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Number of children and their education in Philippine households*

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This paper shows how large family size can be an important contributor to poverty in the Philippines. It examines one of the mechanisms behind this link by focusing on the relation between the number of children and school attendance of children 6-24 years old. It surveys the international literature to establish how the problem has been approached and what the results are for other countries. It then formulates and tests a model using a nationally representative household survey data for the Philippines to explain what determines the decision to keep children in school. The model specifically considered the endogeneity of the number of children-in-school attendance equations.

JEL classification: J13, I21
Keywords: family size, school attendance, Philippines

1. Introduction

Education is well recognized as one of the more potent ways to hasten social mobility. Its importance in a country's overall development is also widely acknowledged. This is clear from the sustained and widespread attention education has received in development literature. One need not dig too deeply to realize that underlying educational progress or retrogress is the decision of

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households to invest in the education of their children. It is, therefore, always important to contribute to the understanding of this process—the ultimate object of this paper.

Relative to countries with about the same level of development, the Philippines is known for high school attendance at all levels. Even with its relatively low per capita income, it has achieved attendance rates that approximate those found in high-income countries, which has led analysts to consider the performance of the Philippines in this area an outlier (see, for instance, Behrman [1990]; Behrman and Schneider [1994]). This advantage, however, has been eroded in recent years. For instance, UNESCO data show that Thailand has surpassed the Philippines in attendance rate at the secondary and tertiary levels since late 1990s.[1] But more alarming, this erosion is faster among larger and poorer Filipino families. The segment of society that needs to invest in education most to alleviate poverty is in fact investing less in the education of their children.

The paper formulates and estimates a model of the determinants of the proportion of school-age children attending school considering the endogeneity of the number of children and using an instrument for it. As far as the author knows, this is the first study that has taken into account the endogeneity of the number of children in the school attendance equation using Philippine data. The quantity-quality literature spawned by the seminal treatment in Becker and Lewis [1973] clearly argues for the endogeneity of the number of children in education equations. Under this framework, ordinary least squares (OLS) estimates of the education equation will be biased and inconsistent. Instrumental variables estimation is needed to generate consistent estimates.

The paper is divided as follows. Section 2 presents a brief review of the previous literature. Section 3 presents the methodology, instrument, and data used. Section 4 outlines the estimation results while section 5 summarizes and identifies some policy implications.

2. Previous studies

The literature on the impact of family size/number of children on the education of a child has a long history. It has produced results ranging from a negative and no impact, to a positive relationship. The methodology of quantification of the relationship has evolved from simple cross-tabulations to elaborate controls not only for other individual, household, and community characteristics but, more important, for the likely endogeneity of family size spawned by the quantity-quality literature originally dealt with in Becker and

[1]See Orbeta [2000] for a discussion on this.

Lewis [1973]. The dependent variable used also ranged from attendance, attainment, and even investments. This section provides a short review of the literature that will highlight some of the main results, grouping the studies according to the methodologies used.

Controlling for the endogeneity of family size or number of children in the education equation of children has been hampered by the lack of appropriate instruments. Almost all of the candidates, such as the education of parents or household income, have direct effects on the education of children, rendering them inappropriate as instruments. Controls for the endogeneity of the number of children or family size in the education of children equations were pioneered by Rosenzweig and Wolpin [1980], with twins as the instrument using data from India. Since couples do not have control over birth outcomes, the birth of a twin is considered a good instrument to control for the endogeneity of family size.

The much more recent applications are for the United States [Vere 2005], Romania [Glick, Marini, and Sahn 2005], and Norway [Black, Devereux, and Salvanes 2004]. Black, Deveruex, and Salvanes [2004] also used sex-mix as an instrument, which was introduced in Angrist and Evans [1998], to control for the number of children in labor supply equation and earnings of their parents. A different tack was adopted in Lee [2004]. He used the Korean preference for sons as an instrument, using Korean data.

Turning to the results, Rosenzweig and Wolpin [1980] found that an exogenous increase in fertility significantly decreased the level of schooling of all children measured as the age-standardized sum of the educational attainment of all children in the household. The outcomes for Romania [Glick, Marini, and Sahn 2005] using the probability of primary school enrollment as the dependent variable also confirm the earlier Rosenzweig and Wolpin [1980] results. Black, Devereux, and Salvanes [2004], however, found a more negligible result for Norway after controlling for birth order, and attributed most of the effect on educational attainment of children to birth order rather than family size. They found that there is substantial differential impact between the first child and subsequent children, i.e., the first child has significantly higher educational attainment than the subsequent children. Black, Devereux, and Salvanes [2004], using sex-mix as an instrument, found a positive relationship between family size and education, but they dismissed it with the argument that sex-mix may be an inappropriate instrument because it may have a direct impact on child outcomes. On the other hand, Lee [2004] found that each additional child has significant negative impact on the monthly household expenditure for education in Korea.

We now turn to multivariate estimates that do not control for the endogeneity of the number of children. The studies cited earlier usually found that not controlling for the endogeneity of the number of children in education equation would understate the impact (see, for instance, Glick, Marini, and Sahn [2005]; Lee [2004]). The result in Lu and Treiman [2005], using data from China and OLS regressions, shows a negative impact of family size on both the educational attainment of children and the familial resources measured by the ownership of a study desk at age 14. Patrinos and Psacharopoulos [1997] show that the greater number of children increases the probability of delay in schooling in Peru. In addition, they found that this effect increases as the number of siblings increases. In the case of Vietnam, a negative relationship between school attendance and family size is found, even after controlling for individual and household characteristics [Ahn et al. 1998]. But this is not true for educational attainment where there is no significant relationship except in large households (family size greater than 5) where the negative relationship is found.

