moreover, better educated women tend to postpone fertility. In what follows we interpret the probability of giving birth as fertility.

Both for women with primary and with lower secondary schooling the probability of giving birth peaks at the ages 21-24 (3.50% and 9.04%, respectively). Higher educated women, i.e. women with upper secondary and tertiary educational levels tend to postpone fertility, which reaches its maximum at the ages 25-29 (12.62%) and 35-39 (6.55%), respectively. For women with primary and lower secondary education fertility decreases monotonically with age, while for tertiary educated women it increases monotonically with age. Women with upper secondary education have an inverse-U shaped pattern of fertility with age.

We could interpret the sum of the probabilities of giving birth for the different age groups by educational level as a raw measure of the hypothetical marital fertility at ages 21-39 (24-39 for women with tertiary education). In fact, assuming that all women get married between age 21 and 24 (between ages 25 and 29 for women with tertiary education) and that their marriages last at least until they are in the age interval 35-39[31], it is evident that *ceteris paribus*, i.e. for an equal duration of marriage,[32] the marital fertility of women with upper secondary schooling is the highest. A rising pattern of fertility with education is also found by Ben-Porath (1973) and Danziger and Neuman (1989) for Israel and Moffitt (1984) for the US. Bloemen and Kalwij (2001) using data from the Netherlands find that 'an increase in years of schooling of a woman causes her to schedule births later in life but it does not significantly affect her completed fertility' (p. 593). Rising marital fertility with increasing education may be explained by the prevalence of income over substitution effects at higher levels of education, especially when child care can be purchased in the market (see for example Ermisch 1989). In that case, in fact, the opportunity cost of giving birth for a woman is the lowest between the income and experience lost by withdrawing from the labour market to care for children and the cost of external child care. Highly educated women, therefore, are more likely to work and to use their income to purchase external child care and, given their higher expected amount of life-cycle wealth, they could eventually 'afford' a higher fertility as well. This is what seems to happen in our sample, since women with upper secondary and tertiary schooling are more likely both to participate and to give birth. Blau and Hagy (1998), for instance, find for the US a positive effect of the mother's wage rate on the probability of buying external child care and conclude that: 'paid child care arrangements and more

[31] This is a measure of period marital fertility, in particular the total fertility of a hypothetical marital cohort with the age-specific marital fertility rates observed in a certain year.

[32] For women with a university degree the hypothetical marriage duration is between age 25 and 39.

formal arrangements are complementary to being employed' (p. 127). In contrast, Chiuri (2000) using 1993 SHIW data does not find a positive effect of education on the probability of using external child care. However, the SHIW data do not include information on the use and the cost of child minders and given the strong restrictions in the places and the timetable available (see Del Boca 1999 and Del Boca and Pasqua 2001), especially for *crèches*, child minders might be an important form of external child care purchased by women working full-time with children aged under two (i.e. in our case). For women with a university education the fertility rate at ages 21-39 is higher than that of women with primary schooling but lower than that of women with the other two levels of education. Since in Italy is extremely rare for students to obtain a university degree before age 24, for this educational group the negative effect of a university education on fertility might run mostly through the postponement of marriage after the completion of tertiary education.[33]

It is worth noting that what we estimate is only a part of the overall effect of education on fertility. What we have estimated is simply the effect of education on marital fertility for the age classes 21-39, conditional on marriage or cohabitation.[34] But as we have seen in figure 4 education may influence also non-marital fertility and fertility before age 21,[35] and marital formation and dissolution. However, since in Italy the nuptiality rate at ages before 21 is very low[36] our estimated effect can be roughly interpreted as the effect of education on marital fertility.

Our findings are not necessarily in contrast with the evidence for the less developed countries (LDCs), which generally shows, instead, that female education has an important negative effect on fertility (see for instance Schultz 1993). Firstly, if one refers to overall (and not only marital) fertility is clear that education may negatively affect fertility by increasing the age at first marriage. Secondly, even if one considers marital fertility only (see, for instance, Lam and Duryea 1999) some possible explanations for these apparently contrasting findings are that while in the developed countries is usually assumed that contraceptive methods are largely available and used for family planning, in poor countries, where education is very low, a rise in schooling could affect the use and the effectiveness of contraceptive methods and lead to fewer unwanted births (see Rosenzweig and Schultz 1985). Moreover, while models for developed countries usually

[33] The percentage of married or cohabitant women with upper secondary school diploma who are students at ages 21-39 is 1.13% in the 1993 wave of the SHIW.

[34] As we noted we do not address in this paper the potential endogeneity of marital status.

[35] Gustafsson et al. (2001), for instance, find that in Britain, Germany, the Netherlands and Sweden combining motherhood and education is not generally chosen by women.

[36] In 1993 the nuptiality rate at age 20 (i.e. number of married women aged 20/number of women aged 20), for instance, was 4.87% (electronic data from ISTAT, Italian National Institute of Statistics).

assume an altruistic, or consumption, motive to have children (see Becker 1981), models for LDCs often stress an egoistic, or investment, motive to have children: the so-called *old-age security hypothesis* (see Cigno 1991). Therefore, the determinants of fertility may be very different in countries at different stage of development (see Hotz et al 1997 for the developed countries and Schultz 1997 for low income countries).

We find that especially for women with primary and lower secondary schooling, working in the labour market appears to be scarcely compatible with child rearing. In fact, most 'fertile' women do not participate in the labour market. The opposite is true for women with tertiary schooling who give birth, for whom the probability of fertility and non participation is null. This could be explained, as we have already said, in terms of the higher value of time and the better access to external private child care on the part of better educated women.

