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Education and Fertility: A comparative Micro-econometric Analysis in Europe

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Abstract.

In this paper we investigate the relationship between education and completed fertility decisions at couple level for some EU countries. For this purpose we control for demographic, social and economic conditions, by using the European Community Household Panel (ECHP) dataset. In order to handle the endogeneity issue in fertility decisions, we use the Linear Generalized Method of Moments (GMM) method, where female's education is instrumented by her partner's education. The contribution to the literature is to investigate the extent to which the effect of education on fertility may be intensified by the postponement and the career effects.

JEL Classification: I21, J13, J24

Keywords: Fertility, Human Capital, Education

1. Introduction

The objective of this paper is that of further investigating the existing relationship between human capital and decisions concerning fertility for most European countries. For this aim we control for demographic, social and economic conditions, by using the European Community Household Panel (ECHP) dataset over the period 1994-2001. The main aim is that of comparing the effect of education and the completed fertility in 9 countries: Austria, Belgium, Denmark, Finland, Greece, Italy, Portugal, Spain and the UK. As we observe in the Table 1, the above countries are characterized by a different dynamics of the total fertility rate in the period 1994-2001. In particular, Belgium and Portugal present a nearly constant trend whereas Denmark, Austria, Finland and the U.K. show a U-shaped dynamics, though based on a different magnitude, with a minimum registered in the second half of 90's. Finally Greece, Italy and Spain show a roughly decreasing trend.

Table 1. Total Fertility Rate by country and year

	1994	1995	1996	1997	1998	1999	2000	2001
Austria	1.48	1.48	1.48	1.37	1.37	1.37	1.39	1.39
Belgium	1.62	1.62	1.69	1.50	1.49	1.49	1.61	1.61
Denmark	1.68	1.69	1.67	1.75	1.68	1.62	1.73	1.73
Finland	1.79	1.79	1.79	1.78	1.73	1.68	1.70	1.70
Greece	1.45	1.46	1.37	1.33	1.31	1.30	1.33	1.33
Italy	1.39	1.41	1.27	1.16	1.19	1.22	1.18	1.18
Portugal	1.46	1.47	1.36	1.36	1.35	1.34	1.47	1.48
Spain	1.40	1.41	1.26	1.18	1.21	1.24	1.15	1.15
The UK	1.83	1.82	1.82	1.65	1.70	1.71	1.74	1,73

Source: CIA - World Factbook, 1994 – 2001.

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At the same time, a remarkable rise in woman education may be observed in these countries[3]. In order to shed some light on the relation between education proxied by the age at which the highest level of education has been completed and the completed fertility, we analyse the main factors which may affect this economic link. This topic is very relevant for the economic theory. The human capital of individuals is increasing with increasing education levels, while population growth may be increasing with a different trend of fertility. Thus the growth rate of aggregate human capital as a whole is not as fast as it would be if the population grew at a constant rate. This effect might have some important implications for economic growth in the long run.

The remainder of the paper is organized as follows. Section 2 presents the review of the literature. Section 3 explains the theoretical framework that motivates the empirical strategy. Section 4 details the data and it describes the empirical model to be estimated. Section 5 shows the results, while section 6 concludes.

