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

Massimiliano Bratti[Y]

1. Introduction

One 'stylised fact' commonly observed in the developed countries is the pattern of the correlation between women's education, labour force participation and fertility. Table 1 shows the secular trends of average years of education in the female population, female labour force participation and Total Fertility Rates (TFRs) in some European countries.

Aggregated time-series data from individual countries seem to show the existence of a negative relationship between education and fertility and a positive relationship between education and labour force participation. However, when comparing different countries the pattern of negative correlation between education and fertility is no longer clear. Some countries with low average years of education in 1995, such as Spain (6.68), Italy (6.98) and Portugal (5.22) also have very low TFRs (1.19, 1.17 and 1.49,

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Ψ Address for correspondence: Dipartimento di Economia, Università degli Studi di Ancona, Piazzale Martelli 8, 60121 Ancona, Italy. Fax: +39 071 2207102 e-mail: massib@dea.unian.it

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

[Table 1 about here]

In particular, the relationship between education and fertility is a complex one and the total effect of education may act through several pathways. Figure 1 shows that education may influence fertility both indirectly by affecting the age at marriage, and other aspects of the marriage such as duration,[3] and directly, through its effect on marital fertility. Furthermore, education may be in part endogenous: strong preferences for market work may pushes women to invest more in education and perhaps to have a lower fertility (these effects operating through preferences are shown in the figure by dotted arrows). In macroeconomic studies of female fertility and labour force participation is difficult to isolate the different effects of education on marriage formation and dissolution, marriage duration and marital fertility.

[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).
[3] Smith (1997), for example, finds that 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.

Hence, the estimated effect is a total effect that does not shed light on the mechanisms through which education affects both fertility and labour force participation.

[Figure 1 about here]

For this reason in the present paper we focus on the investigation of married women's labour force participation and fertility decisions using household survey micro-data, i.e. we analyse the interactions showed by bold arrows in figure 1. In particular, we are interested in Italy, a country which has recently drawn 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 labour force participation. The study of female labour force participation and fertility is important for several reasons:

1. the decline in TFRs has already caused, and will exacerbate in the future, a problem of shortage of workers in Italy, with the consequent necessity to 'import manpower'. In this respect, policies aiming at raising women's labour force participation[4] can provide an effective way to attenuate the problem.
2. Another way to face the problem is to investigate the reasons of the low fertility of Italian women. Once the causes are found, policy makers can influence fertility behaviour by affecting costs and incentives connected to childbearing.
3. To analyse the impact of a widespread phenomenon, namely the increase in women's level of education, on labour force participation and marital fertility. This is interesting both from a positive point of view, in order to predict the possible impact of rising educational levels on female marital

[4] Throughout the paper we sometimes refer to 'labour force participation' simply as 'participation'.

fertility and labour force participation, and from a normative point of view, since the Italian educational system has been recently targeted by an extensive reform, which, among the other, has increased the duration of compulsory schooling.

The plan of the paper is as follows. In the following section we introduce a basic model of female labour force participation and marital fertility to offer a flavour of the economic factors which may affect female marital fertility and participation, with special reference to education. In section three we drop some restrictive assumptions from the model and consider other variables that may affect participation and fertility behaviour. Section four summarises briefly the results of the previous empirical work related to Italy. Section five describes the data and the variables used in the empirical analysis, the econometric model and the main results. Section six concludes.

2. The role of economic factors: a simple economic model of completed marital fertility and fertility timing

This section presents a basic model of completed marital fertility, fertility timing and labour force participation in order to investigate the economic considerations that may be taken into account by a woman, along with her partner, when she decides her level of completed fertility and its timing.

For the theoretical model we draw upon the article of Iyigun (2000) who incorporates the timing of childbearing into a growth model with endogenous fertility. Iyigun considers a set-up in which individuals live for three periods and derive utility from the total number of children and consumption in the last period. We modify his model by considering only two periods and including also consumption in the first period in the lifetime utility function.

The model in this section contains many simplifications since it is merely illustrative and its main purpose is to show how economic factors, such as a woman's education and her earnings potential, may influence her labour force participation and fertility behaviour. The simplifying assumptions will be dropped in the second part of the paper where we focus on an empirical application related to Italy.

In the theoretical model we use some specific assumptions about the spouses' behaviour within a family. We do use neither a unitary model nor a collective model of the family. This is mainly done since the Italian case, which will be the object of the empirical analysis, does not seem to fit in any of the two models. Due to the rigidities in the Italian labour market (see Del Boca, 1999) and to a strong gender role model, women have a primary responsibility for childbearing and the father's time is hardly a substitute for the mother's time (especially for very young siblings), since part-time jobs for men are rarely available. For these reasons it does not seem too restrictive to assume that male labour force behaviour is completely exogenous with respect to female labour force behaviour. Accordingly, we assume here that fertility and, especially, labour force decisions of women are individual and not unitary or collective. We also assume that a woman cohabits with her partner and is the final responsible for her fertility decisions, in the sense that her partner approves them ex-post. In order to simplify the analytical framework, here, we go further adopting the hypothesis that when a woman makes her fertility and labour participation choices she does not consider variables related to her partner.[5]

Women live for two periods and have the following lifetime utility function:

$$U(C_0, C_1, n_0, n_1) = a\left[\ln(C_0) + \beta \ln(C_1)\right] + b\ln(n_0 + n_1) \qquad (1)$$

[5] This assumption will be dropped in the empirical analysis.

where C_0 and C_1 are consumption in the first and the second period, $b < 1$ the discount factor, n_0 and n_1 the number of children in the first and the second period, and $a > 0$, $b > 0$ parameters of the utility functions reflecting the relative weight of consumption and fertility in the lifetime utility function. For the sake of simplicity we assume, in analogy with the previous theoretical literature, that C_0, C_1, n_0, $n_1 \in \Re_0^+$ and that the first derivatives of the utility function with respect to the single arguments are positive and the second derivatives negative.

Income is given by the following earnings function:

$$w_t = \alpha h_t l_t \qquad \forall\, t = 0\,,\,1 \tag{2}$$

i.e. it depends on the return to human capital (α), the stock of human capital accumulated at time t (h_t) and the labour supply (l_t).

The stock of human capital grows according to the following CES production function:

$$h_t = A(h_{t-1}^{\ r} + l_{t-1}^{\ r})^{1/r} \qquad \forall\, t = 0\,,\,1 \tag{3}$$

where $h_0 = A(e^r + l_{-1}^{\ r})^{1/r}$ and $l_{-1} = 0$, since the individual studies only at early stages of her life (i.e. in the period -1, which is not modelled). Education is predetermined at the level e at the beginning of the planning horizon and does not change over the life cycle. A is the *efficiency parameter* and r the *substitution parameter* (with $-\infty < r < 1$). This functional form implies that both education and on-the-job training contribute to the formation of the total stock of human capital, which is rewarded in the labour market. In particular, the economic return to labour–market experience increases with

the level of education (for some recent empirical evidence supporting this assumption see Brunello, 2001).

Women are subject to the following budget and time constraints:

$$C_t = \alpha h_t l_t \qquad \forall\ t = 0, 1 \tag{4}$$

$$l_t + z n_t = 1 \qquad \forall\ t = 0, 1 \tag{5}$$

where we have assumed *perfectly imperfect capital markets* (PICM), so as individuals must balance their budget in each period, and that each child requires z units of normalised time (the total time endowment being normalised to 1).

The problem of the individual is to maximise her lifetime utility subject to the budget, time and non-negativity constraints, the earnings equation and the human capital stock accumulating equation.

Substituting for h_t and l_t in the budget constraints using the time constraints and the expressions for consumption in the lifetime utility function we obtain a maximisation problem in two variables, i.e. fertility in the first (n_0) and in the second (n_1) period.