In general, the probability of LFP rises with education and is particularly high for women with a university education (e.g. it is about 99% in the age group 35-39). Women with tertiary education, for instance, are almost three times more likely to participate in the labour market than women with primary schooling at ages 35-39.

Apart from the exact measures of the estimated effects, we think that the qualitative implications of our analysis are quite clear. Firstly, education raises the LFP of women, especially of women giving births; secondly, for married women aged 21-39 the probability of giving birth increases with years of formal education up to the upper secondary schooling level and then declines; finally, education determines a fertility postponement. The fertility postponement can be explained by some of the economic models reviewed in section 2. For highly educated women an early withdrawal from the labour market is costly both in terms of current opportunity costs (i.e. wages) and future accumulation of human capital (*career planning motive*). Moreover, highly educated women might decide to give birth when their current incomes are relatively higher (*consumption smoothing motive*), which usually happens at older ages given the steeper wage profile for high skilled jobs.

5. Concluding remarks

In this paper we have developed an analysis of female marital fertility (at ages 21-39) and LFP decisions using data from the 1993 Survey of Household Income and Wealth of the Bank of Italy. We had a primary interest in the role of education in shaping labour

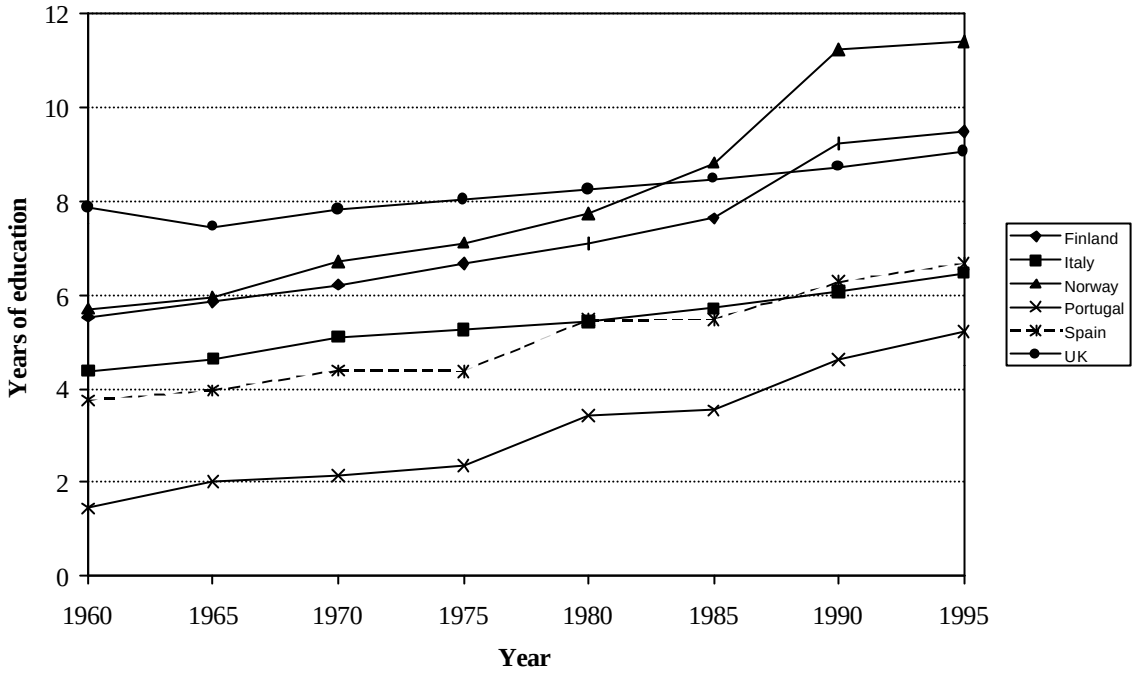
market and marital fertility decisions and therefore a primary concern about its potential endogeneity. The former has been accounted for by including in the model a wide range of controls (*proxying and matching method*), estimating a education regression and testing for weak exogeneity of education. However, after controlling for a wide range of characteristics of a woman's family and marital background we did not find any residual evidence of endogeneity of education with labour force participation and fertility. Our main findings are the following:

1. education increases the job attachment of women, in particular highly educated women also work in the period surrounding a birth event;
2. there is some evidence of a *ceteris paribus* rising pattern of marital fertility with increasing education at ages 21-39, except for women with tertiary education, which can be explained in terms of the prevalence of income over substitution effects due to education and by the greater access to external private child care available to highly educated women. The exception related to university educated women is due to their extremely low fertility rate at the ages 21-29, since they tend to postpone marriage and fertility until the completion of full-time education;
3. rising education determines a fertility postponement, which can be explained by the *career planning* and the *consumption smoothing motives* emphasised by the theoretical literature.

Our results have important policy implications. For example, policies which aim to increase women's education at least up to the upper secondary level have a positive effect upon LFP and marital fertility. In particular, we expect that the recent increase in the duration of compulsory schooling introduced in Italy will raise future female LFP.

