Education and fertility: an investigation into Italian families

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Abstract

Purpose – The purpose of this paper is to analyze the correlation between the educational level and the number of children in Italy, where a very low fertility rate may be observed.

Design/methodology/approach – Since the number of children ever born is a count variable, Poisson regression is the suitable statistical procedure used to conduct the empirical analysis. First, the authors estimate the correlation between the female's education and her number of children, and then the authors use also partner's education to take into account the family dimension. Furthermore, in the context of fertility, zero observations might be due either to the choice not to have children, or to the impossibility of becoming a mother. For this reason, the authors adopt also a more appropriate tool, that is a zero-inflated Poisson regression.

Findings – From the empirical results, a significant negative correlation may be observed between the level of education and the number of children.

Originality/value – There are other studies in the literature focusing on the correlation between female participation rate and her fertility rate in the Italian case. In those frameworks, the education variable is usually considered as a control variable. The paper's contribution to the literature is twofold: on one hand the authors develop a theoretical model giving an intuition reason of mechanism underlying the fertility behaviour of families; on the other hand, the authors implement more appropriate empirical models to test for this hypothesis, taking education as the main variable.

Keywords Italy, Women, Children, Family, Birth rate, Human capital, Education, Fertility

Paper type Research paper

1. Introduction

In the literature, we may observe many works trying to investigate the correlation between education and the number of children. Indeed, Breierova and Duflo (2004) find that women's education increases the age at marriage and decreases the number of children born before the woman turned 15. Aldieri *et al.* (2006) study the linkages between fertility decisions and human capital of both males and females, proxied by years of schooling. The authors obtain a trade-off between years of schooling and the probability of having a new child. Black *et al.* (2008) find that increases in compulsory schooling reduce the incidence of teenage childbearing in the USA and Norway. Monstad *et al.* (2008) study the connection between fertility and education. Their results

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indicate that increasing education leads to postponement of first births away from teenage motherhood and towards women having their first birth in their 20s as well as for a smaller group up to the age of 35-40. However, they do not find that more education results in more women remaining childless or having fewer children. Osilii and Long (2008) pick out a causal effect of education on fertility in Nigeria and this effect is significantly negative. More recently, Kirdar *et al.* (2010) analyse the impact of the extension of compulsory schooling in Turkey from five to eight years on the marriage and fertility behaviour of teenage women. They find that the probability of marriage by age 16 is reduced by 44 percent and the probability of giving birth by age 17 falls by 37 percent. The effects of the education policy on the time until the marriage and first birth persist beyond the completion of compulsory schooling. After a woman is married, schooling does not have an impact on the duration until her first birth. Aldieri *et al.* (2010) investigate the role of women's education in the transition towards having a second child in Italy. By implementing an event-history model, they find a negative effect of women's education on the transition rate towards a second child. Aldieri and Vinci (2010) find a negative impact of educational level on the number of children in Italy, by considering the grandparents' education as an instrument of parents' education. McCrary and Royer (2011) use age at school entry policies to identify the effects of female education on fertility and infant health. They find that education does not significantly impact fertility. In particular, women born just before and after the school entry date are equally likely to become mothers and give birth at similar age.

Our aim in this paper is to provide further evidence for the correlation between the number of children and educational level both at female level and at family level.

The outline of the paper is as follows: in Section 2 we develop a theoretical model about the relation between the number of children and the educational level both at individual level and at family level. Section 3 describes the data and the estimation procedure. Section 4 discusses the empirical results and Section 5 concludes and gives some suggestions for further research.

2. The model setup

2.1 The basic framework

By modifying Kimura and Yasui (2007) where decisions concerning fertility, occupation and education are taken into account and where all of agents live for three different periods: youth, adult age and finally old age; in the first period each subject take delivery of obligatory education and benefits of a predetermined amount of her parents' time; in the second one decisions concerning fertility and labor supply are taken. Moreover, in this period, each agent evaluates the chance of investment in further education in order to supply labor as a more qualified worker. Finally in the old age people consume what saved in adulthood.

The adult subjects are assumed homogeneous, take delivery of utility from children and consumption in the final period, and maximize the following utility function:

$$U_t = \gamma \ln[n_t] + (1 - \gamma)\ln[C_{t+1}] \tag{1}$$

with n_t and C_{t+1} standing, respectively, for the number of children, and consumption in, while the parameter γ, assumed $0 < \gamma < 1$, measures the relative weight for children.