Literature using multivariate analysis and Philippine data shows the preponderance of a negative impact of higher number of children on the education of children although some show no significant relationship. Herrin [1993], using data from Misamis Oriental province, has shown that while school participation and attainment of the 7-12 years old are not affected, school participation of children aged 13-17 are negatively affected by the number of siblings. Similar negative impact of the number of siblings on the school participation of children 7-17 years old were found by DeGraff, Bilsborrow, and Herrin [1996] using the 1983 Bicol Multipurpose Survey data. Paqueo [1985] also found that the number of siblings negatively affects the highest grade completed of children using the 1982 Household School and Matching Survey. Bauer and Racelis [1991], using the 1985 Labor Force Survey (LFS), found that preschool children negatively affects the school attendance of older children (17-24), and primary school children (7-12) reduces the enrollment of older children (13-24). Excess fertility or unwanted births were also found to negatively affect educational attainment [Montgomery et al. 1997]. Finally, Orbeta [2000] found in a joint decision model for school attendance and labor force participation that household size does not significantly affect school-attendance decision but positively affects labor-force participation of children 10-24 years old using the matched data from the 1994 Family Income and Expenditure Survey, LFS, and Functional Literacy Education and Mass Media Survey.

Cross-tabulation evidence bears out findings by Knodel, Havanon, and Sittitrai [1990] that the probability of attending lower secondary and upper secondary is negatively associated with family size among Thai children, using a small sample from two rural areas. This effect, although somewhat reduced, prevails even after controlling for the individual and household characteristics. These results are duplicated in a subsequent study using a nationally representative sample survey [Knodel and Wongsith 1991]. In Kenya, however, Gomes [1984] found a positive relationship between completed family size and the educational attainment of children. This impact remains after controlling for household and individual characteristics.

The preceding paragraphs have shown that the results are not consistent across societies and sometimes even in studies using similar methodologies. The studies that control for the endogeneity of family size in the education equation seem to find negative relationships in lesser developed countries (India and Romania) but seem to have conflicting results in more developed countries (Norway and Korea). Multivariate analyses that did not control for endogeneity appear to have consistently found negative relationships.

Cross-tabulation analysis has also yielded conflicting results. In terms of outcomes, school attendance/enrollment was always found to be negatively correlated with family size [Glick, Marini, and Sahn 2005; Ahn et al. 1998]. On educational attainment there appears to be conflicting results [Rosenzweig and Wolpin 1980; Black 2004; Ahn et al. 1998; Gomes 1984], while on investments the impact is consistently negative [Lee 2004; Lu and Treiman 2005]. The single study using delay in schooling shows the negative impact of family size [Patrinos and Psacharopoulos 1997].

3. Methodology, instrument, and data

3.1. Methodology

To estimate the impact of the number of children on the education of children we follow Rosenzweig and Wolpin [1980] by estimating the following empirical model:

$$E = \alpha_\circ + \alpha_1 n + X\alpha_2 + \varepsilon \tag{1}$$

$$n = \beta_\circ + \beta_1 z + X\beta_2 + \mu \tag{2}$$

E is the education variable, n is the number of children, z is the instrument to control for the endogeneity of n, and X is the vector of individual, household, and community characteristics. The error terms ε and μ are, by implication, correlated. The implied subscripts are omitted for clarity. As shown in

Rosenzweig and Wolpin [1980] this model is derived from the quantity-quality trade-off framework originally introduced in Becker and Lewis [1973].

Estimating (1) with OLS will result in a biased and inconsistent estimate if indeed n is endogenous. We therefore test for the endogeneity of n in (1). If n is endogenous, we use as instruments the sex of the first two children. The validity of this instrument is explained in the next section. Since we use cross-sectional data where heteroskedasticity is commonly present, we also test for heteroskedasticity and apply the generalized method of moments (GMM) estimation[2] if it exists.

The dependent variable we use in this paper is the proportion of school-age children that are in school. Most other studies, except for Rosenzweig and Wolpin [1980] and Lee [2004], used individual outcomes.[3] A household outcome variable, rather than an individualistic outcome, would be closer to the spirit of the Becker and Lewis [1973] framework. Individualistic schooling variable, by implication, adds the assumption of independence of the decision for each child in the same household, which the Becker-Lewis [1973] framework did not consider. Rosenzweig and Wolpin [1980] used an age-standardized aggregate of the years of education of the children in the household. Lee [2004], on the other hand, used the household expenditures on education.

The estimation strategy is as follows. We first establish the endogeneity of the number of children using the sex of the first two children as instruments following Angrist and Evans [1998]. We do this by various tests available in the ivreg2 Stata routine described in Baum, Schaffer, and Stillman [2003]. We also check the relevance of the instruments by checking the first-stage regression results, particularly the partial R2 for the instruments, and verify if we have a weak instrument problem [Bound, Jaeger, and Baker 1995]. We also test for the presence of heteroskedasticity in the data because this is common in cross-sectional data. When endogeneity is established, it is well known that the OLS estimate will be biased and inconsistent. The two-stage least squares (2SLS) or GMM estimates will also provide a consistent estimate and, in the case of the GMM, an efficient estimate as well. When heteroskedasticity is present, GMM will provide a more efficient estimate. When weak instrument is indicated, we present the limited information maximum likelihood (LIML) estimates that are found to be more robust than the GMM in this case [Stock, Wright, and Yogo 2002]. Finally, in the case of using separately both- male and both-female instruments, we check the overidentifying restriction test results. This, of course, cannot be done when using the same sex as instrument as the system is exactly identified.

[2]We use ivreg2 Stata routine [Baum, Schaffer, and Stillman 2003] to test for the endogeneity.

[3]Two of the previous works of the author on the issue used individual outcome variables [Alba and Orbeta 1999; Orbeta 2000].

Notably, because we are dealing with proportions data, Greene [2003] shows that this can be treated as separate responses for each individual child given common household explanatory variables, i.e., these are essentially replications of individual school-attendance decisions within the household. Under this framework, the model can be estimated by the grouped probit using the bprobit routine in Stata. Since this is essentially a probit routine, the endogeneity of the number of children equation is corrected by estimating a two-stage probit using the sex of the first two children as instruments via the proposals discussed in Rivers and Vuong [1988]. But then again, we are back to assuming independence of the decision for each individual child in a household even if we consider that they are grouped.