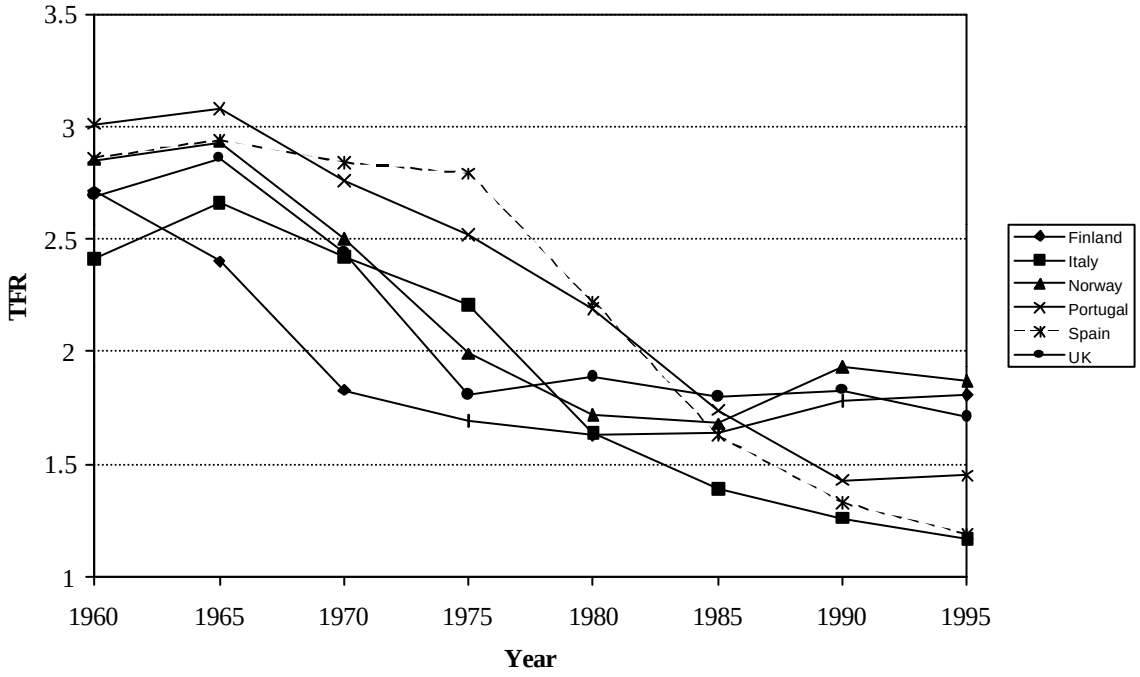
Figures in the main text

Figure 1. Average years of education per woman aged more than 14 in some European countries



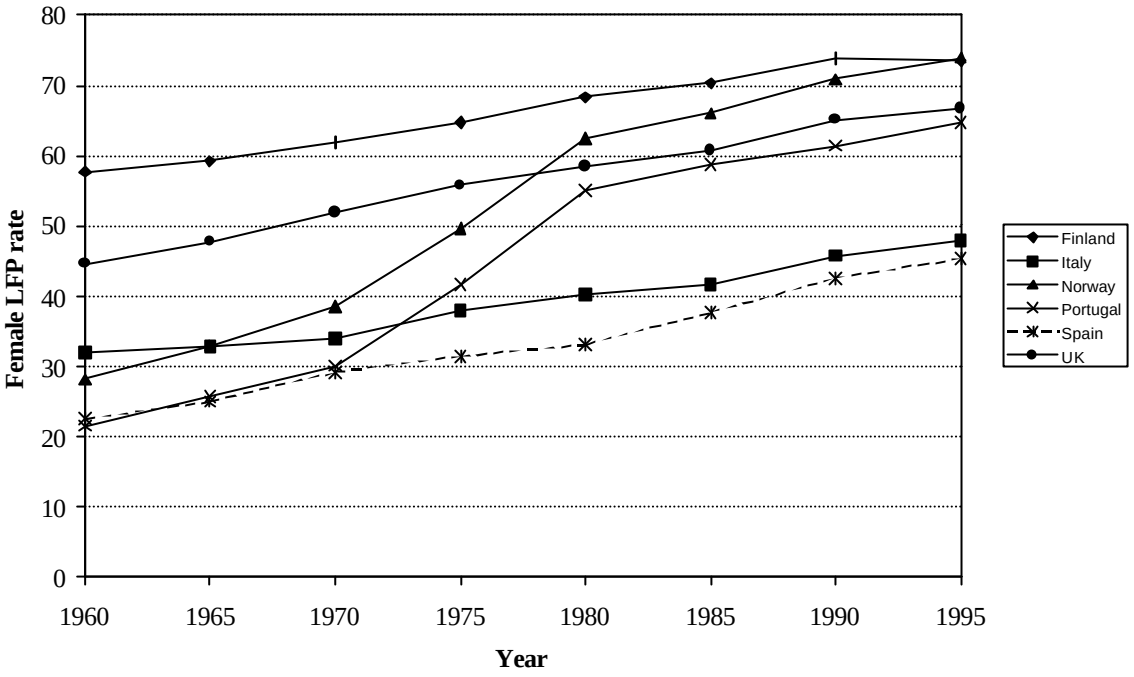
Data source: Barro and Lee (2001).

