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Sibling-sex composition and its effects on fertility and labor supply of Greek mothers

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ABSTRACT

Using Greek census data and applying IV-estimation techniques [Angrist, J., and Evans, W., 1998, Children and their parents' labor supply: evidence from exogenous variation in family size, American Economic Review, 88(3) 450–577.], we investigate whether the sex composition of children identifies the causal effect of fertility on maternal employment. Sibling-sex composition appears to be a rather weak instrument in Greece, a low-fertility/low-employment country.

1. Introduction

In this paper we apply the Angrist and Evans (1998), AE hereafter, identification strategy in order to estimate the causal effect of fertility on employment outcomes of Greek mothers. Greece is an interesting case for applying the AE strategy for two reasons. First, over the last 30 years, fertility has dramatically decreased from around 2.3 children per woman to around 1.3 nowadays and, second, female employment has increased considerably from around 35 to almost 50%. Nevertheless, this rate is still among the lowest in the EU making Greece a typical case of a low-fertility/low female employment country.

Evidence from cross-sectional studies identifies a strong negative correlation between exogenous fertility and employment outcomes in Greece (e.g., Meghir et al., 1989; Kanellopoulos and Mavromaras, 2002; Daouli et al., 2004). Panel data evidence shows that the dynamic behavior of fertility contributes to persistently low female employment rates (Demoussis and Giannakopoulos, 2008). Magdalinos and Symeonidou (1989) raise concerns regarding the assumed reverse causality between fertility and employment, while Hondroyiannis and Papapetrou (2004) using time-series data provide evidence in favor of the endogeneity of the former. Well known international research emphasizes the role of parental preferences, regarding siblings-sex composition, in identifying the "true" effect of fertility on employment. Symeonidou (2000) shows that parental preferences could affect fertility decisions of Greek women as well.

Typically, the AE strategy employs parental preferences to derive IV-estimates of the effects of fertility on maternal labor supply. Recently and among others[1], Cruces and Galiani (2007) replicate the AE strategy with Mexican and Argentinean data concluding that "the mixed-sex sibling preferences" is also present in these countries and arguing that their results can be generalized, both quantitatively and qualitatively. The present study complements the existing empirical literature by providing evidence for the predictive power of the AE instrumental estimation technique in Greece, as suggested by Angrist (2004, p. 80).

2. Data and econometric methodology

We use individual employment and fertility data from the 10% sample of the Greek censuses of 1991 and 2001 (IPUMS, 2007[2]). Specifically, the data pertain to 951,875 individuals from 320,387 households in 1991 and 1,028,884 individuals from 367,438 households in 2001. We restrict our sample to married women between 21 and 35 years old, with at least two children, whose oldest child was at most 17 years old at the time of the census and whose second child is

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[1] References regarding the effects of exogenous variations of family size on female labor supply outcomes include: Iacovou (2001) for the UK, Chun and Oh (2002) for Korea, Maurin and Moschion (2006) for France and Ebenstein (2007) for Taiwan. However, Del Boca et al., (2005) raise concerns regarding the implementation of the AE strategy in European countries since the sample size of women with at least two children is typically small.

[2] Integrated Public Use Microdata Series-International (http://international.ipums.org/international/).

Table 1
Descriptive statistics for Greek married mothers, aged 21–35 with two or more children

Variables	Label	1991 Census	2001 Census
Children ever born	–	2.29 (.59)	2.28 (.61)
First two children were boys (0/1)	–	.27 (.44)	.27 (.44)
First two children were girls (0/1)	–	.23 (.42)	.23 (.42)
First child was a boy (0/1)	Boy1st	.52 (.49)	.52 (.49)
Second child was a boy (0/1)	Boy2nd	.52 (.49)	.51 (.49)
First two children are of the same sex (0/1)	Samesex	.50 (.49)	.50 (.49)
Mother had more than two children (0/1)	Fertility	.23 (.42)	.21 (.41)
Worked for pay (0/1)	Employment	.25 (.43)	.38 (.48)
Mothers' age	Age	30.51 (3.40)	31.43 (3.03)
Age of mother at first birth	Age at 1st birth	21.37 (3.22)	21.46 (3.53)
Foreign born (0/1)	Foreign	.01 (.11)	.18 (.39)
Number of Observations		28271	18604

Source: IPUMS-International. Standard deviations in parentheses.

older than one year old. The employment indicator refers to those women that worked for pay during the census week. The resulting samples consist of 28,271 and 18,604 married women in 1991 and 2001, respectively. The population of Greek married mothers with more than 2 children had an average number of children of about 2.29 in 1991 and 2.27 in 2001 and a median of 2 children in both census-years. Thus, the 2-to-3 "child increment" is examined.