2. Literature

This paper deals with the quantity-quality trade-off assumption in the economic theory of fertility (Becker, 1960). This theory argues that while an overall increase in household income may be expected to increase the demand for children (i. e. quantity of children), it may instead lead to an increase in the cost of children (i. e. quality of children) (Becker and Lewis, 1973). Thus, parents should choose between a large number of children and a smaller number of children of better 'quality'. Since high education is a proxy of the opportunity to find a good occupation and a high income, we may assume a negative correlation between education and 'quantity' of children. This theory might explain the decrease in fertility in industrialized countries. The analysis of relation between education and fertility is very interesting for its relevant implications in terms of economic growth (Becker, Murphy and Tamura, 1990; Tamura, 1994). A large number of studies explore the existing relationship between fertility decisions and human capital. In between the others Michael (1973) gives an explanation to the observed negative correlation between parental educational level and fertility; more particularly he analyses the channels through which human capital influences fertility decisions and how education may affect them. Ben Porath (1973) underlines how parents' education may affect couples' productivities in child care. Moreover, Kalwij (2000) studies the effects of female employment status on the existence and quantity of children across households in the Netherlands, finding that higher educated women plan to have children later in their life compared to lower ones; as a consequence, they have a lower probability of having a child and have fewer children. Huinink (2001), analyzing the role of women's educational attainment for the transition towards a second child, for some European countries, finds evidence that in West Germany there is, among college graduate women, a high share of childless ones, and a high share of women with two or more children. Aldieri, Barone and Vinci (2006) suggest that in Italy may exist a sort of trade-off between human capital proxied by the schooling level and fertility decisions at individual level. In particular, the authors find a positive relation between them in the exogenous 'education' case and a negative effect, once 'education'

[3] Between the 1995 and 2000, the proportion of women aged 25 and over with a higher school qualification raised from 4.4% to 6.1% for Austria, from 9.2% to 11.9% for Belgium, from 8.9% to 10.4% for Denmark, from 8.8% to 11.4% for Finland, from 9.6% to 12.6% for Greece, from 4.6% to 6.3% for Italy, from 3.2% to 4.4% for Portugal, from 5.2% to 7.5% for Spain and, finally, from 6.0% to 7.8% for the UK (data from Barro and Lee, 2001).

is instrumented by the marital status variable. Moreover, Aldieri, Barone and Vinci (2010) investigate the role of women's education in transition towards a second child in Italy and they find a negative effect. Further studies recently emphasize the possibility of a sort of positive relation between education and fertility in alternative to the expected negative one (Kreyenfeld, 2002; Hoem, Neyer and Andersson, 2006; McCrary and Royer, 2006; Kravdal, 2007; Winkler-Dworak and Toulemon, 2007). According to this line, it is worth noting the study by Gerster, Keiding, Knudsen and Strandberg-Larsen (2007), where the relation between education and second birth rates is analysed for Danish one-child females during the period 1981- 1994. One of their main findings concerns the hypothesis that more educated women experience higher second birth rates with respect to low educated ones. The theoretical explanation of the previous papers is that the rise in female's wage may lead to an increase in lifetime earnings but makes also children more costly in terms of foregone incomes. We could expect the substitution effect to dominate the income one in case of low levels of wages, and the opposite result in case of high levels of wages. According to Del Boca and Locatelli (2006), changes in opportunity cost of children could affect only timing of births in case of small wealth effects.

3. The Theoretical Framework

The investment in educational level may produce some relevant effects on females' fertility. Firstly, a *postponement* effect or *tempo* effect may take place (Kohler, Billari and Ortega, 2002). In particular, in order to increase own human capital level, the females would decide to delay motherhood and this motivation entails two possible negative impacts on the fertility rate: the biological effect (Billari, Kohler, Andersson, and Lundstrom, 2007) and the socio-cultural one (Fernandez and Fogli, 2006). For the biological issue, the delayed motherhood may decrease the fertility rate because of the declining fecundability. The magnitude of this effect depends on the possibility to access to Assisted Reproductive Technologies (ART), as suggested in Langdridge and Blyth (2001). For the socio-cultural effect, the females have a low fertility rate after a given age, because they assume to be too old for childbearing. Secondly, the females investing in educational level, would delay motherhood in such a manner that their wages are high enough to bear the costs of childbearing. We may identify this motivation as the *career* effect (Cigno and Ermisch, 1989; Blackburn, Bloom and Neumark, 1993; Walker, 1995; Gustafsson, 2001). Indeed, late motherhood is positively associated with mother's wages (Amuedo-Dorantes and Kimmel, 2005; Miller, 2011), while mothers under 25 are more likely to suffer from a family wage gap than older mothers (Davies and Pierre, 2005). The increase in woman's wages and lifetime earnings may raise the demand for children of working women, leading to a *catch-up* effect (Ahn and Mira, 2002). However, women's wages may produce also a negative substitution effect, the higher the lower the possibility of reconciling family and work (which depends on the institutional environment relative to external child care and part-time opportunities), as suggested in Del Boca and Sauer (2009). Furthermore, since endogeneity may arise because of some unobserved variable, such as preferences towards having children or fecundability, we use the Linear-GMM method, where female's education is instrumented by her partner's education. The idea is that because the cohabitation status (married or not) intervenes after the woman has completed her education, the future partner can base his choice on the education of the woman, by entailing an assortative mating effect.