Figure 2. Total Fertility Rates (TFRs) in some European countries



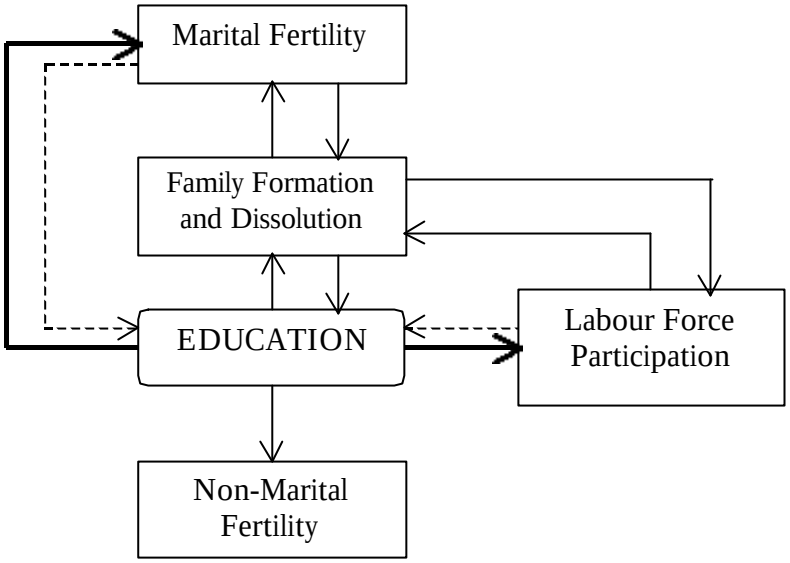
Data source: World Bank (2000). Total Fertility Rates are the number of births per woman at fecund ages.

Figure 3. Female Labour Force Participation (LFP) rate in some European countries



Data source: World Bank (2000). Female LFP rates are computed by dividing female labour force by the female population aged between 15 and 64.

Figure 4. Women's education, fertility and labour force participation: some possible interactions



Note. In the present paper we focus only on the interactions shown by bold or dotted arrows.

Tables in the main text

Table 1. Results of the previous literature on female labour force participation (LFP) and fertility behaviour in Italy

Characteristics	*Articles*		
	Colombino and Di Tommaso (1996)	Del Boca (1999)	Di Tommaso (1999)
data set	SHIW	SHIW	SHIW
sample composition	women 18-40	women 21-45	women 18-40
years	1987, 1989, 1991	1991, 1993, 1995	1987, 1989, 1991
participation definition	employment	employment	employment
fertility definition	one or more children in the household	one or more children in the household < 2 years old	one or more children in the household < 18 years old
econometric technique	bivariate probit	- fixed effects logit model (panel) - two separate logit (cross sections)	bivariate probit

	Effect					
Variables	Part.	Fert.	Part. [(a)]	Fert. [(a)]	Part.	Fert.
woman's wage	+	-			+	-
husband's wage	-	+			-	+
unearned income	-	no	-	no	+	-
wealth	+	no			-	+
centre	-	no				
south	-	+				
family transfers			+	+		
child care			+	no		
parents alive			+	+		
part-time			no	+		
schooling	+	-	+	no	+	-

Note. The + and – signs show the direction of the effect of the variables listed on participation (Part.) and fertility (Fert.), 'no' means that the effect is not found significant. [(a)] results for the 1993 cross-section.

Table 2. Observed distribution of the MNL outcomes by level of women's education

Education	(NP,NF)	(P,NF)	(NP,F)	(P,F)
Primary	74.04	19.23	6.25	0.48
Lower secondary	56.90	33.16	6.90	3.03
Upper secondary	28.96	59.30	4.89	6.85
Tertiary	5.61	80.37	0.00[(a)]	14.02

Note. The sample includes 1,420 observations. The four LFP and fertility outcomes are: (NP,NF), non participation-non fertility; (P,NF), participation-non fertility; (NP,F), non participation-fertility; (P,F): participation-fertility. [(a)] The fact that this cell is empty is not a problem since we do not consider dummies for education but a continuous variable, namely the years of education.

Table 3. Significance of the educational variables in explanation of female LFP and fertility

Variable	(P,NF)		(NP,F)		(P,F)	
	Coeff.	t-student	Coeff.	t-student	Coeff.	t-student
MNL model with controls for 'taste heterogeneity'						
(21-24) * Compulsory	0.19	1.38	0.39	2.15	0.52	1.09
(21-24) * Upper secondary	-0.11	-0.46	-0.20	-0.74	0.26	0.68
(25-29) * Compulsory	0.15	1.43	0.29	2.04	0.73	1.71
(25-29) * Upper secondary	0.18	1.96	0.12	0.85	0.24	1.86
(25-29) * Tertiary	0.15	0.65	-7.84	-25.49	-0.63	-1.46
(30-34) * Compulsory	0.14	1.37	0.30	2.05	0.51	1.24
(30-34) * Upper secondary	0.30	3.61	0.05	0.35	0.42	2.89
(30-34) * Tertiary	0.29	1.28	-7.82	-33.86	0.35	1.24
(35-39) * Compulsory	0.28	2.66	0.21	1.27	0.51	1.16
(35-39) * Upper secondary	0.19	2.81	-0.02	-0.09	0.36	1.96
(35-39) * Tertiary	0.87	3.51	-7.19	-13.50	1.14	3.98
Parsimonious' MNL model						
(21-24) * Compulsory	0.18	1.28	0.39	2.23	0.38	0.84
(21-24) * Upper secondary	-0.08	-0.35	-0.13	-0.49	0.29	0.75
(25-29) * Compulsory	0.14	1.30	0.29	2.01	0.63	1.61
(25-29) * Upper secondary	0.18	1.92	0.11	0.77	0.23	1.73
(25-29) * Tertiary	0.16	0.69	-7.74	-23.32	-0.45	-1.26
(30-34) * Compulsory	0.13	1.25	0.32	2.12	0.41	1.06
(30-34) * Upper secondary	0.30	3.62	0.02	0.15	0.44	2.99
(30-34) * Tertiary	0.27	1.17	-7.62	-31.68	0.38	1.40
(35-39) * Compulsory	0.27	2.54	0.23	1.37	0.44	1.06
(35-39) * Upper secondary	0.19	2.86	-0.03	-0.20	0.36	2.02
(35-39) * Tertiary	0.88	3.60	-6.90	-15.76	1.15	4.18

Note. The four LFP and fertility outcomes are: (NP,NF), non participation-non fertility; (P,NF), participation- non fertility; (NP,F), non participation-fertility; (P,F): participation-fertility. (NP,NF) is the reference outcome. The sample includes in all cases 1,420 women. The table shows the coefficients of the educational variables (by age group and level of education) estimated from the MNL model with all controls and the 'parsimonious' MNL model. The estimates of the coefficients of the other regressors are shown in Appendix B.