In the selected sample (see Table 1), the percentages of mothers with more than two children were 23% in 1991 and 21% in 2001, which is substantially lower than the corresponding percentages in Argentina (57% for 1991), Mexico (59% for 2000) and the US (37% in 1990). Furthermore, the percentage of mothers whose first two children were boys (girls) was 27% (23%) in both, 1991 and 2001 (very similar to those reported in AE and Cruces and Galiani, 2007). It is worth mentioning that the percentage of mothers whose first two children are of the same sex is equal to 50% in both censuses, a common characteristic in all related studies. In contrast, employment rates vary significantly. For instance, only 25% of married mothers aged 21 to 35 with at least two children worked for pay in 1991, a percentage that increased to 38% in 2001. These figures show clearly that although fertility outcomes for the selected samples remained practically unchanged during the 80s and 90s, a significant increase in the employment situation of Greek mothers is clearly identified.

For estimating purposes, we adopt the AE conventional approach which estimates the following two-equation system describing employment (y) and fertility (m):

$$y_i = \mathbf{X}_i\boldsymbol{\gamma} + \beta m_i + u_i \quad (1)$$

$$m_i = \mathbf{Z}_i\boldsymbol{\alpha} + e_i \quad (2)$$

where, $\mathbf{X}$ and $\mathbf{Z}$ are vectors of observed characteristics with $E(\mathbf{X}_i,u_i)=E(\mathbf{Z}_i,e_i)=0$. The coefficient of the fertility variable in the employment equation (β) estimates the average change in the employment probability with regard to increased fertility (more than two children). The adopted instrument z,z $\mathbf{Z}\forall i$ is a combined indicator with regard to the sex of the higher order first two born children (*samesex*in AE)[3] which takes the following form:

$$z_i = b_{1i}\cdot b_{2i} + (1-b_{1i})\cdot(1-b_{2i}) = (2b_{2i}-1)b_{1i} + (1-b_{2i}) \quad (3)$$

where, b_1 and b_2 are indicators for boy-first and boy-second born children, respectively, for the i^{th} mother. For identification purposes, a Wald-type estimate (β_{Wald}) is derived, based on the calculation of the average effect of fertility on labor supply, for those women whose fertility has been affected by the adopted instrument, (i.e., *samesex*).

[3] Since information on the quarter of birth is not available we are not able to generate instrument for the twining effect.

3. Estimation results

The data at hand for 1991 and 2001 show that the mean difference in fertility outcomes, i.e., more than 2 children, between mothers with and without *samesex* children is statistically significant and equal to 0.062 in 1991 and 0.046 in 2001, (the corresponding figure for the US was 0.063 in 1990). In other words, the probability of a third child is higher (by 6 percentage points) for those mothers exposed to the instrument. Turning to the mean difference in employment between mothers with and without *samesex* children, this comes to −0.010 in 1991 (a similar result is reported by AE for 1990) and −0.004 in 2001, which however is not statistically different from zero. Therefore, the Wald-type estimates, (β_{Wald}) for 1991 is equal to −0.161 (−0.010/0.062) with a standard error of 0.082, while for 2001 is equal to −0.093 with a standard error of 0.153 (e.g., Wald-type estimates are around −0.100 for the US and −0.400 for France). These estimates imply that married mothers in 1991 with more than two children exhibit reduced (by 16 percentage points) employment rates as a result of exogenous variations in family size. Accordingly, this reduction comes to almost 10 percentage points in 2001, even though the effect does not differ statistically from zero. These facts suggest that the identified correlation between the instrument and the endogenous fertility variable should be taken into consideration during estimation of the fertility effects on employment outcomes, at least for 1991. Consequently, typical IV estimation techniques are applied.