4. Data and Econometric Framework

Our analysis is based on data taken from the European Community Household Panel (ECHP). The ECHP is a standardized multi-purpose longitudinal survey designed and coordinated by the Statistical Office of the European Communities (EUROSTAT). The survey is conducted annually on a representative panel of households in each member state of the EU. The survey provides a wide range of topics on living conditions such as income, employment, poverty and social exclusion, housing, health and migration. The unit of analysis in the ECHP is the family and information is obtained on all individuals within the household that are 16 of age or older. It is also possible to identify information on family members that are younger than 16. In particular, we use the ECHP user data base released in 2003 and covering the period from 1994 to 2001. Indeed, the survey begins in 1994 (wave 1), following a two-wave pilot wave. Wave 1 covers about 60,000 households and 130,000 individuals in all EU member states. EUROSTAT has terminated the project in 2003 and it has replaced this survey with a new instrument, the EU-SILC (Statistics on Income and Living Conditions), in order to focus more attention on the determinants of poverty and social exclusion. We consider only 9 countries: Austria, Belgium, Denmark, Finland, Greece, Italy, Portugal, Spain and the UK. France, Germany, Sweden and The Netherlands are not considered, because some of the variables used in our analysis are not available for this country and also Luxembourg is dropped because of its small sample size. Birth outcomes in 2001 (wave 8) of the survey are not observed due to a censoring problem. Thus, 2001 is excluded from the estimation sample. It contains women who are continuously married or cohabitant with partners and who have complete fertility and education histories. The final sample contains 455 households from Austria, 262 households from Belgium, 134 households from Denmark, 129 households from Finland, 909 households from Greece, 1701 households from Italy, 738 households from Portugal, 918 households from Spain and 345 households from the UK.

For an empirical analysis, we consider the '*nchild*' variable to measure the completed fertility (at time of the interview) as a dependent variable. As far as the explanatory variables are concerned, we consider the household work income (*hincome)*, deflated by using Index Consumer Prices (ICP) at 1996 Euros, made comparable using Power Purchasing Parity (PPP) specific coefficients provided by Eurostat in the ECHP dataset, divided by 1000 and in logarithms terms. In particular, in order to explore how the effect of family income on fertility changes, we identify two levels of income, one lower than the mean value (*Lowhincome*) and one higher the mean value. Moreover, we include female's age (*age*) and her partner's age (*page*) in four classes: 18-25, 26-35, 36-45 and more than 45, age at which women have got their first child (*agefb),* one dummy indicating the partnership status *(married or cohabitant)*, the tenure status of accommodation (*owner* or not) and the education level for female (*Education*). The education variable is measured by the age at which the highest level of education has been completed. This choice is determined by comparability reasons, as many differences in the educational systems across countries make the educational levels not always strictly comparable (Nicoletti and Tanturri, 2008). Finally, in order to control for the geographical variation in fertility tastes and education opportunities we include the country dummies to the estimated models. In the Table 2, we present the definition of the variables used the empirical analysis.