Finally, to provide estimates of the varying impact of the number of children by socioeconomic class, models that include the interaction of the number of children and the per capita income quintile dummy variables are estimated. The differential impact across socioeconomic classes will be estimated by the sum of the coefficient of the base category and the coefficient of the corresponding interaction term. The estimator that we deem to give the most reliable estimate in the average equation is used here.

3.2. Balanced sex-mix as an instrument

There are not too many instruments that one can find for the number of children in household models. Most of the likely candidates—household income, education of the parents, or age at marriage—are also related to the dependent variable of interest, such as labor-force participation of parents, savings, or education of children, rendering these inappropriate as instruments.

Recent research using US data such as Angrist and Evans [1998] has utilized the hypothesis that families prefer to have a balanced sex-mix of children as an instrument for the number of children. The Philippines is one of the Asian countries where a balanced sex-mix is found to have prevailed, in contrast to countries in South and Eastern Asia where sons are strongly preferred [Wongboonsin and Ruffolo 1995]. Early literature that confirms preference for a balanced sex-mix in the Philippines is found in Stinner and Mader [1975].

The other available instruments are limited by their applicability only in very specific circumstances. The occurrence of twins has also been used as instruments, again using US data first in Rosenzweig and Wolpin [1980] and in subsequent studies such as in Angrist and Evans [1998]. A much more recent application was done for Romania [Glick, Marini, and Sahn 2005; Black, Deveruex, and Salvanes 2004]. Son preference in Korea was also used as an instrument for fertility, for instance in Lee [2004].

Finally, another instrument would be an exogenous policy change that could affect child bearing. Quian [2004], for instance, used the relaxation of the one-child policy in China, which allows rural households to have another child if the first child is a girl. Viitanen [2003], on the other hand, used the large-scale distribution of vouchers for privately provided childcare in Finland.

In the case of the balanced sex-mix hypothesis, the fact that families do not have control over the sex of their children makes same sex for the first two children virtually a random assignment. As argued in Angrist and Evans [1998], using same sex as an instrument will allow a causal interpretation. It should be noted, however, that the downside of this instrument is that it will render families that have less than two children unusable for analysis. While this may be a serious problem in low-fertility areas, this may not be the case in the Philippines where the average number of children exceeds four.

To check the validity of this instrument, Table 1 provides a cross-tabulation of the average proportion of families that have additional children and the average number of children by sex of their first two children for 24,000 families that have two or more children using the Annual Poverty Indicator Survey (APIS) 2002 data set. The table shows that 67.4 percent of families that had one male and one female for their first two children had another child, while 71.8 percent had another child when their first two children are of the same sex or with a difference of more than 4 percent. In terms of the average number of children, this is 3.49 as against 3.61, or an average difference of a little over 0.12 children.

These average differences are statistically significant under the conventional level of significance. Comparing this with Tables 3 and 5 in Angrist and Evans [1998], one can observe several differences. The difference in the proportion of families having a third child for the two groups of families is smaller, and the standard error is larger. In the case of the difference in the average number of children, the difference is larger but so is the standard error. This is not unexpected, given the larger family size in the Philippines and the expected larger dispersion of the distribution. Consequently, the implied *t* statistics in Table 7 are not as large as those in Angrist and Evans [1998], indicating that discrimination generated from the same-sex instrument may not be as strong as those obtained using US data.

Table 1. Proportion of families that had a third child and average number of children by sex of first two children

	Proportion that had a third child			*Number of children*			*Proportion*
Sex of first two children	*Mean*	*SD*	*SE*	*Mean*	*SD*	*SE*	*to sample*
(1) One male, one female	0.6740	0.4688	0.0042	3.4850	1.5436	0.0315	0.964
(2) Both male	0.7179	0.4500	0.0052	3.6452	1.5994	0.0420	0.432
(3) Both female	0.7180	0.4500	0.0063	3.5575	1.4975	0.0495	0.261
(4) Same Sex	0.7179	0.4500	0.0040	3.6095	1.5592	0.0320	1.037
Difference (4)-(1)	0.0439		0.0058	0.1245		0.0449	

Source of basic data: National Statistics Office, Annual Poverty Indicators Survey, 2002

3.3. Data sources

The data on individual and household characteristics and location characteristics were taken from the 2002 APIS. The APIS is a rider survey to the July round of the quarterly Labor Force Survey conducted by the National Statistics Office (NSO). The 2002 round is the third of the APIS series conducted by the NSO. The other two were conducted in 1998 and 1999. It provides basic demographic information on all members of the household as well as household amenities. Income and expenditure data for the past six-month period preceding the survey are also gathered.

All monetary values such as income are deflated using provincial consumer price indices compiled by the Price Division of the NSO. This is done to control for interprovincial price variability.

Barangay- and municipal-level data from the 2000 Census of Population and Housing are also used to provide measures of availability of school facilities. It is therefore assumed that there is not much difference in the structure of distribution of the facilities in 2000 and in 2002, or that whatever changes happened they did not upset the relative distribution of the availability of facilities. These barangay and municipal data sets were aggregated at the domain level of the APIS and attached to the APIS data set using domain identification variables.

3.4. Descriptive statistics

Table 2 provides the attendance rates by per capita income quintile and number of children of the total school-age children (6-24) and also grouped into age groups corresponding to the elementary (6-12), secondary (13-16), and tertiary (17-24) levels. The disparity in school attendance proportion is not very clear in the total school-age category but becomes more apparent as one goes up the education ladder. For instance, for the 6-24 age group, attendance proportion for the poorest is 74.2 percent, while for the richest this is at 76.8 percent. For the elementary level the corresponding attendance proportions are 89.6 percent for the poorest and 99.3 percent for the richest, with about 10-percentage point difference. But for the tertiary level, the attendance proportion is 28.3 percent for the poorest but 54.7 percent for the richest, with about 26-percentage point difference.