The first order conditions for an interior optimum are:

$$\frac{\partial U}{\partial n_0} = -\frac{\alpha z}{1 - z n_0} - \alpha\beta z\left[(Ae)^{\rho} + (1 - z n_0)^{\rho}\right]^{-1}(1 - z n_0)^{\rho - 1} + \frac{\beta}{n_0 + n_1} = 0 \tag{6}$$

$$\frac{\partial U}{\partial n_1} = -\frac{\alpha\beta z}{1 - z n_1} + \frac{\beta}{n_0 + n_1} = 0. \tag{7}$$

Through simple comparative statics calculations when $-\infty < \rho < 0$, it is easy to show that:

$$sign\left(\frac{dn_0^*}{de}\right) = sign\left(-\frac{\partial^2 U}{\partial n_0 \partial e}\frac{\partial^2 U}{\partial n_1 \partial n_1}\right) \text{ i. e. } \quad \frac{dn_0^*}{de} < 0 \tag{8}$$

$$sign\left(\frac{dn_1^*}{de}\right) = sign\left(\frac{\partial^2 U}{\partial n_0 \partial e}\frac{\partial^2 U}{\partial n_1 \partial n_0}\right) \quad \text{i. e. } \quad \frac{dn_1^*}{de} > 0 \tag{9}$$

where:

$$\frac{\partial^2 U}{\partial n_0 \partial n_0} = -\frac{az^2}{(1-zn_0)^2} + \frac{ab\rho z^2(1-zn_0)^{r-2}}{\left[(Ae)^r + (1-zn_0)^r\right]^2}\left[(\rho - 1)(Ae)^r - (1-zn_0)^r\right] - \frac{b}{(n_0+n_1)^2} < 0 \tag{10}$$

$$\frac{\partial^2 U}{\partial n_1 \partial n_1} = -\frac{ab\rho z^2}{(1-zn_1)^2} - \frac{b}{(n_0+n_1)^2} < 0 \tag{11}$$

$$\frac{\partial^2 U}{\partial n_0 \partial e} = \frac{Aab\rho r z^2\left[(1-zn_0)Ae\right]^{r-1}}{\left[(Ae)^r + (1-zn_0)^r\right]^2} < 0 \tag{12}$$

$$\frac{\partial^2 U}{\partial n_0 \partial n_1} = -\frac{b}{(n_0+n_1)^2} < 0\,. \tag{13}$$

Furthermore, it turns out that:

$$sign\left(\frac{dn_T^*}{de}\right) = sign\left(\frac{dn_0^*}{de} + \frac{dn_1^*}{de}\right) = sign\left[\frac{\partial^2 U}{\partial n_0 \partial e}\left(-\frac{\partial^2 U}{\partial n_1 \partial n_1} + \frac{\partial^2 U}{\partial n_0 \partial n_1}\right)\right] < 0 \text{ i.e.}$$

$$\frac{dn_T^*}{de} < 0 \qquad (14)$$

Through this simple analytical framework we want to stress two main points:

1. Fertility and labour force participation decisions are strictly related and can be considered as the outcome of a joint decision process. In particular, economic factors, such as the characteristics of the human capital production function (i.e. r) may affect both completed fertility and fertility timing decisions. In the case discussed above,[6] for instance, an increase in education pushes women to have a lower level of desired completed fertility.[7] Furthermore, the decrease in fertility takes place in the first period. Of course, the predictions of the model rest upon the particular assumptions made, such as the absence of external childcare or the fact that the utility derived from children does not depend on fertility timing.
2. The model also shows that explanatory variables that are commonly used in the empirical work on female labour force participation, such as the number of children, the age of children ('child services' variables in the

[6] In the case $0 < r < 1$ the predictions of the model are exactly opposite.

[7] This does not necessarily contradict the secular trend of decreasing completed fertility and rising levels of education. In fact, the model predicts that in a regime of 'controlled fertility', i.e. when contraception is easily available and fully effective, and observed and desired fertility coincide, *ceteris paribus* women with higher education have a higher level of completed marital fertility. Generally, when observing time-series data we observe periods in which the institutional framework may be very different (such as the access to contraceptive methods) and the *ceteris paribus* assumption may not be applicable. Moreover, the model considers as the 'planning horizon' only the period in which women have completed their investment in education and are married. Hence, a secular reduction in aggregated TFRs may also be due to an increase in

language of Nakamura and Nakamura, 1992) or labour market experience are to be considered endogenous. By including them in regressions explaining labour supply or labour force participation we estimate conditional supply functions. Likewise, regressions explaining the level of fertility conditioning on labour market variables, such as participation or experience, estimate conditional demand functions. But in order to perform policy counterfactuals, researchers are often mainly interested in unconditional demand and supply functions.[8] For this reason in the empirical application we estimate a *purist* reduced form model, in the language used in Browning (1992), of female labour force participation and fertility. This is equivalent to estimating a simultaneous econometric model of female labour force participation and fertility including among the explanatory variables only those exogenous variables that can be considered as the first determinants of participation and fertility behaviour.

3. A 'richer' model

Although the model discussed in the previous section gives some useful insights into the economic mechanisms driving fertility and labour force participation (in particular for the effect of formal education), it contains nonetheless many unnecessary assumptions. In the present section we remove those assumptions so as to identify the main exogenous variables which may affect female fertility and participation decisions, and which will be included in the empirical analysis. The kind of factors which are expected

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the period devoted to education or the postponement of marriage, and the consequent reduction of the length of the 'planning horizon' considered in the model.

[8] For example, if we estimate a female labour supply function including among the explanatory variables the potential wage and the number of children we can find a answer to questions such as: how much does an increase of 1% of the wage raise labour supply given that the number of children remains the same? In reality, an increase in female wages is likely to affect also the desired level of completed fertility and its timing so that the estimated conditional effects are not very informative.

to affect female fertility and labour force participation are well summarised in Lehrer and Nerlove (1986) and Dex and Joshi (1999). Here we consider:

The role of the partner. The husband[9] may affect in several ways a woman's fertility and participation decisions. If we adopt a unitary model of family, labour force participation decisions are jointly made by the spouses, as fertility decisions are. This suggests that husband's labour incomes are endogenous in this 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 a woman, who takes into account her non-labour incomes and the income of her husband (since family incomes are shared according to a certain 'sharing rule'). Unfortunately, in this case past non-labour incomes depend on past labour force participation, fertility and saving behaviour and are likely to be endogenous. We think that because of the strong institutional rigidities existing in the Italian labour market (see Del Boca, 1999) where part-time jobs are scarce and women have a 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 about the number of hours worked so that their incomes can be considered as exogenous with respect to female labour supply and fertility decisions. A collective model is probably more suitable to the Italian case: a woman makes her participation and fertility decisions taking into account the fact that she can share with her partner some family resources (and therefore also her partner's labour incomes). The sign of the impact of husband's income on female fertility can not be determined theoretically. In models that only account for the quantity of children the expected effect is positive. On the contrary, in models accounting also for the demand for quality the effect is generally expected to be negative (see De Tray, 1973,

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

and Becker and Lewis, 1973). Then the question must be addressed empirically.

Besides the role of the husband's income, we consider other husband-related variables that may affect a woman's labour force participation and fertility decisions, namely job qualification, branch of activity, age and level of education. The first two variables are proxies for the permanent income of the family and the time that the husband can potentially devote to child rearing. The third is a proxy for a woman's probability of conception, whereas the last variable may affect both family desired fertility and the husband's attitude towards his wife working.

Preferences and cultural factors. We consider the effect of the *gender role model* that a woman inherited from her mother and the attitude of the husband towards his wife working. 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.

Childcare. In the model of section 2 we assumed that childcare was only intensive in the mother's time. In reality, there are several forms of childcare available. Women have to decide which form of childcare 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 childcare. It is clear that if we include in the model the possibility to purchase external childcare, we break the link between women's value of time and the cost of childcare. The cost of childcare is no longer a woman's wage but the smallest between her wage and the cost of external childcare, and the implications of the theoretical model of section two change.

Easterlin model. In the Easterlin model 'the driving force behind both increased labour force participation 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 reported in Macunovich (1996). They have usually employed proxies for relative incomes, such as parental occupational status, and the empirical evidence on the validity of the hypothesis is mixed.

Endogeneity of female education. In this paper we focus our attention on the role of formal education in shaping participation and fertility decisions of married women. In the theoretical model we stressed that female education is a predetermined variable. This does not exclude that it can be endogenous: women with a higher 'taste for market work' may simultaneously invest more in education, and have higher labour force participation and lower fertility.[10] The observed correlation between education, labour force participation and fertility would be in this case only spurious and driven by a fourth factor: 'taste for market work'. For this reason we shall account in the empirical work for the possible endogeneity of education by including a wide range of family variables which may control for heterogeneity in the 'taste for market work' in the spirit of the *proxying and matching method* (see Blundell *et al.*, 1996), and by applying a Non Linear Instrumental Variables (NLIV) estimation strategy.