The budget constraint concerning childcare, work and education supported by workers differs if we distinguish skilled from unskilled subjects; more precisely we have:

$$C_{t+1} = (1 + r_{t+1})(h_0 + h_t)[1 - \tau n_{s,t} - \beta h_t] \tag{2}$$

for high skilled workers, and:

$$C_{t+1} = (1 + r_{t+1})h_0[1 - \tau n_{u,t}] \tag{3}$$

for the low skilled ones. h_t represents the higher human capital of people who decide to supply labor as skilled workers, h_0 is the compulsory educational level from the first period, $n_{s,t}$ and $n_{u,t}$ are number of children of skilled and unskilled workers, and finally τ and β symbolize, respectively, the quotas of the wage bill devoted to a child care and to further education.

The maximization processes of equation (1), with respect to $n_{s,t}$ and h_t, subject to the budget constraint (2) for the high skilled workers, and with respect to $n_{u,t}$, subject to equation (3) for the low skilled ones, give the following functions[1]:

$$n_{s,t} = \frac{\gamma(1 - \beta h_t)}{\tau} \tag{4}$$

$$h_{s,t} = \frac{[1 - \tau n_{s,t} - \beta h_0]}{2\beta} \tag{5}$$

$$n_{u,t}{}^* = \frac{\gamma}{\tau}. \tag{6}$$

By combining equations (4) and (5) we obtain the following equilibrium values[2]:

$$n_{s,t}{}^* = \frac{\gamma}{\tau}\left[\frac{1 + \beta h_0}{2 - \gamma}\right] \tag{7}$$

$$h_{s,t}{}^* = \frac{(1 - \gamma - \beta h_0)}{\beta(2 - \gamma)}. \tag{8}$$

Proposition 1. There is a negative relationship between the number of children and education from one hand because high skilled workers have fewer children than low skilled ones, from the other one because in the better educated workers pool the higher educational level the lower number of children.

Proof. By comparing equations (6) and (7), from which we may easily derive that: $n_{s,t}{}^* < n_{u,t}{}^*$, and from inspection of equations (4) and (5). □

2.2 Introducing a family context

We now consider the case in which the decisions unit is the family, in the sense of a couple, instead of the single individual. In this light choices on both the desired number of children and investments in further education are jointly taken within a family.

Three different types of families may be distinguished:

(1) a high educated family with both the couple's members investing in further education;

(2) a mixed one with only one investing in further education; and
(3) a low educated family.

The three different constraints are[3]:

$$C_{t+1} = (1 + r_{t+1})\left[\left(h_0 + h_t^m\right) + \left(h_0 + h_t^f\right)\right]\left[1 - \tau n_{s,t} - \beta h_t^m - \beta h_t^f\right] \tag{9}$$

$$C_{t+1} = (1 + r_{t+1})\left[\left(h_0 + h_t^f\right) + (h_0)\right]\left[1 - \tau n_{m,t} - \beta h_t^f\right] \tag{10}$$

$$C_{t+1} = (1 + r_{t+1})2h_0[1 - \tau n_{u,t}] \tag{11}$$

where $n_{s,t}$, $n_{m,t}$ and $n_{u,t}$ represent the desired number of children in the high educated, mixed, and low educated families, while h_t^m and h_t^f stand for the higher level of education for males and females.

In the case of a high educated family, assuming that: $\hat{h}_t = h_t^m = h_t^f$, and maximizing equation (1) subject to budget constraint (9) with respect to $n_{s,t}$ and h_t we may easily obtain:

$$n_{s,t} = \frac{\gamma(1 - 2\beta\hat{h})}{\tau} \tag{12}$$

$$h_{s,t} = \frac{[1 - \tau n_{s,t} - 2\beta h_0]}{4\beta} \tag{13}$$

and as a result the following equilibrium values[4]:

$$n_{s,t}{}^* = \frac{\gamma}{\tau}\left[\frac{(1 + 2\beta h_0)}{(2 - \gamma)}\right] \tag{14}$$

$$\hat{h}_t{}^* = \frac{(1 - \gamma - 2\beta h_0)}{2\beta(2 - \gamma)}. \tag{15}$$

