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IMPACT OF FAMILY SIZE ON EDUCATION, CHILD LABOR AND FEMALE LABOR SUPPLY: THE CASE OF ECUADOR[1]

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ABSTRACT

This paper studies the impact of family size on education, child labor and mother's labor market participation in Ecuador. Parent's preferences and the sex mix of their children are exploited in an instrumental variables setting to overcome endogeneity problems. The results show that an exogenous variation in family size have a negative impact on education investment and literacy at early ages of the oldest child and mixed effects on child labor depending on the residence area, but no effect in other indicators as school attendance and performance. There is evidence of a negative impact on mother's labor supply, especially for those with a *"head of the household"* role.

Key words: family size, instrumental variables, causality.

RESUMEN

Este documento estudia el impacto del tamaño del hogar en la educación, el trabajo infantil y la participación laboral de las madres en Ecuador, utilizando las preferencias de los padres y el sexo de sus dos primeros hijos para sortear los problemas de endogeneidad en el marco de la metodología de Variables Instrumentales. Los resultados apuntan hacia un impacto negativo del tamaño del hogar en la inversión en educación y la lectoescritura a edades tempranas para el hijo mayor, mixtos sobre la probabilidad de que éste trabaje por paga, dependiendo de área de residencia y nulos sobre otros indicadores de educación como la asistencia y el desempeño escolar. Además, el impacto sobre la oferta laboral de la madre se estima negativo, especialmente para aquellas que desempeñan el papel de "jefes de hogar".

Palabras clave: tamaño del hogar, variables instrumentales, causalidad.

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I. Introduction

In sharp contrast with school attendance trends in regions like South Asia and Southern Africa, in Latin America and the Caribbean the number of children not attending school has rose between years 2002 and 2012. Currently, more than 6 million children and adolescents do not attend school and 15.6 million face a high risk of dropping out. About 12.5 million aged 5 to 17 works for pay, frequently in hazardous economic activities (ILO/IPEC, 2013). These facts involve complex decision making mechanisms at the household level, regarding, for instance, children's education and labor market attachment, which could be influenced by family size, after Becker and Tomes (1976) and Rosenzweig and Evenson (1977), among others.

Furthermore, the idea of family size adverse consequences on the well-being has motivated an extensive literature and worldwide fertility-related policies, such as child care and family planning subsidies. Ecuador is one of the Latin American countries where policies on this field take place. For years, the ecuadorian government and the United Nations Population Fund have implemented programs to enhance universal access to family planning methods and teenage pregnancy prevention. The importance of this topic for the ecuadorian society has been reaffirmed by passing a new Constitution that explicitly warrants the right to enjoy reproductive and sexual health methods. On the child care subsidies side, the program "Centros Infantiles del Buen Vivir" provides public assistance and education to children up to five years old from poor families in 9.771 kindergartens since year 2007.

The empirical literature around the impact of family size presents mixed results on children's education, yet there is some consensus about a negative effect on female labor market participation and a positive one on that of their children. Endogeneity and other non-trivial obstacles to the estimation of causal effects of family size and recent literature generally tries to overcome this obstacles by exploiting natural experiments as sources of exogenous variations on the number of children.

In line with this literature, this paper estimates the impact of family size on education, child labor and female labor supply in Ecuador by us-

ing a natural experiment as a source for exogenous variation on the number of children and contributes to previous research in several ways. First, it studies the effect on child labor, an underexplored issue for Latin America with serious social implications. Second, given the persistent economic gap between urban and rural areas in the region, possible rural-urban differentiated effects are explored. Third, the study of the effect on female labor supply departs from previous research by estimating it for *nuclear vs. mother-headed* families instead of the typical *married vs. all* analysis. Fourth, it explores long term effects by estimating the impact on educational mobility as a proxy for social mobility. Fifth and final, this will be the first work in this area that uses the totality of a census dataset instead of a sample, given the literature review for Latin America and the U.S. at the time.

The reminder is organized as follows. Parts II and III review the empirical literature and present the theoretical context. Identification strategy is addressed in part IV. The last three parts present the results, policy advice and conclusions respectively.

II. Empirical Literature

The use of natural experiments as a source of exogenous variation on family size was pioneered among others by Rosenzweig and Wolpin (1980), based on a broadly replicated strategy that exploits the randomness of multiple births occurrence as an exogenous source of variation of the number of children in the family and reports a negative impact on schooling in India. Caceres-Delpiano (2005) follows this strategy, using multiple births occurrence as a source of exogenous variation in family size in the U.S. and founding a 1.3% negative effect on private school attendance conditional on children actually being attending school as a proxy for education investment, but a null effect is reported over school attendance and child's performance in terms of years completed and held-back probability against the cohort. A 4.8% negative impact of family size on mother's labor market participation is also reported. Meanwhile, Angrist and Evans (1998) exploits the parents preferences over the sex mix of their first two children as an instrument for family size using 1980 and 1990 U.S. census data and found that family size reduces mother labor market participation

by 12%. In addition, a strong reduction on income and hours worked per week is reported. Conley and Glouber (2005) implement the same strategy using data from the 1990 U.S. census to estimate the impact on children schooling and their results are in line with those of Caceres-Delpiano.

A variant of this strategy is developed by Chun and Oh (2002) and Lee (2004), that use the sex of the first child as an instrument for family size in South Korea and found a negative effect of 27.5% on married woman's labor supply and an impact between 29% and 36.9% on children's education.

Cruces and Galiani (2006) and Baez (2008) are two outstanding works in this field for Latin America that follows the strategy proposed by Angrist and Evans (1998). The first one use census data from Argentina and Mexico and estimates that family size reduces female labor supply by 6.3% to 9.5% for women aged 21 to 35, with the stronger effect on married women. In a further analysis, Baez (2008) use data from the DHS[1] survey and finds causal evidence for the impact on female labor supply, child labor and a variety of indicators ranging from anthropomorphic measures until the probability of children being exposed to violent episodes. Its main results indicate that family size reduces school attendance by 18.2% and increases the probability of child being held back in school by 20% and that of being attached to labor market by 19% while the mother's labor market participation is reduced by 27%.

Agüero and Mindy (2008) exploits infertility shocks as a natural experiment to estimate the impact of fertility on female labor supply for Guatemala, Dominican Republic, Colombia, Bolivia and Peru, using DHS data. They found no statistical evidence supporting an impact of fertility.