By number of children, the enrollment proportion appears to increase up to about four children then starts to decline as one goes to households with more children, although this is not true for the elementary school-age group. The initial rise for secondary and tertiary groups must give allowance for the fact that smaller households may contain both young families that do not have children in this age category and old families whose children may no longer be with their parents. With this consideration in mind, one observes that the decline in school participation is mild as one moves from small households to large households. This can be explained by the well-known tendency of Filipino parents to keep their children in school as for as long as possible, which explains the relative high attendance rates one finds in the Philippines given its per capita income. De Dios [1995] succinctly describes this Filipino trait in the following statement: "*Makapagpatapos* (to let a son/daughter graduate) is still the standard by which successful parenting is measured; the stereotype of good parents, bordering on caricature, is still those who scrimp and save to send their children to school and to college."

Table 3 provides the descriptive statistics of the variables used in the estimation. The average number of children is about 3.5. The average number of years of education is slightly higher for mothers at 9.2 than for fathers at 9.0. This is not surprising in the case of the Philippines. The proportion of barangays with elementary schools is about 76 percent while that with secondary schools is substantially lower at 24 percent.

Table 2. Proportion of children attending school by age group, per capita income quintile and number of children, 2002

	Age groups			
	6-24	6-12	13-16	17-24
PER CAPITA INCOME QUINTILE				
Poorest	0.742	0.896	0.777	0.283
Lower middle	0.734	0.936	0.834	0.333
Middle	0.720	0.962	0.889	0.349
Upper middle	0.726	0.976	0.946	0.437
Richest	0.768	0.993	0.980	0.547
NO. OF CHILDREN				
2	0.697	0.953	0.892	0.366
3	0.748	0.950	0.896	0.399
4	0.758	0.942	0.890	0.409
5	0.752	0.938	0.842	0.389
6	0.754	0.924	0.828	0.383
7	0.734	0.916	0.789	0.342
8	0.708	0.907	0.779	0.353
9+	0.706	0.919	0.806	0.339
Philippines	0.737	0.942	0.866	0.386

Source of basic data: NSO APIS 2002.

Table 3. Descriptive statistics

Variables	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Prop. of children att school, 6-24 yrs.	22,190	0.74	0.34	0	1
Prop. of children att school, 6-12 yrs.	15,335	0.94	0.20	0	1
Prop. of children att school, 13-16 yrs.	11,317	0.87	0.32	0	1
Prop. of children att school, 17-24 yrs.	11,667	0.39	0.43	0	1
No. of children	24,931	3.55	1.55	2	12
Age, father	13,716	45.15	10.57	20	99
Age, mother	15,210	42.97	10.73	16	99
Years of education, mother	15,210	9.15	3.76	0	17
Years of education, father	13,716	9.01	3.75	0	17
Urban dummy	24,931	0.59	0.49	0	1
Deflated total household income, '0000 (1994=100)	24,931	4.63	6.59	0	270
Proportion of barangays with elementary school	24,931	0.76	0.16	0.20	1
Proportion. of barangays with secondary school	24,931	0.24	0.14	0.07	0.89

Table 3. Descriptive statistics (continued)

Variables	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Region 1 dummy	24,932	0.04	0.21	0	1
Region 2 dummy	24,932	0.04	0.19	0	1
Region 3 dummy	24,932	0.10	0.30	0	1
Region 4 dummy	24,932	0.16	0.37	0	1
Region 5 dummy	24,932	0.05	0.22	0	1
Region 6 dummy	24,932	0.07	0.26	0	1
Region 7 dummy	24,932	0.06	0.23	0	1
Region 8 dummy	24,932	0.05	0.21	0	1
Region 9 dummy	24,932	0.04	0.20	0	1
Region 10 dummy	24,932	0.05	0.22	0	1
Region 11 dummy	24,932	0.05	0.22	0	1
Region 12 dummy	24,932	0.05	0.21	0	1
NCR dummy	24,932	0.10	0.30	0	1
CAR dummy	24,932	0.04	0.20	0	1
ARMM dummy	24,932	0.06	0.23	0	1
Caraga dummy	24,932	0.04	0.19	0	1

4. Estimation results

Table 4 provides the OLS, 2SLS, and GMM estimates of the determinants of the proportion of children 6-24 years old who are attending school, using both-male and both-female or the same sex for the first two births as instruments, respectively. The positive effects of the number of children on the proportion of children 6-24 years old resulting from the OLS regression is suspect because of the expected endogeneity of the number of children in this equation as per the quantity-quality of children trade-off literature. The data set confirms this endogeneity with F-values for the Wu-Hausman test and Chi-square values for Durbin-Wu-Hausman test indicating high significance, implying a rejection of the null hypothesis that the number of children variable is exogenous in this equation. Thus, more consistent estimates are either those of the 2SLS or GMM.

Given that the presence of heteroskedasticity as indicated by the Pagan-Hall test, the GMM estimators would give efficient estimates, although magnitude-wise the estimates are very similar. Given the *z* values of the estimates, those using same sex as instruments are not as significant as those using both-male and both-female as instruments. Thus, the more reliable estimate of the impact of the number of children on the proportion attending is the GMM estimate of about 15 percentage point average decline per additional child. The GMM estimate, however, must also be appreciated in light of the significant overidentification statistic indicating some correlation between the instrument and the error term. Given the difference in the dependent variable used in this study and the other studies, the results cannot be compared directly.

Some of the results from previous studies were confirmed. The older the parents are, the lower the proportion of children attending school. The higher the education of parents, the higher the probability that children attend school. It is noteworthy that the mother's education has about the same impact as the father's. Other studies have shown that mother's education has a higher impact on the education of children. Living in urban areas has no distinct impact on school attendance. The availability of school, indicated by the proportion of barangays with schools, has positive impact on school attendance, although this is only true for elementary schools but not for secondary schools. The income variable is insignificant. The regional dummy variables are expected to pick up whatever area-specific influences on school attendance are not contained in the availability of schools. The National Capital Region (NCR) is the reference area. The positive (negative) significant value would mean higher (lower) proportion of children attending in that particular region compared to the NCR, on average, after controlling for all the other variables.