4. Fertility and labour force participation in Italy: previous research

Although there exist many studies investigating female labour supply and labour market participation conditioning on 'child services' variables and

[10] For a discussion of the endogeneity of education see Macunovich (1996, pp. 118-119).

studies analysing female fertility conditioning on labour force participation,[11] we review here only recent empirical work using an approach similar to ours, i.e. which jointly models and estimates female labour force participation and marital fertility behaviour in Italy.
Some recent contributions are:

[Table 2 about here]

Colombino and Di Tommaso (1996), who estimate a simultaneous model of female marital fertility and labour force participation 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 effects of various measures of unearned income and wealth to investigate income effects. The effect of the regressors included is reported in table 2. 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 (and labour market experience).

Del Boca (1999), who analyses the role of market rigidities upon 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

[11] For some surveys see Browning (1992), Nakamura and Nakamura (1992) and Hotz, Klerman and Willis

and 1995. Her sample includes women aged 21-45. The preferred model is the fixed effect model, which does not allow the estimation of the effect of education. Results are shown in table 2. 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 the three years. From a technical point of view her panel estimation procedure rests upon the assumption of independence of fertility and labour force participation decisions. In that case, once eliminated the unobserved heterogeneity using a fixed effect model the two logit models for participation and fertility can be estimated separately. However, for the estimation of the cross-sections she uses separate logit models 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.

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). She uses a sample of women aged 18-40. Results are shown in table 2. Schooling has a positive impact on participation and a negative impact on fertility through the effect on wages. From the technical point of view the econometric specification of Di Tommaso is based on the restrictive assumption of separability of the lifetime utility function into leisure and fertility. Education is considered exogenous.

With respect to the previous studies the present paper:

1. uses the 1993 SHIW data. The choice of the cohort depends on the availability of the variables that are used in the econometric specification (in particular data on childcare availability by province of residence).[12]

(1997).

[12] Del Boca (1999) uses data on childcare availability at the regional level.

2. Considers a birth event as 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 several economic 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 since we do not know the exact age (number of months) of children less than one year old and we want to avoid considering periods when participation in the labour market may not be possible, e.g. in the first months immediately after the birth.[13] Therefore, we study the issue of fertility and labour force participation in the period surrounding a birth event. This may nonetheless provide useful information on future labour market participation.[14] The nature of the SHIW, which does not include data on fertility and labour force participation histories, does not allow us to estimate a life-cycle model.
3. By including some interaction terms between years of education and age, we analyse also issues related to the effect of education on fertility timing.[15]
4. We explicitly consider family background variables that may affect a woman's, or her husband's, preferences towards fertility and labour force participation, often neglected in past empirical work.
5. We use a multinomial model. A multinomial model is more general than a bivariate model since it accounts for the possible non-separability of the lifetime utility functions into leisure and fertility, as shown in Weeks and Orme (1999).

[13] For the same reason we exclude from the sample women with a child aged less than one since for them giving birth may be impossible.
[14] Previous studies focusing on first birth (Mott and Shapiro, 1979, 1983) showed that women who did not enter the labour market before two years since the birth event have a high probability of staying out of the labour market for the rest of their life.
[15] Due to the cross-sectional nature of our study, in principle it could 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 labour force participation.

6. 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 labour force participation. 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.[16]
7. We account for the potential endogeneity of female education first by including several possible controls for the 'taste for market work' and then applying a Non Linear Instrumental Variables (NLIV) estimation strategy.

5. The empirical analysis

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

5.1 The econometric model

Although in the theoretic model we have considered only two periods, the problem can be generalised to a planning horizon with more periods. Furthermore, as the model did not consider the demand for leisure, there was a trade-off between childbearing and market work. If we assume that also leisure is a 'good', then we may have situations in which women neither participate in the labour market nor they give birth. This is the situation that seems to prevail in Italy where labour force participation and fertility are particularly low.

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

We code participation in period t as $L_t=1$, 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 $B_t=0$.

Each woman has an optimal lifetime plan concerning labour force participation and fertility decisions that can be stated as:

$$P^*=\{(L^*_1, B^*_1),(L^*_2,B^*_2),...,(L^*_T,B^*_T)\} \quad (15)$$

where T is the end of the planning horizon.

The probability to observe in the period t, $L_t=z$ and $B_t=j$, where $z,j=0,1$, is the probability that the couple of decisions $(L_t=z, B_t=j)$ is included in the optimal lifetime plan, i.e. $Pr[(L_t=z, B_t=j)\in P^*]$. If we define as V_t the lifetime utility function evaluated at time t, this probability is:

$$Pr[V_t(\{(L^*_1,B^*_1),(L^*_2,B^*_2),...,(L_t=z\ ,\ B_t=j),...,(L^*_T,B^*_T)\}) > V_t(\{(L^*_1,B^*_1),(L^*_2,B^*_2),...,(L_t=h,B_t=k),...,(L^*_T,B^*_T)\})] \quad (16)$$

$\forall\,(h,k)\neq(z,j)$. 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:

$$Y_{it}=\begin{cases}1 \text{ if } L_{it}=0, B_{it}=0 \text{ (NP - NF)}\\ 2 \text{ if } L_{it}=0, B_{it}=1 \text{ (P - NF)}\\ 3 \text{ if } L_{it}=0, B_{it}=1 \text{ (NP - F)}\\ 4 \text{ if } L_{it}=1, B_{it}=1 \text{ (P - F)}\end{cases} \quad (17)$$

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 lifetime expected utility function as V_{yit} , where t is the period of the choice, and *y* is one of the four possible outcomes of Y_{it} for the individual *i.* Adopting a linear specification we have:

$$V_{yit} = X_{it}' \boldsymbol{b}_y + \boldsymbol{e}_{yit} \tag{18}$$

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:

$$\Pr[Y_{it} = 1] = \Pr[V_{1it} = \arg\max_y V_{yit}] = \frac{\exp(X_{it}' \boldsymbol{b}_1)}{\sum_{y=1}^{4} \exp(X_{it}' \boldsymbol{b}_y)} \tag{19}$$

As equation (15) shows the current value of lifetime utility is a function of past, current and future choice variables, meaning that in the empirical specification we should include among the regressors only lifetime exogenous variables if we want to estimate unconditional effects (such as in the *purist* approach described in Browining, 1992).

We define participation as employment or unemployment and consider as non-participating women who replied to the SHIW that they were housewives (hence, dropping students).

5.2 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 can see Banca d'Italia (1995) and Filippin (1997). We consider women aged between 21 and 39. 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 is done since our 'economic model' of participation and fertility can explain only desired fertility, and we want to focus on ages at which women have a high fecundability.[17] The variables used in the present paper are:

1. Years of formal education. Since the SHIW contains information only on the highest educational qualification obtained, we compute the number of years of education using the years of legal duration of the different educational grades, as follows: primary school (*scuola elementare*) – 5 years; low secondary school (*scuola media inferiore*) – 8 years; high secondary school (*scuola media superiore*) – 13 years; university degree (*laurea*) – 17 years.[18] 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 labour force participation.
2. 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.
3. Municipality size. We include the number of inhabitants of the municipality in which a woman resides to capture differences in labour market opportunities and childcare availability that may exist between municipalities of different size. We consider four possible dimensions:

[17] We observe only realised fertility. Although in our economic model realised and observed fertility are equal, in the 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.

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

very small (< 20 thousands), small (20-40 thousands), medium (40-500 thousands), big (>500 thousands).

4. Partner's income. We include the net disposable total husband's income (in thousands of Italian lira) to control for pure income effects.
5. Parents' availability. This variable is a dummy for 'parents' availability' and is included as a proxy for the availability of low cost external childcare. We built the variable as follows. For each spouse we checked if the province of birth was equal to that of residence, in which case we checked if his/her mother was still alive. If both conditions were satisfied for at least one of the spouses, parents were considered available (we assume that parents did not change residence since the birth of their children, and that they resided in the province in which birth took place). We have considered only the mother to account for a possible gender role model (especially for older people). We preferred this variable, which may nevertheless have some pitfalls, to that of parents living in the household, used in other works (see for example Barrow, 1999, or Del Boca *et al.*, 2000) because 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 may be at work, for example parents may be in bad health conditions (for which we can not control) and the effect on labour force participation and fertility may be just 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.
6. '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 wealth compared to the husband and wife's families. There are three possibilities: less, equal or more resources.