Hagen et al. (2006) studies the effect of the *consumers to producer's proportion*, related to family size, for an ecuadorian Shuar community, using several econometrics methodologies for a sample of 85 individuals aged 3 to 20 and reports a strong negative effect on several anthropometric measures but no effect on productivity and welfare. Meanwhile, Piras et al. (2005) address the relation between family size and female labor supply

1 The Demographic and Health Surveys (DHS).

using household surveys from Brazil, Ecuador, Bolivia and Peru but without a clear strategy for dealing with the presence of endogeneity problems.

While most of previous literature points toward a negative impact on female labor supply and children's schooling, the debate is still open in this area. Angrist et al. (2010) uses *children sex mix*, multiple births occurrence and ethnic preferences as natural experiments to overcome endogeneity problems and find no evidence of an impact on children's education, their income as adults or their mother's labor market participation. Finally and contrary to previous studies, Qian (2009), exploits the China's recently reversal of the "*one boy per couple"* policy as a natural experiment and find evidence supporting a positive impact on children's school attendance, while given the early age of children at the time of the study, the consequences on education attainment and performance are not explored.

III. Theoretical Background

Becker (1960), Becker and Lewis (1973), Lewis (1974), and Becker and Thomes (1976) are three of the main theoretic proposals linking family size and resource allocation in the household, given a set of joint preferences and a maximizing conduct of home members.

Becker's definition of children in a broader sense as "children services" and the idea of parents perceiving utility from them depending on a quantity-quality combination as from other durable goods, allow the study of their decisions through the consumer theory framework. The main hypothesis states that parents face a quantity-quality trade-off given that the more children they have more expensive is quality investment for all of them, and the more qualified the children more expensive results in an increment in their number. To observe this interaction consider the problem that solves a typical home maximizing the following utility function:

$u = u\ (n, q, c)$ (3.1.)

Subject to the following budget restriction:

$I = \pi_h nq + \pi_c c$ (3.2)

Where (I) represents the family income, (n) is the number of children, (q) the quality investment in each child uniformly, and (c) other consumer goods. In the budget restriction, (nq) represents children in a Becker's fash-

ion, (π_h) is the price that family pays for their services, and (π_c) is the price of other consumer goods (c). A main feature of this budget restriction lies in the multiplicative way that quality enters to reflect that it is proportional to the number of children.

Solving the home maximizing problem leads to the following first order conditions (FOC), where (λ) represents the marginal utility of income, (p_n) and (p_q) the marginal cost of family size and children's quality:

$$\frac{\partial u}{\partial n} = \lambda \pi_h q = p_n \tag{3.3}$$

$$\frac{\partial u}{\partial q} = \lambda \pi_h n = p_q \tag{3.4}$$

$$\frac{\partial u}{\partial c} = \lambda \pi_c \tag{3.5}$$

As a direct conclusion from conditions 3.3 and 3.4, the marginal cost of children's quantity p_n is higher the greater their quality and vice versa. Rearranging conditions (3.3) and (3.4), the direct relationship between family size and the relative cost of quality or human capital becomes clear:

$$\frac{p_n}{p_q} = \frac{q}{n} \tag{3.6}$$

This implies that quality investment requires more home resources the greater the family size and the quantity-quality trade-off emerges because, parents have to allocate their time and other resources more strictly when children are more, for a given quality level (Hanusheck, 1992). Thus, an exogenous increase in family size reaches to a reduction in quality investment and reduces mother's labor market participation by raising its opportunity cost (Angrist, 2010).

In this framework, child labor can be understood as a form of quality disinvestment, since resources transferences go from children to families. Some empirical literature linking child labor and family size is in part motivated by the high fertility rates in regions where child labor is more persistent (Sinha, 2003; Cain and Mozumder, 1981; Rosenzweig and Evenson, 1977).

IV. Methodological Design

IV.1. Empirical Model

Consider the following model in which (Y_i) is a vector of education and labor market attachment measures for a child "i", the analysis unit, and measures of labor market participation of her mother. (X_i) is a vector of covariates and (NC_i) is the family size, our causal variable, in terms of the number of children:

$$Y_i = X_i\beta + \gamma NC_i + e_i \quad (4.1)$$

The Ordinary Least Squares (OLS) estimates for this model can suffer from omitted variable bias, given that several unobserved characteristics of the child and her family could be related to her education, her labor market attachment and the labor market participation of her mother. Home environment and preferences are some examples of this type of factors. The unobservable heterogeneity can reach even the quality of time that parents expend in home and parenting related issues (Hanusheck, 1992; Leibowitz, 1974; Blake, 1956).

This problem can be represented by a set of unobservable characteristics v_i as a component of the error term in equation (4.1) besides a random one u_i, then $e_i = v_i + u_i$. Given this, if a particular characteristic of a set of families, as parent's culture, leads them to bear more children and underinvest in education, then $cov(NC_i, v_i) > 0$ and $cov(q_i, v_i) > 0$, in a typical OLS estimation, the parameter (γ_i) will reflect those cultural interactions and underestimate the negative effect of family size on education. Otherwise, if parents adapt their bearing preferences as they observe the quality of their children, a simple OLS estimation of family size effect over children's quality will be biased depending on the unobserved quality-quantity interactions.

IV.2. Identification Strategy

Following Angrist and Evans (1998), parents' preferences or what Angrist and Pishke (2009) refer to as *parents' preferences for sex diversity on their children portfolio*, are used as instrument for family size. If this is the case, parents with first two children of same sex can be induced by their preferences to bear at least a third child, so the probability of having more than

two is increased. So the dummy "*more than two*" represented by (N) in equation 4.2, captures the causal endogenous variable of family size and takes the value of one when the number of children is 3 or more.

The dummy "*same sex*", represented by (Z) in equation (4.2), that takes the value of 1 when parent's first two children are of the same sex and 0 otherwise, will serve as instrument capturing the effect of these preferences.

$$N_i = X_i\alpha + \eta Z_i + \varepsilon_i \quad (4.2)$$

If children's sex combination is a good predictor for family size (N_i), that is $\eta \neq 0$ in equation (4.2), a requirement known in the literature as "relevance", and affects the dependent variable (Y_i), exclusively by its influence on family size, that is $cov(z_i, e_i) = 0$, which is known as the *exclusion restriction*, then can be regarded as a good instrument and allows to identify its impact as:

$$\gamma_{IV} = \frac{cov(Z,Y)}{cov(Z,N)} \quad (4.3)$$

The relevance can be directly tested on first stage, but the exclusion restriction must be explored on the grounds of the randomness of the instrument.