The first-stage results are given in Table 5. It shows the significance of either both-male, both-female, and same-sex as determinants of the number of children. Their usefulness as instruments is further validated by the significance of the partial R-square for the instruments with F values of 14.8 for the both-male and both-female and 21.9 for the same-sex instrument. It is worth noting that both-male and both-female have slightly higher partial R-square of 0.0025 compared to same sex, which has a partial R-square of 0.0018.

Estimation results of models that included the interaction of the number of children and per capita income quintiles are given in the last three columns of Table 4. The interaction terms are all significant. The results highlight the regressive impact of the number of children on school attendance. For the poorest quintile, the impact of each additional child is 18 percent reduction on the proportion of children 6-24 who are attending school, which is higher that the average impact mentioned earlier. The estimates for the other income quintiles are -11.8 percent (-17.8+6.0), -12.0 percent (-17.8+5.8), -12.1 percent (-17.8+5.7), -12.4 percent (-17.8+5.4) for the second to the fifth income quintile, respectively.

Finally, estimates for different age groups approximating the different grade levels—elementary (6-12), secondary (13-16), and tertiary (17-24)—are also done. The estimates for the 6-12 age groups show that the impact of the number of children is not significant, either on average or across socioeconomic classes (Table 6). For the secondary and tertiary education age groups, however, the number of children has significant negative effects on school attendance. The results for the other variables are similar to the results for the total 6-24 age group so no further explanation will be provided. Again, these GMM estimates have to be appreciated given the indication of correlation between the instrument and the error term as specified by the significance of the overidentification statistic.

Table 7 summarizes the impacts and computes these as percentage changes relative to current recorded proportion of children who are attending school. The table clearly shows the regressiveness of the impact of the number of children on school attendance. Notably, the regressiveness of the impact rises as one goes up the age groupings corresponding to the different levels of the education ladder. The poorest-income quintile always has higher negative impact compared to the other socioeconomic groups. For instance, in the 6-24 age group, each additional child will decrease the proportion of children attending school by 24 percent, while for the richest quintile this is only 16 percent. For the tertiary age group, the impact of the poorest quintile is -77 percent, while for the richest quintile this is only -22 percent.

Table 4. Determinants of the proportion of children 6-24 years old who are attending school, 2002

	OLS (Robust SE)			TSLS		
Explanatory variables	*Coef.*	*Std. Err.*	*t*	*Coef.*	*Std. err.*	*z*
No. of children*	0.0045	0.0015	3.02	-0.1483	0.0418	-3.55
No. of children x quintile 2						
No. of children x quintile 3						
No. of children x quintile 4						
No. of children x quintile 5						
Age, father	-0.0052	0.0006	-8.85	-0.0038	0.0008	-4.60
Age, mother	-0.0109	0.0006	-17.04	-0.0137	0.0011	-12.68
Year of schooling, mother	0.0148	0.0010	14.47	0.0072	0.0025	2.91
Year of schooling, father	0.0098	0.0010	9.90	0.0059	0.0017	3.46
Urban	0.0013	0.0058	0.22	-0.0044	0.0079	-0.55
Household income, (0000)	-0.0005	0.0004	-1.38	0.0004	0.0006	0.70
Prop. of bgy with elem. school	0.0859	0.0216	3.98	0.1225	0.0302	4.05
Prop. of bgy with sec. school	-0.0236	0.0239	-0.99	-0.0073	0.0339	-0.22
Region 1	-0.0046	0.0158	-0.29	0.0367	0.0243	1.51
Region 2	0.0350	0.0169	2.07	0.0141	0.0249	0.57
Region 3	-0.0452	0.0136	-3.32	-0.0348	0.0185	-1.88
Region 4	0.0157	0.0115	1.36	0.0331	0.0164	2.01
Region 5	0.0339	0.0151	2.25	0.1151	0.0307	3.75
Region 6	0.0743	0.0131	5.65	0.1252	0.0233	5.37

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 4. Determinants of the proportion of children 6-24 years old who are attending school, 2002 (continued)

	OLS (Robust SE)			*TSLS*		
Explanatory variables	*Coef.*	*Std. err.*	*t*	*Coef.*	*Std. err.*	*z*
Region 7	0.0204	0.0144	1.42	0.0637	0.0225	2.83
Region 8	0.0612	0.0155	3.93	0.1391	0.0305	4.56
Region 9	0.0137	0.0173	0.80	0.0313	0.0229	1.37
Region 10	0.0365	0.0149	2.44	0.0552	0.0216	2.55
Region 11	0.0000	0.0151	0.00	0.0081	0.0211	0.39
Region 12	0.0553	0.0154	3.60	0.1097	0.0254	4.32
CAR	0.0735	0.0147	5.00	0.1496	0.0296	5.06
ARMM	0.0051	0.0172	0.29	0.0669	0.0268	2.50
Caraga	0.0709	0.0167	4.24	0.0888	0.0243	3.66
Constant	1.1199	0.0274	40.89	1.8107	0.1920	9.43
No. of observations	11,995					
R-Square	0.2757					
Overidentification test:						
Sargan (IV) J-Hansen (GMM) (P-value)				11.98 (0.0005)		
Test for heteroscedasticity						
Pagan-Hall test stat (P-value)				75.248 (0.000)		
Endogeneity of no. of children						
Wu-Hausman F test: (P-value)				24.317 (0.000)		
Durbin-Wu-Hausman chi-sq test: (P-value)				24.320 (0.000)		

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 4. Determinants of the proportion of children 6-24 years old who are attending school, 2002 (continued)