Table 2. Definition of used variables

	Dependent variable:
Completed fertility (number of children ever born)	nchild
	Independent variables:
Share of families with work income lower than the mean value	Lowhincome
Female's age (partner's age):	Age (Page):
18-25	A1 (PA1)
26-35	A2 (PA2)
36-45	A3 (PA3)
46+	A4 (PA4)
Female's age at first birth	Agefb
Partnership status	Married
Tenure status of Accommodation	Owner
Female's education	Education
	Instrumental Variable:
Partner's education	Peducation

In the Table 3 we report the descriptive statistics of our sample. We may observe the below replacement fertility of all countries from the mean value of completed fertility, 1.91 with a standard deviation of 0.957. The mean age at which the highest educational level has been completed is 17.22. The mean age at which females have got their first child is 26.80. The share of families with an income lower than the mean value is 58%. Moreover, we distinguish the female's age and her partner's age into four classes. The descriptive statistics show that most of females and their husbands belong to fourth class, aged more than 46 years. The marriage, as a cohabitation status, seems to indicate a fundamental value for the families of all countries. Indeed, the proportion to be married is about 98%. Furthermore, more than 80% of the households is owner of their accommodation.

Table 3. Descriptive statistics

	Mean (Standard Deviation)
Nchild	1.91 (0.957)
Education	17.22 (7.764)
Agefb	26.80 (5.307)
Lowhincome	0.58 (0.493)
A2	0.01 (0.046)
A3	0.29 (0.454)
A4	0.71 (0.455)
PA2	0.01 (0.093)
PA3	0.16 (0.362)
PA4	0.83 (0.373)
Married	0.98 (0.113)
Owner	0.86 (0.346)
Number of households	6,146

We carry out two tests in order to evaluate the overall specification of the model. To test for the endogeneity of education, Hausman specification tests (Wu-Hausman and Durbin-Wu-Hausman, or DWH) are carried out. If the null hypothesis of exogeneity can be rejected, GMM is necessary. As we may observe in the Table 4, the endogeneity tests are rejected at 5% percent level, suggesting that we may treat 'education' variable as endogenous one. The consistency of the endogeneity test as well as coefficient estimates of GMM depend on the relevance and validity of the instruments. These are relative to the variables that have an effect, both theoretically and conceptually on the suspected endogenous variable (education) but that do not otherwise affect the fertility rate. Identification of the causal effect of education on fertility rate will be achieved if the instruments are uncorrelated with the structural error but correlated with the endogenous regressor (education). To evaluate whether potential instrument, the partner's education, is weak, opportune test is employed. Indeed, the relevance of the instrument is assessed by evaluating the *F*-test for the joint significance of the instruments in the first-stage regression. The first-stage regression is reduced-form regression of the endogenous variable on the instrument and other exogenous regressors. As we may observe from the first-stage regression estimates in the Table 5, there is a positive correlation between the dependent variables (Education) and instrumental variable (Peducation). A rule of thumb states that an *F*-statistic below about ten is indicative of a weak instrument problem (Staiger and Stock, 1997; Stock, Wright and Yoko, 2002). Table 5 clearly shows that we have an instrument with an *F*-statistic largely above the threshold value of ten. Moreover, the validity of the instruments should be tested by an over-identification test (the Hansen test in the Linear-GMM model), but we cannot implement directly this test, because we have a just-identified model (one endogenous regressors and one instrument).

Table 4. Endogeneity tests

	Statistics	**P-value**
Wu-Hausman	F(1,6127)=6.530	0.0106
Durbin-Wu-Hausman	$\chi^2(1)$=6.543	0.0105

Table 5. First-stage regression

	Coeff.	**(Std. errors)**
Dependent variable: Education		
Constant	18.35	(1.798)***
Peducation	0.25	(0.010)***
F-test of excluded instrument	F(1,6127)=559.32	[0.0000]

*Note: ***p<0.01. P-value of the tests are indicated in squared brackets. Control variables: Lowhincome, agefb, A2, A3, A4, PA2, PA3, PA4, Married, owner, country dummies. A1 and PA1 are assumed as the reference age category. Denmark is assumed as reference country category.*

Finally, in order to investigate the extent to which the effect of education on fertility may be intensified by the postponement and career effects, discussed in the theoretical framework section, we estimate also other model specifications. In particular, we consider two interaction terms: one between education variable and age at first birth variable, to control for the postponement effect and one between education variable and family income, to control for the career effect. Moreover, we consider the interaction terms between education variable and country dummies, to explore how the institutional characteristics of the countries may affect the impact of education on completed fertility.