Table 4. Hausman test of the independence of irrelevant alternatives

Omitted outcome	Distribution	Test statistic	p-value
(NP,NF)	$Chi^2(122)$	-6.29	[a]
(P,NF)	$Chi^2(122)$	31.35	1.00
(NP,F)	$Chi^2(122)$	10.45	1.00
(P,F)	$Chi^2(122)$	7.15	1.00

Note. In all cases the Hausman test shows that the IIA assumptions cannot be rejected. [a] Hausman and McFadden (1984, footnote 4) maintain that the fact that the test statistic takes on a negative value can be interpreted as strong evidence against rejecting the hypothesis that the IIA assumption holds.

Table 5. Probabilities (%) of the MNL outcomes, by level of education and age-group (parsimonious MNL model)

		LFP and fertility outcomes					
Education	Age	(NP,NF)	(P,NF)	(NP,F)	(P,F)	P[(a)]	F[(b)]
Primary (5 years)							
	21-24	72.07	24.43	3.33	0.17	24.60	3.50
	25-29	76.18	21.04	2.16	0.62	21.66	2.78
	30-34	76.67	20.68	2.45	0.20	20.88	2.65
	35-39	64.41	34.08	1.30	0.20	34.28	1.50
					"Total fertility"=		10.44
Lower secondary (8 years)							
	21-24	57.72	33.24	8.63	0.41	33.65	9.04
	25-29	65.04	26.97	4.43	3.56	30.53	7.99
	30-34	67.06	26.78	5.56	0.60	27.38	6.16
	35-39	44.94	52.74	1.79	0.53	53.27	2.31
					"Total fertility"=		25.50
Upper secondary (13 years)							
	21-24	66.96	25.73	5.25	2.06	27.79	7.32
	25-29	43.74	43.64	5.19	7.42	51.06	12.62
	30-34	34.23	59.82	3.18	2.78	62.59	5.95
	35-39	24.53	72.92	0.83	1.72	74.65	2.55
					"Total fertility"=		28.44
Tertiary (17 years)							
	21-24	-	-	-	-	-	-
	25-29	34.32	64.73	0.00	0.96	65.68	0.96
	30-34	15.55	78.62	0.00	5.83	84.45	5.83
	35-39	0.92	92.53	0.00	6.55	99.08	6.55
					"Total fertility"=		13.34

Note. The four LFP and fertility outcomes are: (NP,NF), non participation-non fertility; (P,NF), participation- non fertility; (NP,F), non participation-fertility; (P,F): participation-fertility. The probabilities of the four MNL outcomes are computed at the sample average values for all variables but education. They may not sum to one because of rounding. "Total fertility" is the sum across age groups of the probability of giving birth by educational level. [(a)] Probability of participation: Pr(P,NF)+Pr(P,F); [(b)] Probability of fertility (i.e. of giving birth): Pr(NP,F)+Pr(P,F).

APPENDIX A. Variables description

The explanatory variables included in the econometric model are:

1. Broad area of residence. This variable is included to account for regional effects due to differences in the institutional and cultural setting. We consider three broad regions: North, Centre, and South.
2. Municipality size. We include the number of inhabitants of the municipality in which a woman resides to capture differences in labour market opportunities and child care availability that may exist between municipalities of different size. We consider four possible dimensions: very small (< 20 thousands), small (20-40 thousands), medium (40-500 thousands), big (> 500 thousands).
3. Partner's income. We include the net disposable total husband's income (in thousands of Italian lira) to control for pure income effects.
4. Parents' availability. This variable is a dummy for 'parents' availability' for child care and is included as a proxy for the availability of low cost external child care. We build the variable as follows. For each spouse we check if the province of birth is equal to that of residence, in which case we check if his/her mother is still alive in 1993. If both conditions are satisfied for at least one of the spouses, parents are considered 'available' for the purpose of child care (we assume that parents had not changed their province of residence since the birth of their child, and that they resided in the province in which birth took place). We consider only the mother to account for a possible gender role model (especially for older people). We prefer this variable, which may nevertheless have some drawbacks, to that of parents living in the household, used in other works (see for example Barrow 1999 or Del Boca et al. 2000) since we consider the interpretation of the effect of the latter more problematic. In fact, living with one's own parents is probably non-random. A mechanism of non-random selection might be at work, for example parents could be in bad health (for which we can not control) and the effect on LFP and fertility may be in the opposite direction to that expected. Anyway, our measure nests that used by previous studies even if the effect of self-selection should be less harmful.
5. 'Easterlin variables'. The 1993 wave of SHIW contains a section on intergenerational information. In particular there is a question on the relative position of the family in terms of accumulated wealth compared to the husband's and wife's families. There are three possibilities: less, equal or more resources.
6. Parents' education. We consider the educational qualifications of a woman's parents. In particular for the father we consider six educational categories: 1) missing education; 2) no formal education; 3) elementary; 4) lower secondary; 5) upper secondary; 6) university degree. For the mother the last two categories are grouped, since the low number of mothers with a university education caused several problems to the estimation procedure.
7. Father's job qualification. We consider the following qualifications: 1) not known; 2) blue collar, white collar low (low skilled) or unemployed (we can not consider the unemployed category separately since the cell of the outcome (P,F) is empty); 3) teacher or white collar high (medium skilled); 4) manager, head teacher, university lecturer, professional, entrepreneur (high skilled); 5) self-employed;
8. Father's branch of activity. We consider the following branches: 1) not known or not applicable; 2) agriculture, hunting, fishing; 3) manufacturing; 4) public administration (PA); 5) other.
9. Mother's job qualification. We consider the following categories: 1) not known; 2) blue collar and white collar low (low skilled); 3) teacher, white collar high, manager,