Using the se combination of first to children as instrument involves an important limitation of the identification strategy whenever limits the analysis to families with at least two children. Nevertheless, given a global fertility rate over 2.7 in Ecuador, as shown in table 4, the analysis can be generalized to an important portion of population. In countries with low fertility rates, such as South Korea, the interest remains in the analysis of smaller families.[2]

IV.3. Database, Sample and the Ecuadorian Context

This paper exploits microdata from the "Censo de Población y Vivienda" that covered 14.48 million people and 3.8 million households around the country on November 28th, 2010. In the Latin American context, this will be

2 Lee (2004) uses first child's sex as instrument for family size, exploiting parent's strong preferences for male children in South Korea, to estimate the impact over schooling investment.

the first work that uses the totality of census microdata instead of a sample from it to address the effect of family size on education and labor supply.[3]

Several features makes Ecuador an interesting field for research in this area, besides the implementation of sexual and reproductive health policies and that of public access to child care services for poor households. First, the literature dealing with the impact of family size over female labor supply and the child labor phenomena from a quasi-experimental approach is scarce. Second, Ecuador is a country widely recognized by its multicultural society: it is inhabited by at least 38 indigenous ethnicities that speak 13 native languages, and the whole population is auto-identified as part of 7 ethnic groups according to its culture and costumes.

For the analysis, secondary households, those with less than two children, children aged 18 or more or living elsewhere at the time of the census and household from mothers which reports a number of children that differs from the effectively counted in the home at the time of the census are excluded from the sample.

Following Baez (2008) and Angrist et al. (2010), the impact over education and child labor is estimated for the oldest child aged 5 to 18 and the effect over female labor supply is estimated for mothers aged 18 to 40. To mitigate measurement errors and reduce the presence of confounding factors such as merged households, the analysis is also limited to families with mothers aged 12 or more at first birth and aged until 49 and fathers aged until 69 at the census date.[4] At this point, the sample includes 2.947.613 parents and children members of 656.055 households.

Restricting the analysis to families with at least two children aged until 17 and dropping out those inclined to measurement error is one the main reasons behind the necessity of a large enough sample. Angrist and Krueger (2001) remark that a large sample not only allows to exploit the consistence property of the IV estimator but virtually discarding the bias problem.

3 Black et Al is the only reference using a dataset that covered the totality of Norwegian population aged 16 to 74 in the period 1986 - 2000.

4 Angrist and Evans (1998) limit the sample to mothers aged 21 to 35, given that few women younger than age 21 have two children in the U.S.

Table 1. Children and Youth's Education in Ecuador

	Children attending school (6-18)	Children´s years of education (6-18)	Children held back in school (6-18)	Early literacy (6-7)	Children attending private school (Conditional on actually being attending school) (6-18)
Observations	3.931.168	3.931.168	3.432.927	603.774	3.432.927
Total	0,87	5,20	0,37	0,80	0,23
Sex					
Boy	0,87	5,13	0,39	0,79	0,23
Girl	0,87	5,27	0,35	0,81	0,23
Group					
Mestizo	0,89	5,36	0,33	0,82	0,25
Indigenous	0,84	4,57	0,52	0,72	0,06
Afroecuadorian	0,83	4,95	0,43	0,77	0,17
Black	0,78	4,48	0,53	0,64	0,13
Mulato	0,84	4,83	0,43	0,76	0,20
Montubio	0,81	4,66	0,48	0,74	0,12
White	0,88	5,16	0,34	0,84	0,39
Other	0,84	5,27	0,39	0,82	0,33
Area					
Rural	0,84	4,83	0,46	0,74	0,11
Urban	0,89	5,44	0,30	0,85	0,31
Geographic Region					
Coast	0,86	5,10	0,39	0,81	0,25
Mountain	0,89	5,39	0,33	0,80	0,24
East	0,87	4,81	0,45	0,71	0,57
Insular	0,93	5,14	0,34	0,90	0,12

Source: own computations based on the Censo de Población y Vivienda 2010 (Instituto Nacional de Estadística y Censos del Ecuador).

Table 1 presents some statistics on education for people aged 6 to 18. While attendance proportion is the same for both genders, there are important gaps by gender, population group and rural status. Men, indigenous and rural people have, on average, accumulate less years of education, and are more susceptible to be behind their cohort's educational level.

Table 2. Child Labor in Ecuador (5 - 17)

	Total		Urban		Rural	
	Works for pay	Hours worked per week	Works for pay	Hours worked per week	Works for pay	Hours worked per week
Observations	3.934.862	189.313	2.343.395	83.068	1.591.467	106.245
Total	0,05	30,18	0,04	31,16	0,07	30,20
Sex						
Boy	0,07	30,61	0,06	30,36	0,10	30,81
Girl	0,03	29,13	0,03	29,68	0,04	28,69
Population Group						
Mestizo	0,05	31,22	0,04	30,25	0,06	32,11
Indigenous	0,10	27,43	0,11	32,45	0,10	26,33
Afroecuadorian	0,06	28,48	0,06	28,55	0,07	28,31
Black	0,08	28,83	0,08	28,65	0,09	29,07
Mulato	0,06	30,13	0,05	30,18	0,08	30,05
Montubio	0,06	28,99	0,06	29,62	0,07	28,75
White	0,04	30,01	0,04	29,67	0,06	30,72
Other	0,06	30,27	0,06	30,27	0,07	30,26
Geographic Region						
Coast	0,05	29,01	0,04	28,90	0,06	29,15
Mountain	0,06	31,37	0,04	31,17	0,08	31,47
East	0,07	27,32	0,06	30,86	0,08	26,04
Insular	0,03	30,57	0,03	31,16	0,03	27,62
Disability						
Permanent (> 1 year)	0,05	26,97				
Intellectual	0,03	25,78				
Physical	0,00	0,00				

Source: own computations based on the Censo de Población y Vivienda 2010 (Instituto Nacional de Estadística y Censos del Ecuador).

The child labor phenomena affects 5% of children and youth aged 5-17 but there are important gaps by gender, ethnicity and rural condition. 7% of boys and 3% of girls in that age range reported being working for pay. Children and youth from rural households are 70% more inclined to be

engaged in some economic activity for pay; meanwhile 10% of indigenous children and youth were in the same condition at the time of the census, a proportion two times higher than whites.