7. 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) low secondary; 5) high secondary; 6) degree. For the mother we consider only 5 categories by grouping the last two, since the low number of mothers with a university education caused several problems to the estimation procedure.
8. Father's job qualifications. We consider the following qualifications: 1) not known; 2) blue collar, white collar low (low skilled) or unemployed;[19] 3) teacher or white collar high (medium skilled); 4) manager, head master, university teacher, professional, entrepreneur (high skilled); 5) self-employed;
9. 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; 5) other.
10. Mother's job qualifications. We consider the following categories: 1) not known; 2) blue collar and white collar low (low skilled); 3) teacher, white collar high, manager, head master, university teacher, professional, entrepreneur (medium and high skilled); 4) self-employed; 5) not working. Compared to father's education categories 3 and 4 are aggregated since only three mothers fall in category 4.
11. Mother's branch of activity. See the father's branch of activity.
12. Husband's education. We include four dummies: 1) primary schooling; 2) low-secondary schooling; 3) high-secondary schooling; 4) university degree or more.
13. Husband's job qualifications. We include 5 dummies: 1) low skilled; 2) medium skilled; 3) high skilled; 4) self-employed; 5) unemployed;[20]

[19] We can not consider the unemployed category separately since the cell of the outcome P-F is empty.
[20] For the content of the different categories see father's job qualifications.

14. Husband's branch of activity. We include five dummies: 1) agriculture, hunting, fishing; 2) building; 3) manufacturing; 4) public administration; 5) other.
15. Husband's age.
16. Childcare availability. We use data on childcare availability, namely places available in public institutions providing childcare by province (ISTAT, 1995), and data on population aged less than two by province, from the 1991 Census data (ISTAT, 1993), in order to build a ratio giving a measure of the 'degree of coverage' of the local potential demand for public childcare.

When it was possible we preferred using missing values dummies rather than discarding observations for which some variables contained missing data. Unfortunately, this was not always possible. In fact, for women for whom data on father or mother's education is missing not all the four MNL outcomes are observed, which caused major problems to the model estimation. Hence, we decided to drop observations with missing data on parent's education.

The full list of the variables is included in the Appendix. Table A1 in the Appendix reports some descriptive statistics for all the variables included. Table 3 shows the distribution of the four MNL outcomes by level of women's education: the positive correlation between education and participation is evident, however the data show also a positive correlation between education and fertility.

[Table 3 about here]

5.3 The effect of education

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 apply a Non Linear Instrumental Variables estimation strategy, by 'instrumenting' education, in order to account for the potential endogeneity of education.

The estimated effect of education in models of women's marital fertility and labour force participation may be partly spurious. It may be unobserved individual heterogeneity (e.g. unobserved preferences for market work) which pushes women to invest more in education and also affects their labour force participation and fertility decisions later on.[21] One way to control for the presence of unobserved heterogeneity (which may affect our estimates) is to include a wide range of family background variables, which are likely to contribute to shaping a woman's preferences, in the model. [22] We included father and mother's education, job qualification and branch of activity, which may affect a woman's 'taste for market work'. The estimates of this model are reported in table A2 in the Appendix. Clearly, even after controlling for possible tastes heterogeneity women's education retains its significance. In order to obtain a 'parsimonious' model we performed some LR tests for the different groups of regressors.[23] The groups of regressors that were not significant at the 10% level, when individually tested, were father's job qualification and branch of activity and husband's job

[21] In the model of Blackburn *et al.* (1993), for example, it is the preference for late childbearing which pushes women to invest more in human capital.
[22] The same procedure is applied by Blackburn *et al.* (1993).
[23] They are available upon request from the author.

qualification and branch of acitivity. However, when jointly tested the restrictions were not valid, while the model omitting only father's qualification and branch of activity was an admissible reduction of the general model. The estimates of the parsimonious model are shown in table 4.

[Table 4 about here]

Since the MNL model uses the maintained assumption of the Independence from Irrelevant Alternatives (IIA), we performed some specification tests to assess the validity of this assumption (see Hausman and McFadden, 1984). All tests concluded that the IIA could not be rejected.[24]

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 we apply a Non Linear Instrumental Variables Estimator[25] (NLIV), by instrumenting education. We use as identifying instruments father's job qualification and branch of activity, which the first part of the analysis suggested does not affect women's labour force participation and fertility, but which may affect their education. Table A3 in the Appendix shows the estimate of the education equation. The instruments turn out to be very significant in the explanation of the number of years of education achieved. Following the suggestions of Bound *et al.* (1995) we computed an F-statistic for the identifying instruments. The value is $\chi^2(8)=80.08$ (p-value: 0.00), which confirms that the instruments are quite good. The estimates obtained using the NLIV procedure are shown in table 5. Using the NLIV estimator reduces the precision of the estimates of the coefficients of education,

[24] In particular, we performed two tests, the first dropping the P-NF outcome only and the second dropping also the NP-F outcome.
[25] See Grogger (1990).

however a LR test for the joint omission of the different dummies for education was rejected at the 5% significance level.

[Table 5 about here]

The NLIV estimator though largely used in the empirical literature has an important potential pitfall. The non-linearity of the MNL model may cause the inconsistency of the estimates even if some very good instruments are used for the potentially endogenous explanatory variable. This result is proved using simulation by Dagenais (1999) and analytically in a particular case by Lucchetti (2000). The inconsistency arises from the potential correlation between the residuals of the non-linear model and the set of instruments used. In order to have a raw idea of the potential asymptotic bias of the estimates Dagenais (1999) reports the correlation between the residuals of the non-linear model and the instruments. We do the same; the correlations are shown in table A4 in the Appendix. The results are quite reinsuring: all the correlations are very close to zero, suggesting that the magnitude of the asymptotic bias is likely to be negligible.

In the light of these results, table 6 shows the predicted probability of the four MNL outcomes by level of education and age group computed at the sample average of all the remaining variables using the NLIV estimator.

[Table 6 about here]

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. Both for women with high secondary and tertiary education fertility peaks at the ages 25-29, whereas for women with low secondary education at the ages 21-24. Women with primary education have very similar probabilities to

be fertile at the ages 21-34. Women with a university education have remarkably high fertility rates at the ages 30-39, compared to women with low and high secondary schooling. Interpreting the sum of the probability of fertility at the different age groups by educational level as a raw indicator of total fertility, it is evident the U-shaped pattern of fertility by level of education which has been found by other researchers (such as Ben-Porath, 1973, and Dazinger and Neuman, 1989). This may be explained by the prevalence of income over substitution effects at very high levels of education and a better access to external childcare (see for example Ermisch, 1989).

It is worth noting that especially for primary and low secondary educated women work in the labour market appears to be scarcely compatible with child rearing. In fact, the most part of 'fertile' women does not participate in the labour market. The opposite is true for high secondary and tertiary educated 'fertile' women. This may be explained in terms of the higher value of time and the better access to external private childcare on the part of better educated women.

With respect to the recent reform of the Italian educational system, which has increased the age of compulsory schooling (by one year) to 15 years,[26] our model predicts a decrease in the NP-NF outcome, by 0.48, 1.58, 1.88 and 4.3 percentage points, at the ages 21-24, 25-29, 30-34 and 35-39 respectively, and an increase in participation. Fertility slightly decreases at all age groups.

Apart from the exact measures of the estimated effects we think that the qualitative suggestions of our analysis are quite clear-cut. Firstly, education raises labour force participation of women, especially of women giving births; secondly, for married women aged 21 to 39 fertility increases at higher levels of education; finally, education determines a fertility postponement. The reasons for this kind of behaviour can be explained by

[26] The duration of compulsory schooling is now 9 years.

the economic model: 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. The positive impact of education on fertility at higher levels of education (and women's wage) can be explained in terms of the different forms of childcare available to women with different levels of education and in terms of positive and large income and wealth effects.

5.4 Effect of other variables

In this section we comment on the qualitative effect of other variables discussed in the literature and which may be important for policy design. The size of the effects is reported in table 7.

[Table 7 about here]

Husband's income. It is a significant determinant of fertility and participation behaviour. In particular, an increase in husband's annual income by one million of Italian lira (about 516 Euro), decreases the probability of participation by about three percentage points while has a very tiny positive effect on fertility. Hence, the effects are in expected direction.

Husband's education. Husband's education raises the probabilities of fertility and participation. This shows that also the characteristics of the partner play a role in a woman's labour force and fertility decisions.

Gender role model. Women whose mother had a high job qualification are more likely to participate and less likely to give birth. This suggests that labour force participation may be an 'attitude' that a woman partly 'inherits' from her mother. Women living in families with a working mother may have developed a particular view of their role in the family. A similar effect is

played by the variable related to the labour market participation of the mother in law. Women whose mother in law worked are about 14 percentage points more likely to participate in the labour market. This confirms the results of the previous section: cultural factors related to a woman's and her partner's views of the gender roles within the family are strong predictors of female labour force and fertility behaviour.