Shifting our attention to the case of a mixed family the maximization process of equation (1) subject to equation (10) gives what follows:

$$n_{m,t} = \frac{\gamma(1 - \beta h_t)}{\tau} \tag{16}$$

$$h_t^f = \frac{[1 - \tau n_{m,t}] - 2\beta h_0}{2\beta} \tag{17}$$

from which:

$$n_{m,t}^* = \frac{\gamma}{\tau}\left[\frac{(1 + 2\beta h_0)}{(2 - \gamma)}\right] \tag{18}$$

$$h_t^{f*} = \left[\frac{(1 - \gamma - 2\beta h_0)}{\beta(2 - \gamma)}\right] \tag{19}$$

In the final case of a low educated family we easily derive that:

$$n_{u,t}{}^{*} = \frac{\gamma}{\tau}. \tag{20}$$

Proposition 2. Even in the case of the family as decision unit, we can set up what follows:
There is a negative relationship between the number of children and education from one hand because high skilled and mixed families have fewer children than low skilled ones, from the other one because there is a negative relation between parents' education and number of children in both educated and mixed educated families.

Proof. The first part of Proposition 2 is from the comparison of, respectively, equations (14) and (18) with equation (20). As far as concerns the second part, it comes from inspections of equations (12) and (16). □

3. Dataset description and modelling

Our analysis is based on data taken from the European Union – Statistics on Income and Living Conditions (EU-SILC) over the period 2004-2007. The EU-SILC database provides comparable, cross-sectional and longitudinal multi-dimensional data on income, poverty, social exclusion and living conditions in the European Union. The data are gathered by the Member States of the European Union and collected by Eurostat. Labor, education and health information is obtained for persons aged 16 and over. Income is mainly collected at personal level, but some components are included in the "household" section. The selected sample for the analysis of childbirths considers 10,720 Italian families over the period 2004-2007.

All the variables used in the estimated model are collected in Table I, while Table II reports the descriptive statistics of our sample.

Our dependent variable is represented by the number of children ever born (*NC*) to each respondent (and to his partner). As can be seen from the table, the mean children ever born for all families is 1.24 with a standard error of 1.056. For our multivariate analysis, we can use the educational levels of the female respondent as a determinant variable and that of her partner in such a manner that we may also identify the high educated families, characterized by a high educational level both for the wife and for her husband. In particular, we use the highest educational level received at the time of the interview. According to Hoem *et al.* (2001), it would be more useful to use education as a time-variant covariate, but in our case, all respondents have completed their studies before the first child was born. We make a distinction between respondents with a lower education (*LowEd*), with lower education certificate, and higher education (*HighEd*), with a secondary school certificate or a university degree. Results show that most of the people have a lower education, with a mean of 0.86, while the families with both partners high educated indicate a mean of 0.06. We control for age, by using five classes. In terms of other control variables, the probability of working for females is 0.28, that of having a permanent contract is equal to 24 percent in our sample, while the mean years of work experience is 19.92. As far as the health conditions are concerned, we consider a dummy which is equal to 0 if the woman's conditions are very good or good. In order to control for the economic situation of the households, we take into account six classes of the yearly family income, whether the family is owner of a house and whether the family has received government transfers for children. Furthermore, in order to control for the geographical variation in fertility tastes and education opportunities in Italy, we include

Number of children ever born	Dependent variables
	NC
	Independent variables
Lower education	*LowEd*
Higher education	*HighEd*
Higher educated family (higher education for wife and her husband)	*HighHighEd*
Class of income[a]: <10,000	*H0*
Class of income: 10,000-19,999	*H1*
Class of income: 20,000-29,999	*H2*
Class of income: 30,000-39,999	*H3*
Class of income: 40,000-49,999	*H4*
Class of income: >50,000	*H5*
Class of age: 25-29	*A1*
Class of age: 30-34	*A2*
Class of age: 35-39	*A3*
Class of age: 40-44	*A4*
Class of age: >45	*A5*
Work = 1 if woman works	*Work*
Permanent = 1 if woman's work is permanent	*Permanent*
Owner = 1 if woman's family is owner of house	*Owner*
Experience = duration in years of woman's work	*Experience*
Health = 1 if woman's health is very good or good	*Health*
Social transfer = government transfers for children	*ST*
Urbanization = 1 if country is densely populated (>50,000 inhabitants per square kilometer)	*UR*

Note: [a]Yearly family income has been deflated according to GDP deflators (2005 euro)

Table I. Definition of used variables

regional dummies in the estimated models. In particular, we consider four regional areas: North-West (reference area), North-East, Center, South. As far as the environmental conditions are concerned, we include a dummy (UR) which is equal to one if the country of residence is densely populated (country has more than 50,000 inhabitants per square kilometer). Finally, we include time dummies in the model to consider a linear trend.