Table 3. Fertility and Female Labor Market Participation (Age > 17)

	All Women			Mother Head of the Household or Mate		Mother Head of the Household	
	Children ever born	Works for pay	Hours worked per week	Works for pay	Hours worked per week	Works for pay	Hours worked per week
Observations	4552188	4648666	1901666	3190691	1340877	1085390	550942
Total	2,76	0,43	35,37	0,44	34,96	0,53	33,85
Civil Status							
Married	2,76	0,44	35,63	0,45	35,68	0,50	33,41
Other	2,83	0,43	35,20	0,43	34,22	0,53	33,94
Education (Years)							
0 - 1	3,49	0,34	32,61	0,30	30,59	0,37	29,93
2 - 6	3,28	0,37	34,69	0,34	33,72	0,46	33,71
7 - 12	2,23	0,45	36,25	0,45	35,20	0,54	35,90
> 12	1,72	0,65	36,85	0,72	36,52	0,68	36,72
Population Group							
Mestizo	2,63	0,44	36,04	0,45	35,65	0,54	34,50
Indigenous	3,51	0,53	31,94	0,55	31,72	0,59	31,06
Afroecuadorian	2,94	0,40	32,15	0,42	31,83	0,53	31,12
Black	3,51	0,41	32,42	0,43	32,07	0,52	31,62
Mulato	2,93	0,42	33,50	0,43	33,02	0,54	31,92
Montubio	3,45	0,25	33,27	0,24	32,56	0,38	31,22
White	2,55	0,43	35,76	0,44	35,45	0,50	34,30
Other	2,39	0,44	36,05	0,45	35,80	0,56	33,48
Area							
Rural	3,35	0,35	34,15	0,35	33,56	0,45	32,53
urban	2,45	0,47	35,87	0,48	35,54	0,56	34,32
Geographic Region							
Coast	2,81	0,36	34,08	0,35	33,41	0,46	32,01
Mountain	2,63	0,52	36,42	0,53	36,13	0,59	35,35
East	3,46	0,45	33,42	0,47	33,07	0,56	33,39
Insular	2,18	0,57	38,52	0,63	38,21	0,74	37,95

Source: own computations based on the Censo de Población y Vivienda 2010 (Instituto Nacional de Estadística y Censos del Ecuador).

As shown in table, 2.7% of working children and youth are engaged in construction activities classified as hazardous in the child work context.[5] The main activities in urban areas affecting one of every two working children and youth are: commerce (28%), manufacture (12%) and construction (9%). While for rural areas three quarters of young workers are engaged in agricultural activities.

Columns 3 to 8 of table 3 present statistics of working condition for women since 18 years old. 43% of women reported being working for pay while the proportion among *Mothers heads of the household (MHH)* in the same condition reaches 52.6%. Labor market participation is about 24% among women with no more than 1 year of education and 2.8 times higher for women in the highest education levels.

Finally, column 2 of table 3 offers a first glance of family size, the causal endogenous variable, for more than 4.5 million Ecuadorian women aged 18 or more, in terms of the number of children ever born. On average, each mother presents 2.7 children, but there are big differences by ethnicity and education level. Family size goes from 1.7 children for women with 12 or more years of schooling to 3.5 for those with one year or less. Indigenous and black women bear 3.51 children on average while whites and *mestizas* have 2.5 children on average.

Table 4 presents some important households characteristics by treatment status. Mothers from control (Z=0) and treatment (Z=1) groups reach about 9.4 years of education, present about 32 years old at the census date, and bear their first child at the age of 21. The proportion of single mothers in both groups is about 21%, and their first and second child present 10.7 and 7 years old respectively at the census date. Participation of households with boy at first and second born is slightly higher for the treated group and participation of households with first two children of the same sex is about 50.5% for both, treatment and control groups.

5 According to ILO, labor that jeopardizes the physical, mental or moral well-being of a child, either because of its nature or because of the conditions in which it is carried out, is known as "hazardous work" and affects about 115 million of children aged 5 to 17 are affected by this phenomena in diverse areas as agriculture, mining, construction, manufacturing, services, among others.

Table 4. Means differences by Treatment Status

Endogenous variable (N): *More than two children* (=1 if the mother have more than two children)					
Instrumental variable (Z): Same_sex (=1 if first two children are of the same sex)					
	Mean	**Z = 0**	**Z = 1**	**Diff.**	**s.e**
Population Group					
Mestizo	0,754	0,753	0,754	0,000	0,001
Indigenous	0,061	0,063	0,061	0,002	0,001
Afroecuadorian	0,038	0,039	0,038	0,000	0,000
Black	0,006	0,006	0,006	0,000	0,000
Mulato	0,018	0,018	0,018	0,000	0,000
Montubio	0,062	0,061	0,062	-0,001	0,001
White	0,057	0,056	0,006	0,000	0,001
Other	0,003	0,003	0,003	0,000	0,000
Area					
Rural	0,366	0,366	0,366	0,000	0,001
Geographic Region					
Coast	0,447	0,445	0,449	-0,004	0,001
Mountain	0,450	0,451	0,448	0,003	0,001
East	0,048	0,048	0,047	0,001	0,001
Insular	0,002	0,002	0,002	0,000	0,000
Mother					
Age	32,150	32,170	32,130	0,032	0,016
Age at firt birth	21,470	21,479	21,460	0,020	0,011
Adolescent at first birth	0,179	0,178	0,179	-0,001	0,001
Education (Years)	9,417	9,420	9,414	0,007	0,012
Married	0,568	0,563	0,558	0,005	0,001
Head of the household	0,213	0,212	0,213	-0,002	0,001
Children and Sex Composition					
Age of 1st born	10,680	10,691	10,679	0,013	0,011
Age of 2nd born	7,017	7,006	7,030	-0,024	0,011
Number of children	2,668	2,639	2,697	-0,059	0,002
More than two (N) (=1 if the number of children is three or more)	0,445	0,425	0,465	-0,039	0,001
Boy_1 (=1 if the first child is a boy)	0,514	0,504	0,524	-0,019	0,001
Boy_2 (=1 if the second child is a boy)	0,509	0,495	0,523	-0,028	0,001
Boy_1_2 (=1 if first two children are boys)	0,264				
Girl_1_2 (=1 if first two children are girls)	0,240				
Same_sex (=1 if first two children are of the same sex)	0,505				

Source: own estimates based on the Censo de Población y Vivienda 2010 (Instituto Nacional de Estadística y Censos del Ecuador).