The 2SLS-IV results are presented at Table 2. The first-stage results show that mothers (column 2) with *samesex* children are more likely (by 6.3 percentage points) to rear an additional child in 1991. The corresponding figure for 2001 (column 5) is 4.6. The assumed herein correlation between the endogenous covariate and the instrument is verified by the data in both census-years, (Bound et al., 1995; Murray, 2006). Overall, the first-stage results reveal that the effect of parental preferences on fertility is positive and statistically significant, albeit of a reduced magnitude in 2001.

Regarding the effects of fertility on the employment decisions of Greek married mothers, the OLS estimates (columns 1 and 4) show that those with more than two children exhibit lower employment probabilities by 8.3 and 10.5 percentage points, respectively. The corresponding 2SLS-IV estimates (columns 3 and 6) imply greater reductions in employment probabilities (−0.136 and −0.100, respectively). It should be noticed that in 1991 the estimated IV coefficient is larger than the OLS one (−0.136 vs. −0.083). The same holds for the estimated standard error. However, the statistical significance of the IV effect is maintained at the 10% level of significance. This is not the case in the 2001 sample where the statistical significance of the IV effect is lost, primarily because of a large increase in the estimated standard error. The problem in the IV estimation arises from the fact that the difference in the employment probabilities between mothers with and without *samesex*children is practically zero in 2001. That is, the causal effect of fertility (assuming endogeneity) on employment outcomes appears to be statistically significant in 1991 but not in 2001. Thus, the effect of parental preferences on fertility decisions weakens over-time making the instrument weak in 1991 and invalid in 2001. Weakness and invalidity also result in failure to reject the exogeneity assumption of fertility as the Durbin–Wu–Hausman test indicates (see DWH chi-squared values at Table 2).

4. Conclusion

Using census data for 1991 and 2001 and applying the IV-estimation techniques of Angrist and Evans (1998) we investigated how parental preferences, in reference to the sex composition of children, identify the causal effect of fertility on maternal labor market outcomes in Greece. Overall, the results of the present study are very similar to those reported by AE and this is more so for the first stage results which appear to be almost identical. Furthermore, the estimated results show that sibling-

Table 2
The effects of fertility on employment outcomes of Greek married mothers aged 21–35 with two or more children (OLS and 2SLS-IV)

	1991 Census			2001 Census		
	(OLS)	(2SLS-IV)		(OLS)	(2SLS-IV)	
	Employment	Fertility	Employment	Employment	Fertility	Employment
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	−.554	.342	−.535	−.636	.347	−.638
	(.024)	(.023)	(.038)	(.037)	(.032)	(.067)
Boy1st	−.017	−.019	−.018	.004	−.021	.004
	(.005)	(.004)	(.005)	(.007)	(.006)	(.007)
Boy2nd	−.008	−.019	−.009	.002	.001	.002
	(.005)	(.004)	(.005)	(.007)	(.006)	(.007)
Age	.013	.020	.014	.020	.014	.020
	(.001)	(.001)	(.002)	(.001)	(.001)	(.002)
Age at 1st birth	.020	−.033	.018	.019	−.027	.019
	(.001)	(.001)	(.003)	(.001)	(.001)	(.004)
Foreign	−.079	.032	−.077	.026	−.042	.026
	(.022)	(.021)	(.022)	(.009)	(.007)	(.010)
Fertility	−.083	–	−.136	−.105	–	−.100
	(.006)		(.079)	(.008)		(.150)
Samesex	–	.063	–	–	.045	–
		(.004)			(.005)	
F-test	287.32	168.05	255.44	190.30	61.22	165.52
Partial-R^2	–	0.0059	–	–	0.0033	–
R^2	0.0575	–	0.0550	0.0578	–	0.0578
DWH-X^2-value		0.446			0.001	
Observations		28271			18604	

Source: IPUMS-International. Standard errors in parentheses.
Note: The model was also estimated pooling data from the two censuses. The obtained OLS coefficient estimate of the effect of "fertility" on "employment" is −.092 with a standard error of .005. The first stage estimate of the 2SLS-IV regarding the effect of the "samesex" on "fertility" is .056 with a standard error of .004, while the second stage estimate of the effect of the instrumented "fertility" on "employment" is equal to −.125 with a standard error of .072.

sex composition is a rather weak instrument in Greece, a low-fertility/low-employment economy.

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