Easterlin model. Compared to women living in families with the same level of resources as both their own and their partner's families, women living in families with more resources are more likely to participate (+17 percentage points) and to give birth (+2 percentage points). Women living in families with fewer resources have a lower probability of participation and a lower probability of fertility. We do not stress much these results because the interpretation of the 'causal' effect of this variable is problematic. In fact, the current level of family resources depends also on previous labour market behaviour, and the latter variable is endogenous.

Childcare. One percentage point increase in the ratio of public childcare places over the population 0-2 year old raises the probability of P-NF by 3.2 percentage points and decrease that of NP-NF by 2.8 percentage points. The effect on fertility is negligible. The interpretation of the effect of this variable is, however, problematic as childcare availability may be endogenous (see for example Del Boca, 1999). Since the childcare sector typically employs female workers, the effect on P-NF may be interpreted as an incentive for women to participate in labour markets that offer good employment opportunities to them. A similar effect is observed for the 'parents' availability' variable. Women whose parents are 'available' have a higher probability of P-NF, but in this case also a higher probability of NP-F.[27] These results may be explained by saying that relatives may look after children already born and allow women to participate, whereas are difficult

[27] It may be the case that they are staying out of the labour market when the child is very young but they plan to enter the labour market later on.

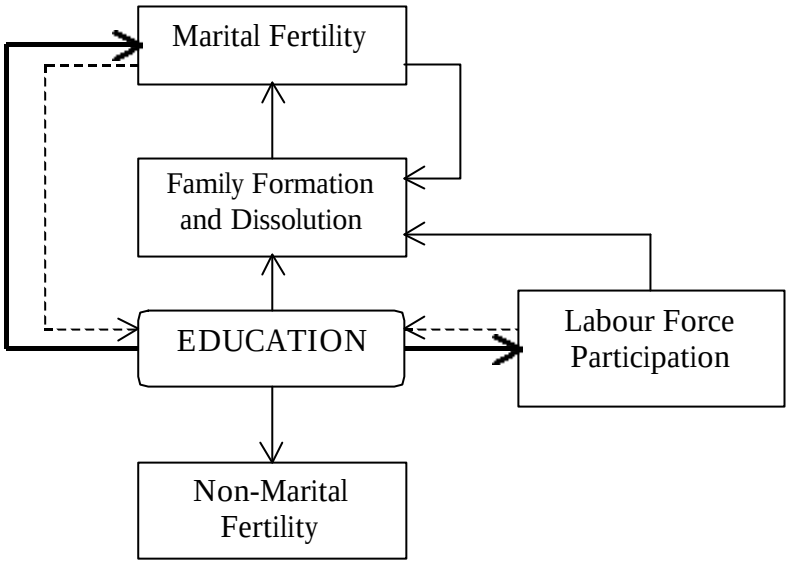
to reconcile with a forward-looking model in which women plan fertility according to the availability of low-cost external childcare.

6. Concluding remarks

In this paper we have developed an analysis of female marital fertility and labour force participation 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. The potential endogeneity of education has been accounted for by including in the model a wide range of controls, which are proxies for heterogeneity in the 'taste for market work' and using a Non Linear Instrumental Variables (NLIV) estimation strategy. Our main findings are the followings. Education raises the job attachment of women, in particular highly educated women work also in the period surrounding a birth event. There is some evidence of a U-shaped pattern of fertility with education, which can be explained in terms of the prevalence of income over substitution effects due to education and by the better access to external private childcare for highly educated women. Education determines a fertility postponement. At least in Italy, cultural factors related to the *gender role model* prevailing within a family have an important role, especially on women's labour force participation. Our results have important policy implications. Policies aiming at increasing women's education have a positive impact upon labour force participation. The impact on fertility is uncertain given the already noted U-shaped education-fertility pattern. In this respect, we expect that the recent increase in the duration of compulsory schooling introduced in Italy will raise female labour force participation in the future.

Figures in the main text

Figure 1. Women's Education, fertility and labour force participation: some possible interactions



Tables in the main text

Table 1. Average years of education per woman aged more than 14 for some European countries

Country	Year							
	1960	1965	1970	1975	1980	1985	1990	1995
Average years of education per woman aged more than 14[a]								
Finland	5.54	5.86	6.22	6.67	7.11	7.64	9.23	9.50
Italy	4.38	4.64	5.11	5.26	5.43	5.72	6.09	6.48
Norway	5.71	5.96	6.72	7.12	7.74	8.83	11.26	11.41
Portugal	1.44	2.01	2.14	2.37	3.42	3.54	4.63	5.22
Spain	3.75	3.96	4.39	4.37	5.47	5.48	6.28	6.68
UK	7.86	7.46	7.83	8.04	8.25	8.49	8.74	9.06
Total Fertility Rates (TFRs)[b]								
Finland	2.71	2.40	1.83	1.69	1.63	1.64	1.78	1.81
Italy	2.41	2.66	2.42	2.21	1.64	1.39	1.26	1.17
Norway	2.85	2.93	2.50	1.99	1.72	1.68	1.93	1.87
Portugal	3.01	3.08	2.76	2.52	2.19	1.74	1.43	1.45
Spain	2.86	2.94	2.84	2.79	2.22	1.63	1.33	1.19
UK	2.69	2.86	2.44	1.81	1.89	1.80	1.83	1.71
Females' labour force participation rates[c]								
Finland	57.70	59.20	61.88	64.67	68.31	70.32	73.92	73.48
Italy	31.99	32.77	33.94	38.00	40.21	41.65	45.75	47.97
Norway	28.13	32.94	38.57	49.61	62.44	66.05	70.90	73.96
Portugal	21.50	25.70	30.07	41.62	55.01	58.77	61.45	64.81
Spain	22.51	24.95	29.15	31.42	33.05	37.63	42.56	45.31
UK	44.65	47.76	51.90	55.81	58.40	60.79	65.11	66.77

Note. [a] Source: Barro and Lee (2001); [b] Total Fertility Rates are the number of births per woman at fecund ages (source World Bank, 2000); [c] Females' participation rates are computed by dividing female labour force by the female population aged between 15 and 64 (source World Bank, 2000).

Table 2. Results of the previous literature on female participation 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.*	Fert.*	Part.	Fert.
woman's wage	+	-			+	-
husband's wage	-	+			-	+
unearned income	-	no			+	-
wealth	no	+			-	+
centre	-	no				
south	-	+				
family transfers			-	+		
childcare			+	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. *: results for the 1993 cross-section.

Table 3. 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
Low secondary	56.90	33.16	6.90	3.03
High secondary	28.96	59.30	4.89	6.85
Degree	5.61	80.37	0.00*	14.02

Note. The sum by row may not be 100 because of rounding. * The fact that this cell is empty is not a problem since we do not consider dummies for educational levels but years of education.