IV.4. Objective Variables

IV.4.a. Education

The analysis of family size effect on education covers the main indicators reported by recent literature, such as school attendance, years of schooling and probability of being below the cohort's average achieved level. The impact on less common education indicators as early literacy, education investment, and social mobility is also explored.

Quality and quantity time devoted by parents to childcare among other factors can account for the differences observed in human capital among children at early ages (Leibowitz, 1974). Given that the human capital accumulated by the child at the starting time at school can play a main role in their future performance, possible effects of family size -on early literacy- is explored by the dummy "Early Literacy", which takes the value of 1 when the child aged 6 to 7 reports that can write and read at the time of the census and 0 otherwise.

Moreover, private school attendance, conditional on actually being attending school, is used as a measure of education investment after Cáceres-Delpiano (2005) and Conley and Glouber (2008), given that choosing a private school implies a direct extra-expenditure on education compared to the public choice.

Furthermore, long term effect of family size on education can be addressed from an intergenerational perspective through its impact on social mobility, a concept usually associated with the transition to a better position in the income distribution. At first glance, this impact can be captured by the probability of children overcoming the average education level of their parents and this objective defines the dummy "Mobility", which takes the value of 1 when the child presents a higher educational level than the average of their parents at the time of the census and zero otherwise.

IV.4.b. Labor Market Participation

The analysis of family size impact on child labor is restricted to children aged 5 to 17, and addressed from a *rural vs. urban* point of view, given the persistent socioeconomic differences between this areas in Ecuador and LATAM.

Meanwhile, in line with a broadly set of social policies that prioritizes single mothers over the rest in LATAM and departing from previous literature, which usually address the analysis of female labor market participation by civil status, that is, *Married Women vs. All Women*, this paper studies the effect for *Mothers from nuclear household (MNH) vs. Mothers heads of the household*, putting the emphasis on the home leadership role played by the mother and reported that way in the census.

V. Results

V.1. WALD Estimates

Wald estimates offer a first approach to the family size impact, captured by the dummy *"more than two children"* on education, child labor and female labor supply. As shown in the first panel of table 5, bearing more than two children reduces schooling investment, measured as the probability that the oldest child attends private school, by 18.5% and early literacy by 26.4%. Both effects are significant at 5% level. There is no evidence of an impact over school attendance, probability of being held back against the cohort schooling level and positive mobility.

On the child labor side, having more than two children raise the probability of children report being working for pay in rural areas by 8.3%, while the effect in the rural areas is negative and of about 2% in urban areas, as shown in panel 2 of table 5.

Finally, panel 3 of table 5 presents the main results for mothers labor supply. On average, having more than two children reduce mother's labor market participation by 13.2%; however, there can be wide differences in this effect once estimated for *MHH* vs. *MNH*. For the last ones, probability of being working for pay is reduced by 12%, while the impact over *MHH* is more than three times higher, about 28%. These results are significant at 5% level.

Table 5. Impact of Family Size on Education, Female Labor Supply and Child Labor: Wald Estimates

Endogenous variable (N): *More than two children* (=1 if the mother have more than two children)			
Instrumental variable (Z): Same_sex (=1 if first two children are of the same sex)			
Objective variable (Y): Education, Child Labor and Female Labor Supply	**E[N|Z=1] - E[N|Z=0]**	**E[Y|Z=1] - E[Y|Z=0]**	**WALD**
1. Education (6 - 18)			
Children attending school	-0,044	0,000	-0,006
s.e	(0,001)	(0,001)	(0,015)
Children attending private school (Conditional on actually being attending school)	-0,044	0,008	-0,185
s.e	(0,001)	(0,001)	(0,028)
Children held back in school	-0,044	0,000	-0,009
s.e	(0,001)	(0,001)	(0,029)
Positive Mobility	-0,047	0,002	-0,035
s.e	(0,001)	(0,001)	(0,026)
Early literacy (6-7)	-0,028	0,007	-0,264
s.e	(0,003)	(0,003)	(0,095)
2. Child Labor (5 - 17)			
Works for pay (Rural)	-0,031	-0,003	0,083
s.e	(0,002)	(0,001)	(0,029)
Works for pay (Urban)	-0,048	0,001	-0,021
s.e	(0,002)	(0,001)	(0,011)
3. Female Labor Supply (18 - 40)			
Works for pay	-0,036	0,005	-0,132
s.e	(0,001)	(0,001)	(0,036)
Works for pay (*MNH*)	-0,039	0,005	-0,120
s.e	(0,001)	(0,001)	(0,037)
Works for pay (*MHH*)	-0,026	0,007	-0,279
s.e	(0,003)	(0,003)	(0,11)

Source: own estimates based on the Censo de Población y Vivienda 2010 (Instituto Nacional de Estadística y Censos del Ecuador).

V.2. Instrumental Variables Estimates

V.2.a. First Stages

Two conditions are necessary for the validity of the *same sex* instrument: first, it has to be a good predictor for family size, usually known as relevance condition; and second, it must be uncorrelated with the error term of the structural model, which is known as exclusion restriction. In this section, the first condition is directly tested by estimating model 4.2 for the dummy more than two, including a set of covariates (X_i) to control for the sex of first two children, their ages and their mother's, her civil status, years of education, and teenage mother condition at first birth. Controls for household geographic region and ethnic group of the unit of analysis are also included, and with the exception of first stages for child labor, all models include controls for rural condition of the dwelling. In first stages for child labor and education, a dummy for mother headed homes is included while those of female labor market participation are estimated for mothers of single and nuclear homes separately.

As shown in table 6, the parameter for same sex is highly precise and with the correct sign in all subsamples. In particular, having the first two children of the same sex rise the probability of bearing at least one more child by 2.6% to 4.7%, with a 99% confidence, a result in line with what was reported by Angrist and Evans (1998).

Intensity of correlation between the endogenous variable (N) and the instrument (Z) plays a central role in the internal validity of the strategy, an issue that can be seen through the *plim* equation of the IV estimator:

$$plim(\beta_{IV}) = \beta + \frac{Corr(z,e)}{Corr(z,N)}\frac{\sigma_e}{\sigma_N} \qquad (5.1)$$

Where σ_e y σ_N are the standard errors of the residuals and the instrumented variable respectively. Bound et al. (1995) highlights that in finite samples IV estimates are biased in the same direction as OLS estimates, and this bias approaches to the bias of OLS estimates when the correlation between the instrument and the endogenous variable tend to zero. If this correlation is weak, a slight violation of exclusion restriction in the form of some correlation between the instrument and the error of the structural

model leads to inconsistences that cannot be overcome by using a large sample.