5. Empirical results

Table 6 collects for the 9 EU countries under study the estimated coefficients of the pooled countries model. As far as the impact of the schooling level on the fertility rate is concerned, the result shows a negative effect. This result seems to indicate that there is a prevalence of substitution effect over the income one. Taking into account the impact of control variables on our dependent variable, we may observe that families with an income lower than the mean value have a fertility rate of 26% lower than one of richer families. This result turns out the income effect. As expected, the higher age at first birth is, the lower the fertility rate is. This seems to indicate a biological problem for older females. Being married affects positively the fertility rate, then the marriage as a cohabitation status plays a relevant role in the family fertility decision. Finally, being owner of the accommodation determines a positive effect, in line with the empirical literature (Simon and Tamura, 2009).

As far as the country dummies are concerned, it is worth noting that all countries disclose a negative effect on fertility with respect to Denmark, with exception of Finland, whose coefficient is not significant.

Table 6. Pooled countries GMM-results

	Coeff.	**(Std. errors)**
Constant	4.36	(0.271)***
Education	-0.02	(0.005)***
Lowhincome	-0.26	(0.030)***
Agefb	-0.05	(0.002)***
A2	-0.01	(0.269)*
A3	0.14	(0.035)***
PA2	-0.11	(0.206)*
PA3	-0.12	(0.180)*
PA4	-0.22	(0.177)*
Married	0.15	(0.118)*
Owner	0.01	(0.035)*
Austria	-0.51	(0.063)***
Belgium	-0.54	(0.068)***
Finland	0.02	(0.132)
Italy	-0.55	(0.059)***
Greece	-0.69	(0.065)***
Spain	-0.31	(0.058)***
Portugal	-0.62	(0.066)***
UK	-0.65	(0.065)***
R^2	0.16	
Observations	6,146	

*Note: ***p<0.01, *0.05<p<0.10. Education is instrumented by Peducation. A1 and PA1 are assumed as the references age category. Denmark is assumed as the reference country category.*

In order to explore more deeply the effect of educational level on the fertility rate, we estimate our model with three interaction terms: one between education variable and age at first birth, to control for the postponement effect; one between education variable and family income, to take into account the career effect and one between education variable and country dummies. In this way, on one hand, we may investigate the extent to which the effect of education on fertility may be intensified by the postponement and the career effects, as explained in the theoretical framework section, on the other hand, we may explore how the institutional characteristics of the countries may affect the impact of education on completed fertility. From the inspection of the empirical results in the Table 7, we may observe that the postponement effect is negative. Thus, accumulating human capital and then the postponement of motherhood might produce a lower fecundability rate, because of biological or cultural issues. Furthermore, the career effect is positive but its magnitude is lower. This result seems to grasp the prevalence of postponement effect over the career one. Hence, both the postponement and the career effects condition the impact of education on fertility rate, but the career effect is less relevant. Indeed, from results of interaction term between

country dummies and education variable we may observe that there is a positive career effect in all countries, but the lowest coefficients are relative to some Southern European countries, Italy, Spain and Portugal, where the flexible work arrangements to reconcile motherhood and work are weak (Bratti and Tatsimaros, 2011).