Since the number of children ever born is a count variable, Poisson regression is the statistical procedure to conduct these analysis (Winkelmann and Zimmermann, 1995). The Poisson model is superior to ordinary least squares or other linear models because the distribution of a count variable, such as *NC*, is one that is heavily skewed with a long right tail. The skewed distribution of the *NC* is due to the observed distribution of data with a very low mean, a result which may be attributed to many females desiring few children and few females wanting many children in low fertility countries, such as in Italy. In addition, in the context of fertility, zero observations might be due either to the choice not to have children (i.e. the expected *NC*s are not always 0) or to impossibility to become a mother (i.e. the expected *NC*s are always 0). In order to handle this situation, we also estimate a zero-inflated Poisson regression (Winkelmann, 2000).

4. Empirical results

By implementing a Poisson regression model we can try to estimate the impact of the females' level of education on the number of children ever born. In Table III, we estimate four models:

Table II.
Descriptive statistics

	Mean	SD
NC	1.24	1.056
LowEd	0.86	0.347
HighEd	0.14	0.347
HighHighEd	0.06	0.237
H0	0.26	0.438
H1	0.16	0.367
H2	0.18	0.388
H3	0.16	0.363
H4	0.10	0.300
H5	0.14	0.346
A1	0.03	0.174
A2	0.08	0.265
A3	0.10	0.305
A4	0.12	0.319
A5	0.65	0.477
Work	0.28	0.447
Permanent	0.24	0.428
Owner	0.80	0.400
Experience	19.92	11.665
Health	0.55	0.498
ST	0.39	0.488
UR	0.34	0.473

(1) a Poisson regression for only female's education;

(2) a Poisson regression where we consider the correlation between the number of children and high educated families with both partners high educated;

(3) a zero-inflated Poisson regression for only female's education; and

(4) a zero-inflated Poisson regression for high educated families with both partners high educated.

In particular, for zero-inflation Poisson models, we identify two variables which we think may determine the excess zeros: "health" and "age". We may rationalize that the excess zeros in the fertility process may increase if health is not good or if age rises. From the empirical results indicated in Table III, we can observe a negative correlation between the number of children ever born and educational level, by confirming the results of previous theoretical model. In Poisson model, compared to being low educated females, being high educated ones decreases the expected number of children ever born by 14 percent ($e^{-0.15} - 1$), other aspects being equal. This seems to indicate a substitution effect higher than the income one. This negative effect for Italy confirm that found in Aldieri *et al.* (2006, 2010) and Aldieri and Vinci (2010). The result is very similar for high educated families with respect to mixed families and low educated families. As far as the control variables are concerned, the yearly family income is positively correlated with the fertility variable by showing an income effect, while experience variable is negatively correlated with the expected number of children, suggesting a problem to reconcile motherhood with a career. Higher is age (A5) lower is the expected number of children, stressing a biological matter to procreate for females