Table 4. 'Parsimonious' model

	P-NF			*NP-F*			*P-F*	
Variable	Coeff.	t-student	Variable	Coeff.	t-student	Variable	Coeff.	t-student
ymale	-1.3 E-05	-2.09	ymale	7.92 E-06	0.84	ymale	-3 E-05	-2.48
geogr1	0.57	1.95	geogr1	0.30	0.59	geogr1	1.55	2.71
geogr2	0.03	0.09	geogr2	0.28	0.56	geogr2	0.63	1.18
citta1	0.47	2.27	citta1	-0.05	-0.14	citta1	-0.47	-1.04
citta2	0.08	0.34	citta2	-0.45	-1.05	citta2	0.15	0.31
citta4	-0.39	-1.11	citta4	0.47	0.85	citta4	-0.35	-0.70
h1	0.16	2.12	h1	0.13	1.34	h1	0.20	1.51
h2	0.18	3.95	h2	0.09	1.23	h2	0.36	4.32
h3	0.21	5.19	h3	0.09	1.38	h3	0.30	4.02
h4	0.29	7.55	h4	0.00	0.02	h4	0.34	4.75
parav	0.89	3.54	parav	0.87	1.78	parav	0.07	0.15
childcar	11.40	3.92	childcar	-7.38	-1.37	childcar	0.93	0.18
easth1	0.96	2.65	easth1	1.12	1.66	easth1	-1.36	-1.71
easth2	0.72	2.32	easth2	0.92	1.74	easth2	0.22	0.44
easth3	-0.02	-0.07	easth3	0.18	0.32	easth3	-0.36	-0.53
easts1	0.06	0.17	easts1	0.27	0.39	easts1	-0.64	-0.70
easts2	0.14	0.50	easts2	0.15	0.28	easts2	0.59	1.26
easts3	-0.03	-0.10	easts3	0.26	0.50	easts3	0.04	0.08
istruf2	-0.24	-0.66	istruf2	0.17	0.39	istruf2	0.03	0.04
istruf4	-0.59	-2.03	istruf4	-0.59	-1.24	istruf4	-0.34	-0.62
istruf5	0.34	0.76	istruf5	0.98	1.08	istruf5	-0.64	-1.02
istruf6	-0.23	-0.30	istruf6	-0.89	-0.48	istruf6	0.43	0.42
istrum2	-0.13	-0.40	istrum2	0.05	0.12	istrum2	-2.00	-2.24
istrum4	0.25	0.69	istrum4	-1.76	-2.44	istrum4	0.48	0.77
istrum5	-0.57	-0.92	istrum5	-0.59	-0.51	istrum5	0.03	0.04
jbmoth1	0.62	0.67	jbmoth1	1.71	1.93	jbmoth1	0.46	0.26
jbmoth2	0.47	0.92	jbmoth2	-0.09	-0.09	jbmoth2	-3.35	-2.24
jbmoth3	0.51	0.77	jbmoth3	-0.22	-0.16	jbmoth3	-2.09	-1.62
jbmoth4	-0.91	-1.57	jbmoth4	-0.80	-0.70	jbmoth4	-0.81	-0.49
sectm2	0.34	0.59	sectm2	1.42	1.40	sectm2	0.08	0.04
sectm3	0.68	1.13	sectm3	-0.30	-0.23	sectm3	2.66	1.74
sectm4	1.11	1.70	sectm4	-1.42	-0.99	sectm4	3.72	2.89
sectm5	0.72	1.33	sectm5	0.80	0.77	sectm5	1.23	0.84
istruh1	-0.03	-0.12	istruh1	-0.20	-0.41	istruh1	-2.12	-1.69
istruh3	0.36	1.55	istruh3	-0.30	-0.68	istruh3	0.07	0.15
istruh4	1.06	1.98	istruh4	-0.64	-0.46	istruh4	0.86	1.09
jbhusb2	-0.15	-0.32	jbhusb2	-1.31	-1.44	jbhusb2	0.04	0.06
jbhusb3	-0.55	-2.11	jbhusb3	0.11	0.27	jbhusb3	-0.25	-0.36
jbhusb4	-0.78	-1.74	jbhusb4	-0.40	-0.47	jbhusb4	-0.14	-0.20
jbhusb5	0.22	0.39	jbhusb5	0.70	1.04	jbhusb5	-1.35	-1.13
seth1	0.19	0.36	seth1	0.67	0.98	seth1	-0.44	-0.34
seth2	-0.32	-1.21	seth2	-0.22	-0.51	seth2	0.23	0.40
seth3	-0.11	-0.36	seth3	-0.89	-1.74	seth3	1.03	1.59
seth4	-0.01	-0.05	seth4	-0.07	-0.14	seth4	-0.39	-0.74
etah	-0.06	-2.20	etah	-0.10	-2.18	etah	-0.06	-1.29
mothlaw	0.54	2.40	mothlaw	-1.02	-1.82	mothlaw	0.65	1.56
constant	-1.92	-1.56	constant	-0.06	-0.03	constant	-3.28	-1.78

N. obs.	1420
Prob > χ^2	0.00*
Pseudo R^2	25.69%

Note. NP-NF is the reference outcome. *: test for the joint significance of the whole set of the regressors included (except the constant).

Table 5. NLIV model

	P-NF			*NP-F*			*P-F*	
Variable	Coeff.	t-student	Variable	Coeff.	t-student	Variable	Coeff.	t-student
ymale	-1.2 E-05	-1.87	ymale	8.05 E-06	0.84	ymale	-2.5 E-05	-2.23
geogr1	0.41	1.40	geogr1	0.27	0.49	geogr1	1.30	2.28
geogr2	-0.08	-0.27	geogr2	0.25	0.48	geogr2	0.49	0.92
citta1	0.51	2.49	citta1	-0.04	-0.11	citta1	-0.42	-0.90
citta2	0.11	0.46	citta2	-0.50	-1.13	citta2	0.31	0.60
citta4	-0.47	-1.40	citta4	0.45	0.81	citta4	-0.40	-0.84
h1	0.05	0.29	h1	-0.12	-0.27	h1	0.26	1.10
h2	0.08	0.45	h2	-0.14	-0.32	h2	0.44	1.84
h3	0.10	0.59	h3	-0.14	-0.33	h3	0.35	1.57
h4	0.19	1.09	h4	-0.24	-0.57	h4	0.38	1.68
parav	0.85	3.46	parav	0.85	1.69	parav	0.06	0.13
childcar	12.43	4.38	childcar	-6.99	-1.29	childcar	2.52	0.52
easth1	0.57	1.67	easth1	1.05	1.54	easth1	-1.70	-2.10
easth2	0.50	1.68	easth2	0.88	1.69	easth2	0.00	-0.01
easth3	-0.18	-0.53	easth3	0.17	0.30	easth3	-0.62	-1.02
easts1	0.07	0.16	easts1	0.29	0.42	easts1	-0.44	-0.51
easts2	0.24	0.87	easts2	0.17	0.34	easts2	0.72	1.64
easts3	0.12	0.42	easts3	0.26	0.51	easts3	0.32	0.66
istruf2	-0.30	-0.77	istruf2	-0.04	-0.06	istruf2	0.26	0.32
istruf4	-0.54	-1.92	istruf4	-0.43	-0.75	istruf4	-0.40	-0.82
istruf5	0.51	1.08	istruf5	1.39	1.46	istruf5	-1.05	-1.63
istrum2	-0.07	-0.19	istrum2	-0.11	-0.17	istrum2	-1.81	-2.01
istrum4	0.20	0.50	istrum4	-1.64	-1.98	istrum4	0.17	0.25
istrum5	-0.70	-1.09	istrum5	-0.54	-0.44	istrum5	-0.27	-0.38
jbmoth1	0.43	0.57	jbmoth1	1.41	1.38	jbmoth1	0.51	0.30
jbmoth2	0.33	0.67	jbmoth2	-0.05	-0.05	jbmoth2	-3.39	-2.33
jbmoth3	0.56	0.85	jbmoth3	-0.23	-0.16	jbmoth3	-2.26	-1.76
jbmoth4	-0.91	-1.58	jbmoth4	-0.52	-0.43	jbmoth4	-0.98	-0.61
sectm2	0.36	0.65	sectm2	1.14	1.00	sectm2	0.20	0.10
sectm3	0.74	1.19	sectm3	-0.41	-0.31	sectm3	2.68	1.78
sectm4	1.19	1.75	sectm4	-1.21	-0.80	sectm4	3.51	2.70
sectm5	0.85	1.54	sectm5	0.89	0.82	sectm5	1.24	0.88
istruh1	-0.22	-0.80	istruh1	-0.26	-0.54	istruh1	-2.37	-1.93
istruh3	0.79	3.69	istruh3	-0.14	-0.33	istruh3	0.68	1.41
istruh4	1.86	3.64	istruh4	-0.35	-0.27	istruh4	2.01	2.56
jbhusb2	-0.07	-0.16	jbhusb2	-1.22	-1.35	jbhusb2	0.26	0.41
jbhusb3	-0.46	-1.82	jbhusb3	0.15	0.36	jbhusb3	-0.16	-0.26
jbhusb4	-0.73	-1.57	jbhusb4	-0.23	-0.27	jbhusb4	0.03	0.05
jbhusb5	-0.01	-0.02	jbhusb5	0.64	0.96	jbhusb5	-1.81	-1.52
seth1	0.19	0.40	seth1	0.67	1.00	seth1	-0.15	-0.12
seth2	-0.25	-0.99	seth2	-0.18	-0.43	seth2	0.31	0.56
seth3	-0.27	-0.86	seth3	-0.95	-1.85	seth3	0.83	1.33
seth4	0.06	0.23	seth4	-0.04	-0.08	seth4	-0.30	-0.58
etah	-0.08	-2.60	etah	-0.10	-2.03	etah	-0.05	-1.16
mothlaw	0.51	2.46	mothlaw	-1.01	-1.82	mothlaw	0.57	1.44
constant	-0.56	-0.28	constant	2.05	0.47	constant	-4.46	-1.63

N. obs.	1420
Prob > χ^2	0.00*
Pseudo R^2	23.12%

Note. NP-NF is the reference outcome. *: test for the joint significance of the whole set of the regressors included (except the constant).