head teacher, university lecturer, professional, entrepreneur (medium and high skilled); 4) self-employed; 5) not working. Compared to father's education categories 3 and 4 are grouped since only three mothers fall in category 4.

10. Mother's branch of activity. See the father's branch of activity.
11. Husband's education. We include four dummies: 1) primary schooling; 2) lower secondary schooling; 3) upper secondary schooling; 4) university degree or more.
12. Husband's job qualifications. We include 5 dummies: 1) low skilled; 2) medium skilled; 3) high skilled; 4) self-employed; 5) unemployed (for the content of the different categories see father's job qualifications);
13. Husband's branch of activity. We include five dummies: 1) agriculture, hunting, fishing; 2) building; 3) manufacturing; 4) public administration; 5) other.
14. Husband's age.
15. Child care availability. We use data on child care availability, namely places available in public institutions providing child care by province (ISTAT 1995), and data on population aged under two by province, from the 1991 Census data (ISTAT 1993b), in order to build a ratio giving a measure of the 'degree of coverage' of the local potential demand for public child care.

APPENDIX B. FURTHER TABLES

Table B.1. Descriptive statistics for some variables

Variable	Obs.	Mean	S.D.
Husband's income	1420	30282.17	17659.70
(21-24) * Compulsory	1420	0.30	1.48
(21-24) * Upper secondary	1420	0.05	0.51
(25-29) * Compulsory	1420	1.66	3.21
(25-29) * Upper secondary	1420	0.47	1.46
(25-29) * Tertiary	1420	0.03	0.32
(30-34) * Compulsory	1420	2.69	3.69
(30-34) * Upper secondary	1420	0.80	1.83
(30-34) * Tertiary	1420	0.09	0.60
(35-39) * Compulsory	1420	2.91	3.69
(35-39) * Upper secondary	1420	0.86	1.88
(35-39) * Tertiary	1420	0.18	0.84
Parents available	1420	0.76	0.43
Public child care	1420	0.06	0.05
Father's education: none	1420	0.22	0.41
Father's education: lower secondary	1420	0.16	0.36
Father's education: upper secondary	1420	0.08	0.27
Father's education: degree	1420	0.03	0.18
Mother's education: none	1420	0.27	0.45
Mother's education: lower secondary	1420	0.11	0.31
Mother's education: upper secondary or higher	1420	0.07	0.26
Father's job: missing	1420	0.02	0.14
Father's job: medium skilled	1420	0.04	0.19
Father's job: high skilled	1420	0.04	0.19
Father's job: self-employed	1420	0.22	0.42
Father's branch: missing	1420	0.07	0.25
Father's branch: agriculture	1420	0.19	0.39
Father's branch: manufacturing	1420	0.24	0.43
Father's branch: PA	1420	0.16	0.37
Mother's job: missing	1420	0.01	0.11
Mother's job: low skilled	1420	0.19	0.39
Mother's job: medium and high skilled	1420	0.03	0.17
Mother's job: self-employed	1420	0.10	0.30
Mother's branch: agriculture	1420	0.10	0.30
Mother's branch: manufacturing	1420	0.06	0.23
Mother's branch: PA	1420	0.06	0.23
Mother's branch: other	1420	0.10	0.30
Husband's education: primary	1420	0.15	0.36
Husband's education: upper secondary	1420	0.32	0.47
Husband's education: degree	1420	0.08	0.28
Husband's job: medium skilled	1420	0.07	0.25
Husband's job: high skilled	1420	0.18	0.38
Husband's job: self-employed	1420	0.04	0.18
Husband unemployed	1420	0.04	0.19
Husband's branch: agriculture	1420	0.04	0.20
Husband's branch: manufacturing	1420	0.27	0.44
Husband's branch: building	1420	0.12	0.32
Husband's branch: PA	1420	0.28	0.45
Husband's age	1420	36.70	5.47
Mother in law worked	1420	0.30	0.46