Table 7. Postponement, career and country effects results

	Coeff.	**(Std. errors)**
Education*Agefb	-0.03	(0.010)***
Education*Hincome	0.02	(0.010)**
Education*Austria	0.07	(0.031)**
Education*Belgium	0.10	(0.032)***
Education*Finland	0.07	(0.031)***
Education*Italy	0.06	(0.030)***
Education*Greece	0.06	(0.031)***
Education*Spain	0.06	(0.031)***
Education*Portugal	0.06	(0.031)***
Education*UK	0.09	(0.032)***

*Note: ***p<0.01. Education is instrumented by Peducation. Control variables: Lowhincome, agefb, A2, A3, A4, PA2, PA3, PA4, Married, Owner and country dummies. A1 and PA1 are assumed as the references age category. Denmark is assumed as the reference country category.*

6. Concluding remarks

In this study we focus on the existing linkages between completed fertility decisions at couple level and human capital, proxied by the age at which the highest educational level has been completed, by using data taken from the European Community Household Panel (2001) for 9 EU countries. For this purpose we control for demographic, social and economic conditions. The investment in educational level may produce some relevant effects on females' fertility. Firstly, a *postponement* effect or *tempo* effect may take place. In particular, in order to increase own human capital level, the females would decide to delay motherhood and this motivation entails two possible negative impacts on the fertility rate: the biological effect and the socio-cultural one. For the biological issue, the delayed motherhood may decrease the fertility rate because of the declining fecundability. For the socio-cultural effect, the females have a low fertility rate after a given age, because they assume to be too old for childbearing. Secondly, the females investing in educational level, would delay motherhood in such a manner that their wages are high enough to bear the costs of childbearing. We may identify this motivation as the *career* effect. The increase in woman's wages and lifetime earnings may raise the demand for children of working women, leading to a *catch-up* effect. However, women's wages may produce also a negative substitution effect, the higher the lower the possibility of reconciling family and work. Furthermore, since endogeneity may arise because of some unobserved variable, such as preferences towards having children or fecundability, we use the Linear-GMM method, where female's education is

instrumented by her partner's education. The idea is that because the cohabitation status (married or not) intervenes after the woman has completed her education, the future partner can base his choice on the education of the woman, by entailing an assortative mating effect. The contribution to the literature is to investigate the extent to which the effect of education on fertility may be intensified by the postponement and the career effects. As far as the impact of the schooling level on the fertility rate is concerned, the result shows a negative effect. This result seems to indicate that there is a prevalence of substitution effect over the income one. Taking into account the impact of control variables on our dependent variable, we may observe that families with an income lower than the mean value have a fertility rate of 26% lower than one of richer families. This result turns out the income effect. As expected, the higher age at first birth is, the lower the fertility rate is. This seems to indicate a biological problem for older females. Being married affects positively the fertility rate, then the marriage as a cohabitation status plays a relevant role in the family fertility decision. Finally, being owner of the accommodation determines a positive effect, in line with the empirical literature (Simon and Tamura, 2009). As far as the country dummies are concerned, it is worth noting that all countries disclose a negative effect on fertility with respect to Denmark, with exception of Finland, whose coefficient is not significant. In order to explore more deeply the effect of educational level on the fertility rate, we estimate our model with three interaction terms: one between education variable and age at first birth, to control for the postponement effect; one between education variable and family income, to take into account the career effect and one between education variable and country dummies. In this way, on one hand, we may investigate the extent to which the effect of education on fertility may be intensified by the postponement and the career effects and on the other hand, we may explore how the institutional characteristics of the countries may affect the impact of education on completed fertility. From the inspection of the empirical results, we may observe that the postponement effect is negative. Thus, accumulating human capital and then the postponement of motherhood might produce a lower fecundability rate, because of biological or cultural issues. Furthermore, the career effect is positive but its magnitude is lower. Hence, both the postponement and the career effects condition the impact of education on fertility rate, but the career effect is less relevant. Indeed, from results of interaction term between country dummies and education variable we may observe that there is a positive career effect in all countries but the lowest positive coefficients are relative to some Southern European countries, Italy, Spain and Portugal, where the flexible work arrangements to reconcile motherhood and work are weak (Bratti and Tatsimaros, 2011).

However, further analysis to deal with the heterogeneity issue is needed. On one hand, it might be useful to replicate our investigation, by using another dataset, where the information about the desired fertility is available and to verify the robustness of our empirical results. On the other hand, further analysis should focus on single country, in such a manner that it is possible to deepen the institutional characteristics impact.

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