		GMM			*GMM*	
Explanatory variables	*Coef.*	*Std. err.*	*z*	*Coef.*	*Std. err.*	*z*
Region 7	0.0630	0.0224	2.81	0.0778	0.0248	3.13
Region 8	0.1381	0.0303	4.56	0.1621	0.0350	4.62
Region 9	0.0319	0.0234	1.37	0.0399	0.0248	1.61
Region 10	0.0558	0.0206	2.71	0.0785	0.0237	3.32
Region 11	0.0098	0.0204	0.48	0.0139	0.0212	0.66
Region 12	0.1088	0.0256	4.26	0.1428	0.0320	4.46
CAR	0.1502	0.0291	5.17	0.1505	0.0287	5.24
ARMM	0.0661	0.0285	2.32	0.0344	0.0244	1.41
Caraga	0.0896	0.0232	3.86	0.1182	0.0273	4.33
Constant	1.8019	0.1942	9.28	1.8710	0.2022	9.25
No. of observations						
R-Square						
Overidentification test:						
Sargan (IV) J-Hansen (GMM) (P-value)	12.52(0.0004)			8.74(0.003)		
Test for heteroscedasticity						
Pagan-Hall test stat (P-value)						
Endogeneity of no. of children						
Wu-Hausman F test: (P-value)						
Durbin-Wu-Hausman chi-sq test: (P-value)						

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 4. Determinants of the proportion of children 6-24 years old who are attending school, 2002 (continued)

	GMM			GMM		
Explanatory variables	*Coef.*	*Std. err.*	*z*	*Coef.*	*Std. err.*	*z*
No. of children*	-0.1460	0.0425	-3.44	-0.1783	0.0485	-3.68
No. of children x quintile 2				0.0601	0.0154	3.91
No. of children x quintile 3				0.0582	0.0157	3.70
No. of children x quintile 4				0.0569	0.0161	3.54
No. of children x quintile 5				0.0540	0.0151	3.58
Age, father	-0.0037	0.0008	-4.46	-0.0043	0.0008	-5.33
Age, mother	-0.0137	0.0011	-12.36	-0.0150	0.0014	-10.93
Year of schooling, mother	0.0072	0.0025	2.88	0.0043	0.0032	1.35
Year of schooling, father	0.0060	0.0017	3.49	0.0016	0.0026	0.60
Urban	-0.0044	0.0080	-0.55	-0.0348	0.0128	-2.71
Household income, (0000)	0.0003	0.0006	0.62	-0.0010	0.0007	-1.35
Prop. of bgy with elementary School	0.1196	0.0308	3.88	0.1648	0.0371	4.44
Prop. of bgy with secondary school	-0.0075	0.0329	-0.23	-0.1076	0.0403	-2.67
Region 1	0.0357	0.0246	1.45	0.0297	0.0243	1.22
Region 2	0.0160	0.0237	0.68	-0.0129	0.0266	-0.49
Region 3	-0.0344	0.0180	-1.91	-0.0737	0.0190	-3.87
Region 4	0.0321	0.0159	2.02	0.0189	0.0149	1.27
Region 5	0.1132	0.0312	3.63	0.1385	0.0363	3.82
Region 6	0.1246	0.0230	5.43	0.1324	0.0247	5.36

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 5. First stage regression(Dependent variable: No of children)

	Both male & both female			*Same sex*		
Explanatory variable	*Coef.*	*Std. err.*	*t*	*Coef.*	*Std. err.*	*t*
Age, father	0.0089	0.0032	2.83	0.0091	0.0032	2.88
Age, mother	-0.0185	0.0033	-5.52	-0.0183	0.0033	-5.47
Year of schooling, mother	-0.0494	0.0059	-8.39	-0.0497	0.0059	-8.44
Year of schooling, father	-0.0253	0.0058	-4.38	-0.0256	0.0058	-4.42
Urban	-0.0367	0.0342	-1.07	-0.0364	0.0342	-1.06
Disp. Income, per cap (0000)	0.0064	0.0025	2.63	0.0063	0.0025	2.56
Prop. of bgy with elem. school	0.2541	0.1252	2.03	0.2519	0.1253	2.01
Prop. of bgy with sec. school	0.1065	0.1477	0.72	0.1047	0.1477	0.71
Region 1	0.2707	0.0945	2.86	0.2705	0.0945	2.86
Region 2	-0.1441	0.1065	-1.35	-0.1397	0.1065	-1.31
Region 3	0.0718	0.0801	0.90	0.0723	0.0801	0.90
Region 4	0.1158	0.0691	1.68	0.1165	0.0691	1.69
Region 5	0.5271	0.0932	5.65	0.5314	0.0932	5.70
Region 6	0.3305	0.0820	4.03	0.3311	0.0820	4.04
Region 7	0.2859	0.0838	3.41	0.2823	0.0839	3.37
Region 8	0.5137	0.0959	5.36	0.5138	0.0959	5.36

Table 5. First stage regression (Dependent variable: No of children) (continued)

	Both male & both female			*Same sex*		
Explanatory variable	*Coef.*	*Std. err.*	*t*	*Coef.*	*Std. err.*	*t*
Region 9	0.1145	0.0981	1.17	0.1133	0.0982	1.15
Region 10	0.1211	0.0923	1.31	0.1226	0.0924	1.33
Region 11	0.0530	0.0920	0.58	0.0513	0.0920	0.56
Region 12	0.3595	0.0904	3.98	0.3620	0.0904	4.00
CAR	0.4974	0.0920	5.41	0.4942	0.0920	5.37
ARMM	0.4108	0.0911	4.51	0.4080	0.0911	4.48
Caraga	0.1159	0.1044	1.11	0.1160	0.1044	1.11
Both male	0.1871	0.0344	5.44			
Both female	0.0696	0.0386	1.80			
Same sex				0.1384	0.0296	4.68
Constant	4.4528	0.1449	30.73	4.4476	0.1449	30.69
Obs.	11,995					
R2	0.8599					
Partial R2 of excl. inst	0.0025			0.0018		
Test of excluded instruments						
F(P-value)	14.82 (0.000)			21.89 (0.000)		

Table 6. Determinants of the proportion of children attending school by age groups, 2002(GMM Estimates)