Table B.2. MNL with controls for heterogeneity

Variable	(P,NF)		(NP,F)		(P,F)	
	Coeff.	t-student	Coeff.	t-student	Coeff.	t-student
Husband's income	-1.5E-05	-2.25	6.82E-06	0.71	-2.9E-05	-2.62
Parents available	0.87	3.47	0.93	1.85	-0.04	-0.09
Public child care	11.69	3.84	-9.30	-1.67	1.58	0.32
Father's education: none	-0.28	-0.78	0.11	0.22	-0.15	-0.21
Father's education: lower secondary	-0.58	-1.94	-0.47	-0.96	-0.33	-0.59
Father's education: upper secondary	0.24	0.51	1.18	1.37	-1.02	-1.56
Father's education: degree	-0.67	-0.82	0.39	0.17	-0.30	-0.29
Mother's education: none	-0.08	-0.24	-0.01	-0.03	-1.78	-2.07
Mother's education: lower secondary	0.33	0.92	-1.95	-2.45	0.54	0.89
Mother's education: upper secondary or higher	-0.51	-0.86	-0.86	-0.68	-0.04	-0.05
Father's job: missing	-1.47	-2.04	-1.20	-1.72	-2.49	-2.25
Father's job: medium skilled	0.72	1.04	-1.88	-1.11	1.43	1.60
Father's job: high skilled	0.36	0.68	-0.51	-0.41	0.81	1.02
Father's job: self-employed	-0.15	-0.55	0.02	0.03	-0.36	-0.76
Father's branch: missing	-0.54	-1.25	0.45	0.61	-0.67	-0.89
Father's branch: agriculture	-0.01	-0.04	0.40	0.93	0.92	1.49
Father's branch: manufacturing	-0.27	-0.97	-0.50	-0.91	0.20	0.41
Father's branch: PA	-0.44	-1.48	-0.76	-1.35	-0.52	-1.24
Mother's job: missing	1.17	1.39	1.95	2.22	1.98	1.38
Mother's job: low skilled	0.48	0.90	-0.27	-0.27	-2.67	-1.91
Mother's job: medium and high skilled	0.48	0.68	-0.84	-0.40	-1.27	-1.06
Mother's job: self-employed	-0.90	-1.55	-1.21	-1.02	-0.08	-0.05
Mother's branch: agriculture	0.22	0.37	1.52	1.44	-1.01	-0.49
Mother's branch: manufacturing	0.65	1.00	0.13	0.10	2.10	1.42
Mother's branch: PA	1.25	1.92	-0.83	-0.56	3.28	2.63
Mother's branch: other	0.68	1.25	1.00	0.95	0.96	0.67
Husband's education: primary	-0.10	-0.35	-0.08	-0.15	-2.08	-1.67
Husband's education: upper secondary	0.35	1.47	-0.26	-0.58	0.16	0.31
Husband's education: degree	0.86	1.67	-0.19	-0.14	0.68	0.86
Husband's job: medium skilled	-0.23	-0.50	-1.55	-1.59	-0.14	-0.21
Husband's job: high skilled	-0.57	-2.11	0.07	0.18	-0.28	-0.46
Husband's job: self-employed	-0.66	-1.40	-0.33	-0.38	-0.38	-0.53
Husband unemployed	0.26	0.48	0.69	0.97	-1.22	-1.10
Husband's branch: agriculture	0.15	0.28	0.48	0.71	-0.38	-0.27
Husband's branch: manufacturing	-0.27	-0.97	-0.25	-0.53	0.35	0.64
Husband's branch: building	-0.20	-0.63	-0.85	-1.63	1.01	1.57
Husband's branch: PA	0.00	0.00	-0.01	-0.03	-0.22	-0.39
Husband's age	-0.07	-2.21	-0.11	-2.09	-0.03	-0.68
Mother in law worked	0.54	2.34	-1.02	-1.80	0.73	1.78
constant	-1.28	-0.89	-1.35	-0.61	-6.55	-1.76
N. obs.	1420					
Overall p-value	0.00[(a)]					
Pseudo R^2	28.07%					

Note. (NP,NF) is the reference outcome. The model controls also for the area of residence, the municipality size and Easterlin's variables (see Appendix A). The reference characteristics are: southern residence; medium municipality; father's education: primary school; father's job: low skilled or unemployed; father's branch: other; mother's education: primary school; mother's job: not working; mother's branch: not applicable; 'parents not available'; mother in law did not work; husband's education: lower secondary; husband's job: low skilled; husband's branch: other. [(a)] test for the joint significance of the whole set of regressors included (except the constant).

Table B.3. Likelihood-ratio tests for model reduction

N. Group	Variable description	Distribution	Test statistic	p-value
1	Education	$Chi^2(33)$	160.78	0.00
2	Husband's income	$Chi^2(3)$	13.73	0.00
3	Geographic area	$Chi^2(6)$	19.73	0.00
4	Municipality size	$Chi^2(9)$	27.86	0.00
5	Parents' availability	$Chi^2(3)$	25.94	0.00
6	Child care	$Chi^2(33)$	47.7	0.00
7	Easterlin variables (husband)	$Chi^2(9)$	30.44	0.00
8	Easterlin variables (wife)	$Chi^2(9)$	4.58	0.87
9	Father's education	$Chi^2(12)$	20.03	0.07
10	Mother's education	$Chi^2(9)$	16.26	0.06
11	Father's job	$Chi^2(12)$	15.51	0.21
12	Mother's job	$Chi^2(12)$	16.11	0.19
13	Father's branch	$Chi^2(12)$	38.07	0.00
14	Mother's branch	$Chi^2(12)$	24.1	0.02
15	Husband's education	$Chi^2(9)$	13.43	0.14
16	Husband's job	$Chi^2(12)$	13.13	0.36
17	Husband's branch	$Chi^2(12)$	16.19	0.18
18	Husband's age	$Chi^2(3)$	16.36	0.00
19	Mother in law worked	$Chi^2(3)$	24.25	0.00
	8+11+13+15+16+17	$Chi^2(66)$	89.41	0.03
	8+11+13	$Chi^2(33)$	36.34	0.32