	1	2	3	4
Constant	−0.30 (0.058)***	−0.30 (0.058)***	−0.26 (0.063)***	−0.26 (0.063)***
HighEd	−0.15 (0.013)***		−0.13 (0.016)***	
HighHighEd		−0.17 (0.013)***		−0.16 (0.022)***
H1	−0.23 (0.055)***	−0.24 (0.055)***	−0.16 (0.058)***	−0.17 (0.058)***
H2	0.17 (0.052)***	0.16 (0.052)***	0.15 (0.056)***	0.14 (0.056)**
H3	0.41 (0.052)***	0.40 (0.052)***	0.36 (0.056)***	0.35 (0.056)***
H4	0.57 (0.052)***	0.56 (0.052)***	0.50 (0.057)***	0.50 (0.057)***
H5	0.82 (0.052)***	0.81 (0.052)***	0.75 (0.056)***	0.74 (0.056)***
A2	−0.05 (0.026)*	−0.05 (0.026)*	−0.05 (0.030)	−0.05 (0.030)
A3	0.18 (0.023)***	0.17 (0.023)***	0.18 (0.027)***	0.17 (0.027)***
A4	0.25 (0.023)***	0.25 (0.023)***	0.24 (0.027)***	0.25 (0.027)***
A5	−0.08 (0.023)***	−0.07 (0.023)***	−0.05 (0.026)*	−0.04 (0.026)
North-East	0.10 (0.014)***	0.10 (0.014)***	0.10 (0.017)***	0.10 (0.017)***
Center	0.15 (0.014)***	0.15 (0.014)***	0.15 (0.017)***	0.15 (0.017)***
South	0.34 (0.013)***	0.33 (0.013)***	0.32 (0.017)***	0.32 (0.017)***
Work	0.04 (0.021)*	0.03 (0.022)	0.01 (0.026)	0.01 (0.026)
Permanent	−0.01 (0.021)	−0.01 (0.022)	−0.02 (0.027)	−0.01 (0.027)
Owner	−0.02 (0.012)	−0.02 (0.012)	−0.01 (0.015)	−0.01 (0.015)
Experience	−0.01 (0.001)	−0.01 (0.001)	−0.01 (0.001)***	−0.01 (0.001)***
Health	0.13 (0.010)***	0.13 (0.011)***	0.10 (0.013)***	0.10 (0.013)***
ST	0.33 (0.010)***	0.34 (0.010)***	0.34 (0.012)***	0.35 (0.012)***
UR	−0.08 (0.010)***	−0.08 (0.010)***	−0.07 (0.013)***	−0.07 (0.013)***
Pseudo-R^2	0.0749	0.0745		
Vuong test			Z = 10.34 Pr > Z = 0.0000	Z = 10.38 Pr > Z = 0.0000

Notes: Significant at: *0.05 < p < 0.10, **0.01 < p < 0.05, ***p < 0.01; robust standard errors are indicated in brackets; time dummies are included

Table III. Estimation results

starting family later. Having a good health and receiving government transfers for children affect positively the expected number of children, while living in a country densely populated reduces it. Finally, the Vuong test compares the zero-inflated model with an ordinary Poisson regression model. The significant z-test indicates that the zero-inflated model is better.

5. Discussion and concluding remarks

The aim of this paper is to investigate from a theoretical and empirical perspective the correlation between the level of education and the number of children both at female decision level and family decision level. For this end, after having described a theoretical where we find a negative link between the level of education and the number of children of the individual and of the family, we use 10,720 Italian families from the 2004-2007 EU-SILC dataset. Our dependent variable is represented by the number of children ever born to each respondent. Since the number of children ever born is a count variable, Poisson regression is the suitable statistical procedure used to conduct the empirical analysis.

First, we estimate the correlation between the female's education and her number of children, and then we use also partner's education to take into account the family dimension. Furthermore, in the context of fertility, zero observations might be due either to the choice not to have children or to impossibility to become a mother. For this reason, we adopt also a more appropriate tool, that is a zero-inflated Poisson regression.

From the empirical results, we can observe a negative correlation between the number of children ever born and educational level, by confirming the results of previous theoretical model. In Poisson model, compared to being low educated females, being high educated ones decreases the expected number of children ever born by 14 percent ($e^{-0.15} - 1$), other aspects being equal. This seems to indicate a substitution effect higher than the income one. The result is very similar for high educated families with respect to mixed families and low educated families. As far as the control variables are concerned, the yearly family income is positively correlated with the fertility variable by showing an income effect, while experience variable is negatively correlated with the expected number of children, suggesting a problem to reconcile motherhood with a career. Higher is age (A5) lower is the expected number of children, stressing a biological matter to procreate for females starting family later. Having a good health and receiving government transfers for children affect positively the expected number of children, while living in a country densely populated reduces it.

Further investigation is certainty required for a more comprehensive analysis. In particular, it would be interesting to investigate the role of wealth inequality in the human capital accumulation process and in the fertility decision both at individual and at regional perspective, in such a way that it is possible to analyse the relative effects on the local growth rate.

Notes

1. The conditions for a maximum are obviously assumed in this and in the following maximization processes.
2. $1 - \gamma > \beta h_0$ is assumed for : ${h_{s,t}}^* > 0$.
3. We consider the case with the females more inclined than males to acquire new skills.
4. $1 - \gamma > 2\beta h_0$ is obviously assumed for: $\hat{h}_t^* > 0$.

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