This problem is known in the literature as "weak instruments" and has become an important issue in recent years. Bound et al. (1995) states that the first stage F statistic contains valuable information regarding the finite sample bias of the IV estimator and highlights that, after Stiger and Stock (1997), the quotient 1/F offers an approximation of the finite sample bias in terms of that of the OLS estimator. Angrist and Pishke (2009) address this issue by expressing the finite sample bias of (β_{IV}) in terms of the first stage F statistic, the covariance between the errors of the structural model and the instrumental equation $\sigma_{e\varepsilon}$ and its error variance σ_{ε}^2:

$$E(\beta_{IV} - \beta_{MCO}) = \frac{\sigma_{e\varepsilon}}{\sigma_{\varepsilon}^2}\frac{1}{F+1} \qquad (5.2)$$

As a rule of thumb, after Stiger and Stock (1997), a first stage F statistic less than 10 should be a motive of concern, under the assumption of i.i.d. errors. As shown in table 6, the first stage F statistic for each subsample oscillates between 1099.5 and 5606.3, which could be a first signal against the presence of weak instruments problems.

Table 6. First Stages

Endogenous variable (N): *More than two children* *(=1 if the mother have more than two children)*	**Education**	**Child Labor**		**Mother´s Labor Supply**		
	6 - 18	**5 - 17**		**18 - 40**		
	Total	**Urbano**	**Rural**	**Total**	**Mothers from nuclear household (MNH)**	**Mothers heads of the household (MHH)**
Boy_1 (=1 if the first child is a boy)	-0,006	-0,006	-0,005	-0,006	-0,007	-0,003
s.e	(0,001)	(0,002)	(0,002)	(0,001)	(0,001)	(0,003)
Boy_2 (=1 if the second child is a boy)	-0,002	0,000	-0,006	-0,003	-0,003	-0,003
s.e	(0,001)	(0,002)	(0,002)	(0,001)	(0,001)	(0,003)
Instrumental variable (Z): Same_sex (=1 if first two children are of the same sex)	**0,044**	**0,047**	**0,032**	**0,037**	**0,040**	**0,026**
s.e	(0,001)	(0,002)	(0,002)	(0,001)	(0,001)	(0,003)
Observations	560.237	356.186	202.612	590.281	466.962	123.319
F Statistic	3.852	2.353	1.686	6.141	5.606	1.100

Source: own estimates based on the Censo de Población y Vivienda 2010 (Instituto Nacional de Estadística y Censos del Ecuador).

A formal definition for this problem was proposed by Stock and Yogo (2001), in terms of its consequent distortions on Wald Statistic based on inference and the bias against the OLS estimator, as shown in table 5.1. Such distortions emerge in the presence of a weak instrument problem as a result of the loss of precision of the standard errors of the IV estimator, i.e., in the presence of weak instruments, the Wald statistic allows to reject more frequently the null hypothesis of $\beta_{iv}=0$, rising the probability of incurring in type I error. In terms of the test, an instrument is considered weak if the significance (α) level (α – level) based on IV statistics has an actual size that could exceed a tolerable threshold, 10% in this case. With the family size as the only endogenous variable and the *same sex* of first two children as the only instrument, the test statistic is the *first stage F statistic* and its critical value is 16.37, for testing the null hypothesis that the instrument does not enter the first stage, with a desired maximal size of 10%, for a 5% Wald test of $\beta = 0$. Column 6 of table 7 shows that with the exception of the first stage for the hours worked per week for children and youth aged 5 to 17, all the F statistics are higher that a critical value, so the null hypothesis that the instrument *same sex* is weak can be rejected.[6]

V.2.b. The Impact of Family Size on Education, Child Labor and Female Labor Supply.

This section presents the main results of the OLS and IV estimates of the family size impact on education a labor supply.

As shown in column 3 of table 7 and in line with previous literature, OLS estimates indicate a strong and highly significant effect of family size on several measures of education, child labor and mother's labor supply. With the exception of the effect on positive mobility, all estimators are highly significant and present the expected sign in theoretical terms, but once endogeneity is controlled using the dummy "*Same_sex_1_2*" as instrument, mixed effects of family size on child labor are identified and adverse effects on some indicators of education and mother's labor market

6 Most of the cited empirical bibliography does not implement this type of test for formally evaluate the risk of weak instruments. Stiger and Stock (1997) find that none of the 18 articles published by The American Economic Review that implemented IV estimates reported the F statistic of the first stages.

participation. In line with Báez (2008), most cases OLS models tend to underestimate the adverse effects of family size.

The potential importance of these results can be explored in the domain of a growing literature that studies the technology underlying cognitive and non-cognitive skill formation at different stages of children life cycle. Cuhna and Heckman (2008) stem that the effect of parents investment on their children, measured in a broadly sense, from the number of books in the house to the number of museum or theatre visits, over cognitive and non-cognitive skills formation is stronger at early ages, precisely from 6 to 8 years of age. Meanwhile, Cunha et al (2010) points out the importance and convenience of intervention at early ages of cognitive skills disadvantages and finds evidence supporting the existence of complementarities between parent's investment and their children cognitive skills that get more relevant as children grow up. Given this type of complementarities and its implications on cognitive skill formation, a family size adverse impact on investment and early literacy can play a central role for policy design in this field.

On the positive mobility side, having more than two children reduces by 3.7% the probability of the oldest child overcoming the average educational level of her parents. This offers a first approach to possible long term or secular effects from family size in social mobility from a generational perspective. The importance of this result, although it is significant at a 10% level, is that quantity-quality empirical literature generally does not report evidence over this type of indicators that involves a generational component.