Table B.4. 'Parsimonious' MNL model

Variable	(P,NF)		(NP,F)		(P,F)	
	Coeff.	t-student	Coeff.	t-student	Coeff.	t-student
Husband's income	-1.4E-05	-2.17	8.71E-06	0.92	-3E-05	-2.48
Parents available	0.88	3.58	0.86	1.71	0.10	0.21
Public child care	11.56	3.86	-8.49	-1.51	1.12	0.22
Father's education: none	-0.25	-0.71	0.16	0.34	0.08	0.11
Father's education: lower secondary	-0.60	-2.06	-0.63	-1.34	-0.41	-0.74
Father's education: upper secondary	0.29	0.62	0.87	1.00	-0.86	-1.35
Father's education: degree	-0.38	-0.48	-0.46	-0.24	0.01	0.01
Mother's education: none	-0.08	-0.24	0.08	0.17	-1.82	-2.05
Mother's education: lower secondary	0.32	0.90	-1.69	-2.30	0.62	1.06
Mother's education: upper secondary or higher	-0.50	-0.77	-0.67	-0.56	0.06	0.08
Mother's job: missing	0.51	0.58	1.70	1.82	0.72	0.42
Mother's job: low skilled	0.43	0.85	0.10	0.11	-2.63	-2.10
Mother's job: medium and high skilled	0.51	0.76	-0.17	-0.11	-1.15	-1.14
Mother's job: self-employed	-1.01	-1.83	-0.65	-0.55	-0.74	-0.61
Mother's branch: agriculture	0.36	0.64	1.30	1.29	-0.08	-0.05
Mother's branch: manufacturing	0.72	1.20	-0.53	-0.44	2.14	1.64
Mother's branch: PA	1.20	1.87	-1.38	-0.98	2.99	2.77
Mother's branch: other	0.81	1.53	0.65	0.61	1.31	1.15
Husband's education: primary	-0.13	-0.46	-0.05	-0.10	-2.11	-1.65
Husband's education: upper secondary	0.33	1.39	-0.29	-0.67	0.13	0.27
Husband's education: degree	0.89	1.58	-0.23	-0.18	0.80	0.96
Husband's job: medium skilled	-0.11	-0.24	-1.44	-1.43	0.04	0.06
Husband's job: high skilled	-0.57	-2.16	0.09	0.23	-0.30	-0.46
Husband's job: self-employed	-0.67	-1.44	-0.31	-0.37	-0.23	-0.31
Husband unemployed	0.19	0.34	0.70	1.01	-1.38	-1.26
Husband's branch: agriculture	0.17	0.32	0.59	0.85	-0.32	-0.25
Husband's branch: manufacturing	-0.32	-1.21	-0.25	-0.58	0.37	0.65
Husband's branch: building	-0.20	-0.64	-0.93	-1.83	1.16	1.79
Husband's branch: PA	-0.03	-0.12	-0.11	-0.24	-0.35	-0.63
Husband's age	-0.07	-2.14	-0.10	-2.05	-0.04	-0.77
Mother in law worked	0.55	2.41	-0.99	-1.75	0.73	1.84
constant	-1.43	-1.01	-1.58	-0.73	-5.81	-1.66
N. obs.			1420			
Overall p-value			0.00[(a)]			
Pseudo R^2			26.86%			

Note. (NP,NF) is the reference outcome. The model controls also for area of residence, the municipality size and Easterlin's variables (see Appendix A). The reference characteristics are: southern residence; medium municipality; father's education: primary school; mother's education: primary school; mother's job: not working; mother's branch: not applicable; 'parents not available'; mother in law did not work; husband's education: lower secondary; husband's job: low skilled; husband's branch: other. [(a)] test for the joint significance of the whole set of regressors included (except the constant).

Table B.5. Education equation

Variable	Coeff.	t-student	p-value
North	-0.32	-1.09	0.27
Centre	-0.27	-0.94	0.35
Town: very small	0.05	0.25	0.80
Town: small	-0.26	-1.08	0.28
Town: big	-0.22	-0.85	0.39
Father's education: none	-0.48	-1.51	0.13
Father's education: low secondary	0.33	1.18	0.24
Father's education: high secondary	1.12	2.83	0.01
Father's education: degree	2.31	3.61	0.00
Father's job: missing	0.40	0.38	0.70
Father's job: medium skilled	1.36	2.57	0.01
Father's job: high skilled	1.44	2.95	0.00
Father's job: self-employed	1.16	4.44	0.00
Father's branch: missing	0.01	0.02	0.99
Father's branch: agriculture	-0.19	-0.62	0.53
Father's branch: manufacture	0.52	1.99	0.05
Father's branch: PA	0.61	2.05	0.04
Mother's education: none	-0.56	-1.82	0.07
Mother's education: low secondary	0.34	1.05	0.30
Mother's education: high secondary or higher	-0.19	-0.46	0.65
Mother's job: missing	-0.53	-0.47	0.64
Mother's job: low skilled	0.30	0.62	0.54
Mother's job: medium and high skilled	0.23	0.35	0.72
Mother's job: self-employed	0.54	1.02	0.31
Mother's branch: agriculture	-0.77	-1.38	0.17
Mother's branch: manufacturing	-0.72	-0.94	0.35
Mother's branch: PA	0.86	1.56	0.12
Mother's branch: other	0.59	1.16	0.25
constant	9.37	13.06	0.00
N.obs.		1420	
Overall p-value		0.00[(a)]	
R^2		49.08%	

Note. The dependent variable is the number of years of formal education. The reference characteristics are: southern residence; medium size municipality; father's education: primary school; father's job: low skilled or unemployed; father's branch: other; mother's education: primary school; mother's job: not working; mother's branch: not applicable. The regression included also all the other family background variables included in the MNL model with controls for heterogeneity (see table B.2). [(a)] test for the joint significance of the whole set of regressors included (except the constant).

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