Table 6. Probabilities (%) of the MNL outcomes, by level of education and age-group (NLIV model)

Education	Age	*NP-NF*	*P-NF*	*NP-F*	*P-F*	*P**	*F***
Primary							
	21-24	64.95	23.64	11.21	1.99	25.63	13.20
	25-29	63.31	26.31	9.92	4.56	30.87	14.48
	30-34	61.74	28.60	9.37	2.90	31.50	12.27
	35-39	55.36	39.30	5.04	3.06	42.36	8.10
Low secondary							
	21-24	64.33	27.40	7.84	0.43	27.83	8.27
	25-29	60.33	31.77	6.30	1.60	33.37	7.90
	30-34	57.50	36.02	5.70	0.77	36.79	6.47
	35-39	43.45	53.90	1.90	0.76	54.66	2.66
High secondary							
	21-24	60.71	33.61	4.14	1.54	35.15	5.68
	25-29	48.34	37.79	2.57	11.31	49.10	13.88
	30-34	46.25	47.93	2.26	3.57	51.50	5.83
	35-39	23.39	73.55	0.30	2.76	76.31	3.06
Degree							
	21-24	55.60	37.96	2.38	4.05	42.01	6.43
	25-29	29.10	31.20	0.90	38.80	70.00	39.70
	30-34	34.60	53.63	0.96	10.81	64.44	11.77
	35-39	12.24	81.02	0.06	6.68	87.70	6.74

Note. The probabilities of the four MNL outcomes are computed at the sample average values for all variables but education. They may not sum to 100 because of rounding. * Participation; ** Fertility.

Table 7. Effect of some selected variables on the probabilities (%) of the MNL outcomes (NLIV model).

Variable	*NP-NF*	*P-NF*	*NP-F*	*P-F*	P^{*}	F^{**}
Reference$^{\Psi}$	47.92	47.92	2.46	1.70	49.62	4.16
ymale +1 million	50.42	45.37	2.79	1.43	46.80	4.22
childcare + 1%	45.12	51.08	2.16	1.64	52.72	3.80
parav = 0	63.08	33.09	1.70	2.13	35.22	3.83
parav = 1	43.03	52.72	2.71	1.55	54.26	4.26
jbmoth1	41.87	51.89	2.82	3.42	55.31	6.24
jbmoth2	35.80	61.81	2.29	0.10	61.91	2.39
jbmoth3	31.01	67.07	1.66	0.26	67.33	1.92
jbmoth4	63.77	31.71	2.56	1.95	33.67	4.52
same resources	57.19	39.28	1.50	2.04	41.31	3.53
more resources	38.66	55.63	2.90	2.81	58.44	5.72
less resources	58.20	37.91	2.34	1.54	39.45	3.88
istruh2	56.22	38.62	3.23	1.92	40.55	5.16
istruh1	62.55	34.48	2.77	0.20	34.68	2.97
istruh3	38.00	57.52	1.90	2.58	60.10	4.48
istruh4	17.51	77.29	0.71	4.48	81.78	5.20
mothlaw = 0	51.08	43.85	3.54	1.53	45.38	5.07
mothlaw = 1	39.83	57.06	1.01	2.10	59.16	3.11

Note. The probabilities of the four MNL outcomes are computed at the sample average values for all variables but that listed. They may not sum to 100 because of rounding. $^{\Psi}$ For the characteristics of the reference individual see the variables description in the Appendix;* Participation; ** Fertility.

APPENDIX. Variables description

Name	Description
ymale	husband's income (thousands of Italian lira)
geogr1	north
geogr2	centre
geogr3	south (*reference group*)
town1	municipality very small
town2	municipality small
town3	municipality medium (*reference group*)
town4	municipality big
h1	years of education * age(21-24) dummy
h2	years of education * age(25-29) dummy
h3	years of education * age(30-34) dummy
h4	years of education * age(35-39) dummy
parav	dummy for parent availability' (=1)
childcar	public childcare
easth1	missing family resources (head's family)
easth2	more resources than head's family
easth3	less resources than head's family
easth4	same resources as head's family (*reference group*)
easts1	missing family resources (spouse's family)
easts2	more resources than spouse's family
easts3	less resources than spouse's family
easts4	same resources as spouse's family (*reference group*)
eduf1	Father's education: missing
eduf2	father's education: none
eduf3	father's education: primary (*reference group*)
eduf4	father's education: low secondary
eduf5	father's education: high secondary
eduf6	father's education: degree
edum1	mother's education: missing
edum2	mother's education: none
edum3	mother's education: primary (*reference group*)
edum4	mother's education: low secondary
edum5	mother's education: high secondary or higher
jbfath1	father's job: missing
jbfath2	father's job: low skilled or unemployed (*reference group*)
jbfath3	father's job: medium skilled
jbfath4	father's job: high skilled
jbfath5	father's job: self-employed
sectf1	father's sector: not known
sectf2	father's sector: agriculture, hunting, fishing
sectf3	father's sector: manufacture
sectf4	father's sector: public administration
sectf5	father's sector: other (*reference group*)
jbmoth1	mother's job: missing
jbmoth2	mother's job: low skilled
jbmoth3	mother's job: medium and high skilled
jbmoth4	mother's job: self-employed
Jbmoth5	mother's job: not working (*reference group*)
sectm1	mother's sector: not known or not applicable (*reference group*)
sectm2	mother's sector: agriculture, hunting, fishing
sectm3	mother's sector: manufacturing
sectm4	mother's sector: public administration

continue

continue	
sectm5	mother's sector: other
eduh1	husband’s education: missing
eduh2	husband’s education: primary
eduh3	husband’s education: low secondary (*reference group*)
eduh4	husband’s education: high secondary
edu5	husband’s education: tertiary or higher
jbhush1	Husband’s job: low skilled (*reference group*)
jbhush2	Husband’s job: medium skilled
jbhush3	Husband’s job: high skilled
jbhush4	Husband’s job: self-employed
jbhush5	Husband’s job: unemployed
secth1	Husband’s sector: agriculture, hunting, fishing
secth2	Husband’s sector: building
secth3	Husband’s sector: manufacturing
secth4	Husband’s sector: public administration
secth5	Husband’s sector: other (*reference group*)
ageh	Husband’s age
mothlaw	Dummy for mother in law worked (=1)

Table A1. Descriptive statistics

Variable	N. obs.	Mean	Std. Dev.
ymale	1420	30282.17	17659.70
geogr1	1420	0.38	0.48
geogr2	1420	0.21	0.41
citta1	1420	0.22	0.41
citta2	1420	0.20	0.40
citta4	1420	0.08	0.27
h1	1420	0.35	1.80
h2	1420	2.15	4.37
h3	1420	3.58	5.25
h4	1420	3.95	5.48
parav	1420	0.76	0.43
childcar	1420	0.06	0.05
easth1	1420	0.13	0.33
easth2	1420	0.42	0.49
easth3	1420	0.18	0.39
easts1	1420	0.06	0.23
easts2	1420	0.40	0.49
easts3	1420	0.20	0.40
istruf2	1420	0.22	0.41
istruf4	1420	0.16	0.36
istruf5	1420	0.08	0.27
istruf6	1420	0.03	0.18
istrum2	1420	0.27	0.45
istrum4	1420	0.11	0.31
istrum5	1420	0.07	0.26
jbfath1	1420	0.02	0.14
jbfath3	1420	0.04	0.19
jbfath4	1420	0.04	0.19
jbfath5	1420	0.22	0.42
sectf1	1420	0.07	0.25
sectf2	1420	0.19	0.39
sectf3	1420	0.24	0.43
sectf4	1420	0.16	0.37
jbmoth1	1420	0.01	0.11
jbmoth2	1420	0.19	0.39
jbmoth3	1420	0.03	0.17
jbmoth4	1420	0.10	0.30
sectm2	1420	0.10	0.30
sectm3	1420	0.06	0.23
sectm4	1420	0.06	0.23
sectm5	1420	0.10	0.30
istruh1	1420	0.15	0.36
istruh3	1420	0.32	0.47
istruh4	1420	0.08	0.28
jbhusb2	1420	0.07	0.25
jbhusb3	1420	0.18	0.38
jbhusb4	1420	0.04	0.18
jbhusb5	1420	0.04	0.19
seth1	1420	0.04	0.20
seth2	1420	0.27	0.44
seth3	1420	0.12	0.32
seth4	1420	0.28	0.45
etah	1420	36.70	5.47
mothlaw	1420	0.30	0.46