Table 7. Impact of Family Size on Education, Female Labor Supply and Child Labor: OLS and IV estimates

Endogenous variable (N): *More than two children* (=1 if the mother have more than two children)								
Instrumental variable (Z): Same_sex (=1 if first two children are of the same sex)								
Objective variable (Y): Education, Child Labor and Female Labor Supply	**Observations**	**Mean**	**OLS**		**IV**		**Stock-Yogo (F)**	**Hausman H**	**p - val**
1. Education (6 - 18)									
Children attending school	560.237	0,932	-0,013	***	0,005		1241,64	1,472	0,225
s.e			(0,001)		(0,015)				
Children´s years of education	521.889	5,467	-0,101	***	0,117		1182,91	5,806	0,016
s.e			(0,004)		(0,091)				
Children attending private school (Conditional on actually being attending school)	521.889	0,273	-0,052	***	-0,18	***	1182,91	25,559	0,000
s.e			(0,001)		(0,025)				
Children held back in school (Conditional on actually being attending school)	521.889	0,330	0,039	***	-0,034		1182,91	6,809	0,009
s.e			(0,001)		(0,028)				
Early literacy (6-7)	77.747	0,845	-0,03	***	-0,234	**	78,85	5,495	0,019
s.e			(0,003)		(0,09)				
Positive Mobility	456.304	0,208	0,002	*	-0,037	*	1184,95	3,811	0,509
			(0,001)		(0,02)				
2. Child Labor (5 - 17)									
Works for pay (Rural)	202.612	0,045	0,01	***	0,067	**	251,79	4,371	0,037
s.e			(0,001)		(0,028)				
Hours worked per week (Rural)	8.536	28,503	2,214	***	12,317		14,88	0,854	0,355
s.e			(0,458)		(11,267)				
Works for pay (Urban)	356.186	0,027	0,009	***	-0,03	**	937,34	12,202	0,001
s.e			(0,001)		(0,011)				
Hours worked per week (Urban)	8.316	26,579	2,628	***	0,262		25,20	0,064	0,800
s.e			(0,515)		(9,372)				
3. Female Labor Supply (18 - 40)									
Works for pay	590.281	0,440	-0,056	***	-0,096	***	1026,04	1,573	0,210
s.e			(0,001)		(0,032)				
Hours worked per week	247.468	35,019	-1,466	***	-0,169		384,23	0,343	0,558
s.e			(0,087)		(2,218)				
Works for pay (MNH)	466.962	0,396	-0,056	***	-0,07	**	955,33	0,188	0,665
s.e			(0,001)		(0,033)				
Hours worked per week (MNH)	176.706	35,629	-1,37	***	2,579		349,19	2,976	0,845
s.e			(0,102)		(2,301)				
Works for pay (MHH)	123.319	0,603	-0,052	***	-0,255	**	101,55	4,036	0,045
s.e			(0,003)		(0,103)				
Hours worked per week (MHH)	70.762	33,498	-1,553	***	-11,048	*	51,60	2,344	0,126
s.e			(0,168)		(6,345)				
The symbols (***), (**) and (*) represent significance at 1%, 5% and 10% levels respectively.									

Source: own estimates based on the Censo de Población y Vivienda 2010 (Instituto Nacional de Estadistica y Censos del Ecuador).

Unobservable interactions between private school attendance, family size and parent's religious characteristics can underlay the wide difference observed between OLS and 2SLS estimates of the impact over private school attendance probability. Adsera (2006) stems that protestant and catholic families in developing countries usually bear a higher number of children than families from other religious beliefs.

Finally and against OLS estimates and theory predictions but in line with the findings of Cáceres-Delpiano (2006) and Angrist et al. (2010), there is no statistical evidence of an effect over school attendance and the probability of the oldest child present a lower education level compared to her cohort. Given the importance of school attendance, Cáceres-Delpiano (2006) proposes as a possible explanation for these results the possibility that parents reallocate resources in a way that compensate the possible restrictions arising from family size on school attendance and performance of the oldest child. Conley and Glouber (2005) argue that in spite of the scarce data on religious affiliation, catholic parents are more likely to send their children to catholic schools, usually privates.[7] Without addressing the endogeneity problems, these authors find a positive effect from family size over the probability that children attend private school, but once the endogeneity is controlled by instrumenting the number of children the effect becomes negative.

The second panel of table 7 presents the results for the family size impact over child labor. As mentioned above, given the generalized socioeconomics differences between the urban and rural areas, the analysis is addressed for each one separately.

OLS estimates of family size effect on the probability of the oldest child aged 5 to 17 reports being working for pay are positive and about 4.5% for the rural areas and 2.7% for the urban ones. The effect on *hours worked per week* is also positive and highly significant. Once the endogeneity is addressed by instrumenting the family size, mixed results are obtained

7 The first statistics for religious affiliation was presented in 2012 by the "Instituto Nacional de Estadísticas y Censos (INDEC)" using a sample of 3.960 urban dwellings and 13.122 people. The main results indicate that 91.95% of the people belongs to some religion and it is catholic in the 80.4% of the cases.

depending on the area. In rural household, having more than two children increase by 6.7% the probability of the oldest child report being working for pay, while the effect is negative and about 3% for urban ones. Both effects are significant at a 5% level.

These results suggest that besides the preponderance of the child labor phenomena in rural areas, it responds to an exogenous increase in family size in a quite different way depending on the area. For the rural ones, my estimates are in line with those reported by Báez (2008) for Colombia, notwithstanding the effect identified for urban households deserves a more detailed analysis.

Several hypothesis can explain this behavior that defies conventional wisdom and theory. First, there can be possible economies of scale as consequence not of the sex mix of first two children but associated to the presence of more siblings in the household, that can benefit the oldest one. If in urban areas, exist complementarities between siblings regarding the time allocation between school or other activities and work, the oldest child can perceive as convenient to avoid the work duties given that there are more worker prospects in the home.

Second, the theoretical models of *emotionless maximizers* have been seriously questioned by recent research. Mullainathan (2010) stems, for example, that *beckerian* model of education ignores the presence of self-control and time inconsistencies faced by individuals as decision makers and this inconsistences are more relevant under scarcity conditions and could lead to counter intuitive decisions by family members in terms of the conventional model. From this perspective, arises the possibility of an inverse relationship between family size and the *working-for-pay* condition of the oldest child, given that the arrival of more siblings represents not only an eventual increase in economic restrictions but in future family income as well. Accounting for the future labor market attachment of the new sibling and independently of the realization of these expectations in the future, intertemporal preferences of the oldest child can indeed been affected in such way that induce her to leave or postpone the working activities.