	Age 6-12					
	Model 1			*Model 2*		
Explanatory variable	*Coef.*	*Std. err.*	*z*	*Coef.*	*Std. err.*	*z*
No. of children*	-0.0317	0.0228	-1.39	-0.0380	0.0240	-1.59
No. of children x quintile 2				0.0126	0.0061	2.07
No. of children x quintile 3				0.0143	0.0063	2.26
No. of children x quintile 4				0.0109	0.0061	1.80
No. of children x quintile 5				0.0056	0.0043	1.29
Age, father	0.0002	0.0007	0.28	0.0001	0.0007	0.09
Age, mother	0.0042	0.0007	6.03	0.0039	0.0006	6.51
Year of schooling, mother	0.0050	0.0017	2.94	0.0045	0.0019	2.35
Year of schooling, father	0.0037	0.0011	3.52	0.0028	0.0014	2.06
Urban	0.0075	0.0047	1.59	0.0001	0.0059	0.01
Disp. Income, per cap (0000)	-0.0002	0.0002	-1.03	-0.0002	0.0002	-0.99
Prop. of bgy with elem. school	0.0827	0.0188	4.39	0.0944	0.0215	4.39
Prop. of bgy with sec. school	0.0236	0.0180	1.31	-0.0046	0.0201	-0.23
Region 1	0.0021	0.0143	0.15	0.0002	0.0135	0.01
Region 2	0.0183	0.0098	1.88	0.0116	0.0106	1.10
Region 3	-0.0136	0.0099	-1.37	-0.0257	0.0091	-2.82

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 6. Determinants of the proportion of children attending school by age groups, 2002 (GMM Estimates) (continued)

	Age 6-12					
	Model 1			*Model 2*		
Explanatory variable	*Coef.*	*Std. err.*	*z*	*Coef.*	*Std. err.*	*z*
Region 4	0.0018	0.0085	0.21	-0.0017	0.0076	-0.22
Region 5	0.0018	0.0192	0.1	0.0067	0.0203	0.33
Region 6	0.0113	0.0130	0.87	0.0123	0.0131	0.94
Region 7	-0.0191	0.0131	-1.46	-0.0161	0.0136	-1.18
Region 8	0.0052	0.0180	0.29	0.0093	0.0187	0.50
Region 9	-0.0519	0.0143	-3.64	-0.0512	0.0144	-3.57
Region 10	-0.0105	0.0111	-0.95	-0.0058	0.0122	-0.48
Region 11	-0.0277	0.0117	-2.38	-0.0272	0.0117	-2.33
Region 12	-0.0260	0.0156	-1.67	-0.0174	0.0180	-0.97
CAR	0.0254	0.0161	1.58	0.0245	0.0149	1.64
ARMM	-0.1451	0.0174	-8.35	-0.1542	0.0156	-9.91
Caraga	0.0018	0.0117	0.15	0.0067	0.0129	0.52
Constant	0.7835	0.0679	11.53	0.7941	0.0691	11.50
No. of observations	8,949					
Overidentification test:						
J-Hansen (GMM) (P-value)	1.83(0.176)			1.32(0.250)		

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 6. Determinants of the proportion of children attending school by age groups, 2002 (GMM Estimates) (continued)

	Age 13-16					
	Model 1			*Model 2*		
Explanatory variable	*Coef.*	*Std. err.*	*z*	*Coef.*	*Std. err.*	*z*
No. of children*	-0.2212	0.0729	-3.04	-0.2269	0.0694	-3.27
No. of children x quintile 2				0.0619	0.0188	3.29
No. of children x quintile 3				0.0672	0.0192	3.50
No. of children x quintile 4				0.0696	0.0190	3.67
No. of children x quintile 5				0.0588	0.0169	3.48
Age, father	0.0007	0.0015	0.47	-0.0005	0.0013	-0.41
Age, mother	-0.0076	0.0031	-2.42	-0.0087	0.0032	-2.74
Year of schooling, mother	0.0014	0.0050	0.28	-0.0010	0.0051	-0.19
Year of schooling, father	0.0041	0.0032	1.27	-0.0011	0.0041	-0.26
Urban	0.0299	0.0135	2.21	-0.0093	0.0171	-0.54
Disp. Income, per cap (0000)	0.0020	0.0011	1.83	-0.0005	0.0008	-0.66
Prop. of bgy with elem. school	0.0177	0.0514	0.34	0.0571	0.0524	1.09
Prop. of bgy with sec. school	0.1313	0.0613	2.14	-0.0224	0.0589	-0.38
Region 1	0.1066	0.0509	2.10	0.0845	0.0430	1.97
Region 2	-0.0019	0.0415	-0.05	-0.0385	0.0437	-0.88
Region 3	0.0065	0.0313	0.21	-0.0415	0.0282	-1.47

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 6. Determinants of the proportion of children attending school by age groups, 2002 (GMM Estimates) (continued)

	Age 13-16					
	Model 1			*Model 2*		
Explanatory variable	*Coef.*	*Std. err.*	*z*	*Coef.*	*Std. err.*	*z*
Region 4	0.0407	0.0283	1.44	0.0206	0.0234	0.88
Region 5	0.1174	0.0547	2.15	0.1303	0.0526	2.48
Region 6	0.1089	0.0404	2.70	0.1147	0.0383	3.00
Region 7	0.0744	0.0418	1.78	0.0963	0.0416	2.32
Region 8	0.1122	0.0551	2.04	0.1277	0.0540	2.37
Region 9	0.0479	0.0428	1.12	0.0517	0.0407	1.27
Region 10	0.0391	0.0339	1.15	0.0757	0.0345	2.20
Region 11	0.0301	0.0364	0.83	0.0457	0.0346	1.32
Region 12	0.1059	0.0498	2.13	0.1421	0.0539	2.64
CAR	0.1767	0.0561	3.15	0.1598	0.0477	3.35
ARMM	0.1724	0.0459	3.75	0.1264	0.0353	3.58
Caraga	0.1078	0.0411	2.62	0.1467	0.0444	3.30
Constant	2.0323	0.4518	4.50	1.9998	0.4091	4.89
No. of observations	6,435					
Overidentification test:						
J-Hansen (GMM) (P-value)	10.48(0.0012)			9.81(0.0017)		