Table A2. MNL with controls for heterogeneity

	P-NF			NP-F			P-F	
Variable	Coeff.	t-student	Variable	Coeff.	t-student	Variable	Coeff.	t-student
ymale	-1.4 E-05	-2.19	ymale	5.81 E-06	0.63	ymale	-3.1 E-05	-2.62
geogr1	0.60	2.04	geogr1	0.51	1.01	geogr1	1.56	2.86
geogr2	0.02	0.05	geogr2	0.37	0.76	geogr2	0.62	1.20
citta1	0.44	2.12	citta1	-0.08	-0.22	citta1	-0.60	-1.26
citta2	0.05	0.21	citta2	-0.43	-1.00	citta2	0.05	0.11
citta4	-0.36	-1.04	citta4	0.46	0.77	citta4	-0.29	-0.58
h1	0.16	2.13	h1	0.12	1.18	h1	0.24	1.74
h2	0.19	4.02	h2	0.11	1.34	h2	0.36	4.30
h3	0.22	5.16	h3	0.10	1.41	h3	0.30	3.99
h4	0.29	7.41	h4	0.01	0.11	h4	0.34	4.63
parav	0.90	3.53	parav	0.92	1.87	parav	-0.01	-0.03
childcar	11.51	3.85	childcar	-8.32	-1.55	childcar	1.18	0.23
easth1	0.95	2.61	easth1	1.11	1.59	easth1	-1.34	-1.70
easth2	0.71	2.27	easth2	0.99	1.82	easth2	0.16	0.32
easth3	-0.05	-0.13	easth3	0.14	0.26	easth3	-0.44	-0.65
easts1	0.02	0.04	easts1	0.46	0.65	easts1	-0.64	-0.68
easts2	0.13	0.46	easts2	0.07	0.13	easts2	0.64	1.41
easts3	-0.04	-0.13	easts3	0.27	0.51	easts3	0.10	0.18
istruf2	-0.27	-0.73	istruf2	0.12	0.26	istruf2	-0.16	-0.22
istruf4	-0.57	-1.91	istruf4	-0.42	-0.87	istruf4	-0.30	-0.54
istruf5	0.29	0.63	istruf5	1.28	1.47	istruf5	-0.76	-1.20
istruf6	-0.38	-0.49	istruf6	0.06	0.03	istruf6	0.31	0.27
istrum2	-0.12	-0.37	istrum2	-0.03	-0.07	istrum2	-1.98	-2.32
istrum4	0.29	0.80	istrum4	-1.96	-2.58	istrum4	0.48	0.76
istrum5	-0.64	-1.09	istrum5	-0.79	-0.66	istrum5	-0.18	-0.25
jbfath1	-1.61	-2.15	jbfath1	-1.13	-1.64	jbfath1	-2.30	-2.12
jbfath3	0.73	1.14	jbfath3	-1.93	-1.17	jbfath3	1.39	1.63
jbfath4	0.11	0.21	jbfath4	-0.79	-0.63	jbfath4	0.12	0.15
jbfath5	-0.18	-0.65	jbfath5	0.00	-0.01	jbfath5	-0.40	-0.83
sectf1	-0.55	-1.27	sectf1	0.49	0.67	sectf1	-0.77	-1.13
sectf2	0.03	0.10	sectf2	0.40	0.94	sectf2	0.85	1.43
sectf3	-0.25	-0.90	sectf3	-0.50	-0.89	sectf3	0.11	0.23
sectf4	-0.45	-1.51	sectf4	-0.84	-1.50	sectf4	-0.58	-1.31
jbmoth1	1.37	1.58	jbmoth1	1.98	2.34	jbmoth1	1.33	1.08
jbmoth2	0.50	0.93	jbmoth2	-0.36	-0.35	jbmoth2	-3.29	-2.27
jbmoth3	0.54	0.77	jbmoth3	-0.47	-0.26	jbmoth3	-1.96	-1.53
jbmoth4	-0.82	-1.36	jbmoth4	-1.22	-1.00	jbmoth4	-0.42	-0.23
sectm2	0.20	0.32	sectm2	1.56	1.44	sectm2	-0.55	-0.24
sectm3	0.64	0.99	sectm3	0.22	0.17	sectm3	2.37	1.54
sectm4	1.18	1.75	sectm4	-0.89	-0.59	sectm4	3.89	3.04
sectm5	0.63	1.13	sectm5	1.07	0.98	sectm5	1.09	0.66
istruh1	0.00	-0.01	istruh1	-0.23	-0.44	istruh1	-2.24	-1.79
istruh3	0.38	1.64	istruh3	-0.27	-0.60	istruh3	0.11	0.23
istruh4	1.04	2.08	istruh4	-0.52	-0.38	istruh4	0.80	1.06
jbhusb2	-0.26	-0.57	jbhusb2	-1.42	-1.58	jbhusb2	0.00	0.01
jbhusb3	-0.56	-2.09	jbhusb3	0.10	0.25	jbhusb3	-0.26	-0.38
jbhusb4	-0.80	-1.75	jbhusb4	-0.45	-0.51	jbhusb4	-0.36	-0.54
jbhusb5	0.26	0.46	jbhusb5	0.67	0.97	jbhusb5	-1.32	-1.14
seth1	0.16	0.30	seth1	0.56	0.83	seth1	-0.51	-0.36
seth2	-0.25	-0.91	seth2	-0.22	-0.46	seth2	0.23	0.40
seth3	-0.10	-0.31	seth3	-0.77	-1.50	seth3	1.02	1.57

continue

continue

seth4	0.03	0.12	seth4	0.04	0.08	seth4	-0.30	-0.55
etah	-0.06	-2.18	etah	-0.11	-2.32	etah	-0.07	-1.37
mothlaw	0.53	2.36	mothlaw	-1.06	-1.86	mothlaw	0.64	1.50
constant	-1.79	-1.45	_cons	0.27	0.14	_cons	-2.95	-1.62

N. obs.	1420
Prob > χ^2	0.00*
Pseudo R^2	26.80%

Note. NP-NF is the reference outcome. *: test for the joint significance of the whole set of the regressors included (except the constant).

Table A3. Estimates of the education equation

Variable	Coeff.	t-student	p-value
geogr1	0.19	0.79	0.43
geogr2	0.02	0.06	0.95
citta1	-0.05	-0.23	0.82
citta2	-0.37	-1.43	0.15
citta4	0.03	0.12	0.90
istruf2	-0.79	-2.08	0.04
istruf4	0.62	1.95	0.05
istruf5	1.59	3.17	0.00
istruf6	2.77	3.50	0.00
jbfath1	0.32	0.29	0.77
jbfath3	2.60	4.36	0.00
jbfath4	2.32	4.47	0.00
jbfath5	1.42	4.70	0.00
sectf1	0.19	0.43	0.67
sectf2	-0.50	-1.40	0.16
sectf3	0.33	1.09	0.28
sectf4	0.60	1.77	0.08
istrum2	-0.94	-2.54	0.01
istrum4	0.79	2.13	0.03
istrum5	0.25	0.38	0.70
jbmoth1	-0.88	-0.85	0.40
jbmoth2	0.20	0.40	0.69
jbmoth3	-0.05	-0.06	0.95
jbmoth4	0.46	0.85	0.39
sectm2	-0.60	-1.05	0.29
sectm3	-0.11	-0.15	0.89
sectm4	1.40	2.27	0.02
sectm5	0.85	1.59	0.11
constant	9.23	29.71	0.00
N.obs.	1420		
F-test	0.00*		
R^2	33.38%		

Note. The dependent variable is the number of years of formal education. *: test for the joint significance of the whole set of regressors included (except the constant).

Table A4. Correlation between instruments and MNL residuals (NLIV model)

Instruments	MNL residuals			
	e_1	e_2	e_3	e_4
jbfath1	0.057	-0.020	-0.048	-0.028
jbfath2	-0.005	0.052	-0.031	-0.066
jbfath3	-0.020	0.028	0.013	-0.028
jbfath4	-0.050	0.033	0.032	0.003
sectf1	0.025	-0.044	0.014	0.025
sectf2	-0.014	-0.012	0.005	0.049
sectf3	0.018	-0.021	-0.009	0.017
sectf4	0.026	0.014	-0.017	-0.066

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