Third, facing a new situation in the household, such as the presence of more siblings can lead to unpredictable conducts or reactions from urban

children. Bernejee and Duflo (2011, page 71) find situations where some children from poor families reported not being attending school because "they simply refused to do so," which can be directly extended to their decision to participate in the labor market for pay. Furthermore, regarding the effects on urban child labor, school attendance and performance of the oldest child that defy the theoretical model, recent causal evidence have been reported, at least on the effect of family size on children's education in the developing world. At the end of 1970's decade, China government partially disarticulated the *one child policy*, allowing homes of certain characteristics in certain regions which only child was a girl to bear an additional one. Qian (2009) exploits this policy change as a natural experiment to estimate the impact of family size on the oldest child education, using as instrument a triple interaction between race, residence region and first child sex. The main findings indicates that an exogenous one child increase in families with three or less children with about 49% level of children's school attendance, actually increase by a range of 14% to 16% the probability that the oldest child attends school. For families with 54% of children's school attendance, the effect is also positive and about 12% for the oldest child. In addition to these counter-intuitive results, Angrist et al. (2010) implement a multiple natural experiment strategy to address endogeneity in the quantity-quality trade-off analysis and find no significant impact on children education.

Finally, as shown in the third panel of table 7, the results for family size impact on labor market participation of mothers aged 18 to 40 not only confirm previous findings in this area but it also uncovers important differences depending on the *monoparental* condition of the household, defined in such way that captures the mother leadership of the household by her "*head of the family*" response at the time of census instead of the *single* status in marital sense. Furthermore, the analysis departs from previous literature in other way, by studying the family size impact on single mothers vs. mothers from nuclear families instead of the usual married vs. *other* analysis, given that in the Latin American context, mother's leadership of the family is a powerful criteria for policy design.

The results indicate that OLS procedure underestimates the effect of

family size on mother's *working-for-pay* probability. The IV effect for all mothers is negative and about 9.6% with a 1% significance level. Once the sample is split into single and nuclear homes mothers, important differentiated effects arose. In particular, having more than two children reduce by 7% the probability of mothers from nuclear families reports being working for pay, while the adverse impact is more than three times higher for single mothers (25.5%.) Both results are significant at a 5% level and confirm the remarks of Arias and Palloni (1999) and Baez (2008) regarding the economic vulnerability of single mother's households.

VI: Robustness Check

VI.1. Hausman Test

Accounting for the important costs in terms of the efficiency by using the instrumental variables procedure to obtain consistent estimates, a Hausman test is implemented for the presence of endogeneity by the direct statistical comparison of IV and OLS estimators, under the null hypothesis of no endogeneity.[8]

As shown in the last two columns of table 7 that report the test statistic and the p-value associated for each regression, the null hypothesis of no endogeneity can be rejected in the estimation of the family size impact on education investment, literacy at early ages and the probability of being working for pay for children aged 5 to 17 and mothers aged 18 to 40.

VI.2. Exclusion Restriction

One of the most important critiques to the same sex instrument strategy was first stated by Rosenweig and Zhang (2006). The main argument against the use of the children's sex mix as instrument for family size stems that it can generate scale economies that could affect education investment through a channel other than family size, by allowing, e.g. the possibility of clothes and other sex related expenditures, to be shared or transferred among siblings, a statement that can be explored by observing the importance of clothing and related expenditures for the ecuadorian homes. If

8 The asymptotic variance of the IV estimator is always greater and in some cases much greater than the asymptotic variance of the OLS estimator (Wooldridge, 2006).

these type of expenditures represent an important proportion of the family budget, then the implicit risk of violating the exclusion restriction can be considered a motive for concern.

According to the "Encuesta de Ingresos y Gastos de Hogares Urbanos y Rurales del Ecuador" for the period 2011-2012, the expenditures on footwear and clothes for all family members represent the 8% of the total family budget. The most representative expenditures are food and transport, which represents 40% of the total family expenditure and does not depend on the sex of its members. In this sense, given the expenditures patterns in Ecuador, there is scarce evidence supporting the hypothesis of Rosenweig and Zhang (2006). Besides, Deaton (1997) remarks that consumption statistics are usually extracted from surveys that not cover the expenditure distribution among family members, so researchers face important difficulties in establishing the family members' preferences, their tastes or sex discrimination as a possible source of expenditure patterns.

Selective abortion constitute another source of concern after Schultz (2007), meaning that if parents can decide or manipulate the sex of their births, then the sex mix of the first two as treatment should not be as good as randomly assigned, which is the core assumption of our identification strategy. The hypothesis is that *"Techniques to test for the sex of the fetus early in a pregnancy (e.g. by means of ultrasound, amniocentesis, or chorionic villus sampling) allow parents who have a sufficiently strong preference for the gender of their child to abort a fetus of the unwanted sex. If this occurs, the sex composition of children may become correlated with the couples' preferences for women to work (and other family choice outcomes), and sex of the child cease to be a valid instrument for estimating the cross-effect of fertility."* Nevertheless, while abortion is legally allowed in Ecuador in some circumstances, the phenomena of selective abortion as a consequence of strong sex preferences of the couples is not common in Latin America and the statistics does not support such hypothesis. According to the population census of 2010, the proportion of men and woman among the population is almost the same, a less common fact in countries like India and other Asian, with strong preferences for one sex.

VII. Conclusions

Following Angrist and Evans (1998), this paper has exploited the randomness of the sex mix of first two births and parents preferences for sex diversity among their children portfolio as a natural experiment to overcome the challenges posed by the endogeneity of family size in the estimation of its effect on the education of the oldest child, her labor market attachment and the labor market participation of her mother.

The results suggest that having more than two children has an adverse effect on some education and labor market indicators but not in all of them, as usually suggested by the theoretic models. Expected reductions of 18% and 23.4% on education investment and literacy at early ages, respectively, are identified, but there is no evidence supporting a negative impact on school attendance in general and on children's performance at school in terms of years of education and probability of being behind her cohort average years of education. The estimates support a positive effect on child labor for rural households but a negative one for urban ones, which defies the prediction of the theoretical approaches and shed lights around the rural urban gaps that persist in Latin America. Remarkable differentiated effects were identified on the family size effect on mothers' labor market participation depending on her household's leader condition, an approach that departs from the broadly implemented married vs. all analysis.

The relevance of the instrument was confirmed in the first stages and formally tested with favorable results by using the Stock and Yogo (2001) approach, which is based on the inference distortions that arises as a consequence of the weak instrument problem and raises the probability of committing type I error.

Finally, the presence of endogeneity was tested and probed in most cases, especially in those where I found the most interesting results, by implementing a Hausman's test for each regression, with the objective of weighting the need for an instrumental variables procedure given the actual costs associated in terms of efficiency loss of the estimates against the OLS approach.

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