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 6. Determinants of the proportion of children attending school by age groups, 2002 (GMM Estimates) (continued)

	Age 17-24					
Explanatory	*Model 1*			*Model 2*		
Variables	*Coef.*	*Std. err.*	*z*	*Coef.*	*Std. err.*	*z*
No. of children*	-0.2270	0.0795	-2.86	-0.2306	0.0672	-3.43
No. of children x quintile 2				0.0855	0.0244	3.50
No. of children x quintile 3				0.0908	0.0242	3.76
No. of children x quintile 4				0.1007	0.0243	4.14
No. of children x quintile 5				0.1087	0.0238	4.56
Age, father	-0.0043	0.0017	-2.54	-0.0053	0.0017	-3.20
Age, mother	-0.0210	0.0060	-3.48	-0.0194	0.0046	-4.25
Year of schooling, mother	0.0094	0.0049	1.91	0.0066	0.0045	1.48
Year of schooling, father	0.0130	0.0034	3.77	0.0067	0.0039	1.70
Urban	0.0109	0.0167	0.65	-0.0338	0.0208	-1.63
Disp. Income, per cap (0000)	0.0054	0.0014	3.80	-0.0002	0.0010	-0.17
Prop. of bgy with elem. school	0.0876	0.0590	1.48	0.1482	0.0573	2.59
Prop. of bgy with sec. school	-0.0263	0.0797	-0.33	-0.1978	0.0674	-2.93
Region 1	0.0994	0.0615	1.62	0.0872	0.0494	1.76
Region 2	0.0307	0.0488	0.63	-0.0064	0.0477	-0.13
Region 3	-0.0407	0.0389	-1.05	-0.1006	0.0320	-3.15

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 6. Determinants of the proportion of children attending school by age groups, 2002 (GMM Estimates) (continued)

Explanatory	Age 17-24					
	Model 1			Model 2		
Variables	*Coef.*	*Std. err.*	*z*	*Coef.*	*Std. err.*	*z*
Region 4	0.0413	0.0375	1.10	0.0092	0.0286	0.32
Region 5	0.1551	0.0633	2.45	0.1755	0.0563	3.12
Region 6	0.2240	0.0569	3.94	0.2184	0.0462	4.73
Region 7	0.1286	0.0520	2.47	0.1507	0.0476	3.17
Region 8	0.2122	0.0691	3.07	0.2166	0.0578	3.75
Region 9	0.2058	0.0611	3.37	0.2150	0.0551	3.90
Region 10	0.0668	0.0444	1.50	0.1053	0.0432	2.44
Region 11	0.0350	0.0461	0.76	0.0451	0.0420	1.07
Region 12	0.2761	0.0557	4.95	0.3208	0.0553	5.80
CAR	0.2886	0.0642	4.50	0.2694	0.0503	5.35
ARMM	0.4180	0.0746	5.60	0.3613	0.0527	6.85
Caraga	0.1522	0.0576	2.64	0.2000	0.0572	3.49
Constant	2.1660	0.6451	3.36	1.9115	0.4637	4.12
No. of observations	6,060					
Overidentification test:						
J-Hansen (GMM) (P-value)	10.69(0.001)			8.51(0.0035)		

* For 2SLS and GMM estimates, instrumented with both male and both female for the first two births.

Table 7. Impact on proportion of enrollment of children by per capita income quintile, %

	Age Groups			
	6-24	6-12	13-16	17-24
Average	-19.3	ns	-25.6	-57.4
Poorest	-23.6	ns	-29.1	-76.7
Lower middle	-15.5	ns	-16.0	-41.9
Middle	-16.0	ns	-16.5	-37.5
Upper middle	-16.0	ns	-16.5	-28.3
Richest	-16.1	ns	-17.1	-22.2
Curr. attendance	73.7	94.2	86.7	38.6

ns - not statistically significant

5. Summary and policy implications

The paper presents what to the author's knowledge is the first attempt at considering the endogeneity of the number of children in the estimation of the education of children equation using Philippine data. The endogeneity of the number of children is argued in the quantity-quality literature spawned by the seminal treatment in Becker and Lewis [1973]. The estimation framework in this study follows the pioneering test of this quantity-quality framework in Rosenzweig and Wolpin [1980], but instead of twins this study used the balanced sex-mix hypothesis and the sex of the first two births as instruments for the number of children. This instrument was first used by Angrist and Evans [1998] in a study on the effect of the number of children on their parents' labor supply and earnings. The use of this instrument was prompted by the observation of demographers that the Philippines, unlike many countries in East and South Asia, has a preference for balance in the sex of their children [Wongboonsin and Ruffolo 1995; Stinner and Mader 1975]. This was confirmed by a simple tabulation of the difference of the number of children by the sex of the first two children.

The estimation result shows that the number of children has negative impact on the proportion of school-age children attending school. The average effect for children 6-24 years old is a 19 percent decline per additional child, or almost one in every five children. Estimates considering per capita income quintile show that for the poorest quintile the impact is a 24 percent decline, or almost one in four, while for the richest quintile this is a 16 percent decline, or around 4 in 25 per additional child. Moreover, while this impact is not significant for the elementary school-age children, these are much bigger in magnitude and much more regressive at higher school-age groupings, reaching as much as 77 percent for the poorest quintile for the tertiary school-age group, or 8 in 10 children for this age group.

These results have important policy implications. Poverty alleviation efforts that address only the current needs of the poor may consign the next generation from poor and large households into deeper poverty. Each additional child, by driving more school-age children out of schools, also pushes the succeeding generation into poverty. Effectively, each additional child constitutes an intergenerational tax that households impose upon themselves, and this tax is highly regressive. There may be a need for targeted education subsidies for large households, particularly those who have completed family size and perhaps those who will effectively promise to bear no more children. Orbeta [2004] has shown that there is higher unmet need for family planning and that the desired family size is also larger among the poor. Given these, poverty alleviation packages should include assistance to enable poor families to achieve their desired family sizes. In addition, advocacy for smaller family size needs to be intensified among the poor.

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