Analítika

Impact of Fertility on Female Labor Supply

Andrea Molina Vera

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Abstract

This paper studies the effect of fertility on Ecuadorian female labor participation. It uses, as source of exogenous variability in family size, the instrument introduced by Angrist and Evans in 1998 for the United States: parental preferences for a mixed sibling-sex composition on their children. The empirical application shows that women with two boys or two girls are 4 percentage points more likely to have a third child than women with one boy and one girl (for both samples: all and married women). 2SLS estimations show that a third child causes a negative impact of 9 percentage points on female labor supply in all work definitions for married women, meanwhile for all women, there is a negative impact of 8 percentage points in "work outside home" and "paid work outside home" as measures of labor supply. On the other hand, OLS estimates are significant and negative for all definitions of work and for both samples.

1   Introducción

For the U.S., Angrist and Evans found that fertility has a negative impact of about 12 percentage points on female labor supply (Angrist and Evans (1998)). Likewise, in Ecuador there seems to be a negative relationship between fertility and female labor supply, arising the question: can the U.S. results be extrapolated to Latin American developing countries as Ecuador?

The differences of labor markets and family contexts between U.S. and Ecuador motivates this question. Also, it is important to take into account some differences that developing countries have in comparison to the developed ones: high levels of underemployment and informal economy, high heterogeneity in work arrangements (Delpiano (2012)), higher fertility, lower levels of female education and fewer facilities for formal childcare (Cruces and Galiani (2007)).

Also, in empirical works, the problem of endogeneity between fertility and labor market outcomes is widely known. Angrist and Evans (1998) mention that this problem arises

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since there are strong theoretical reasons to believe that fertility and labor supply are jointly determined. Aguero and Marks (2008) acknowledge the possibility of endogeneity for omitted variable bias which influences fertility and labor force participation simultaneously (e.g. ambition or talent). Thus, several studies have exploited exogenous changes in family size to identify the causal relationship between the number of children and female labor supply. Some examples include twins at first birth (Rosenzweig and Wolpin (1980); Bronars and Grogger (1994)) and sex of the two first children (Angrist and Evans (1998)). Most of these approaches show a reduced but still significant effect of children on female labor supply.

In Latin America there are few studies which address the endogeneity of fertility decisions and provide evidence for developing countries. Among those studies are: Cruces and Galiani (2007), Aguero and Marks (2008) and Delpiano (2012). Cruces and Galiani study the effect of fertility on maternal labor supply in Argentina and Mexico, exploiting the source of exogenous variability in family size introduced by Angrist and Evans, finding that the U.S. results can be generalized both qualitatively and quantitatively to Argentina and Mexico. Agüero and Marks using a subsample of Latin American countries and introducing female infertility as a source of variation in family size, do not find a significant relationship between fertility and mothers' employment. Finally, Cáceres Delpiano studies the impact of fertility on mothers' employment for a sample of developing countries using fertility shock (multiple births) and founds that children have a negative impact on female employment but with different impacts depending on the order that child of different sex are born.

All these results seem contradictory, while Cruces and Galiani (2007), and Delpiano (2012) show that children have a negative impact on female employment, Aguero and Marks (2008) do not find a significant impact. One reason for this is that the local result depends on the instrument used and the compliers are different for the three researches.

The present study highlights some fundamental aspects. The first one is the definition of women's employment. Delpiano (2012) underlines this issue since in developing countries labor markets have higher levels of informality and heterogeneous payment alternatives. I contribute to the discussion by presenting the impact of fertility on the following definitions of employment: a) overall labor participation (paid or unpaid), b) paid work (inside or outside the home), c) work outside the home (paid or unpaid) and d) work outside the home and paid. These definitions pretend to capture location and compensation issues. The second aspect highlighted is the exploration of the external validity of results (Angrist (2004)).

Thus, I find that using Angrist and Evans' instrument, the OLS and IV estimations are significant and negative for married women in all employment definitions used (between 8-9 percentage points). However, for all women the significance of the effect on labor supply depends on the definition of employment: there is a negative impact for "work outside the home" and "paid work outside the home" definitions (8 percentage points). These results are confirmed using boys and girls as instrument and using the number of children as a fertility measure.

The paper has the following structure: Section 2 presents the identification strategy and

the theoretical model. Section 3 presents the data, summary statistics and the construction of the instrumental variable. Section 4 presents the main impacts of fertility on labor supply. Section 5 presents exclusion restrictions related to the instruments used in this study. Finally, section 6 presents the conclusions.

2   Identification Strategy and Theoretical Model

2.1   Identification Strategy

As Rosenzweig and Wolpin (2000) indicate, impact of fertility on the participation of married women in the labor force was investigated first in the United States. Taking into account that fertility and participation on labor force are endogenous, some identification strategies were the use of twins on the first birth (Rosenzweig and Wolpin (1980); Bronars and Grogger (1994)) and the Angrist and Evans' natural instrument (1998) of the sex of the first two births, specifically sex-sameness. Some recent strategies involve infertility shocks (Aguero and Marks (2008)), exploit the multiple births in higher parities (Delpiano (2012)) or research about a particular sample (Cristia (2008)).

This paper employs the Angrist and Evans' instrument which "exploits the parental preferences for a mixed sibling-sex composition that can be thought as randomly assigned. Then, a dummy variable that indicates whether the sex of the second child matches the sex of the first one provides a plausible instrument for further childbearing among women with at least two children" (Angrist and Evans (1998):451).

This instrument must meet two conditions to be valid:

- It must be relevant. It must be found that parents whom their first two children have the same sex are more likely to have an additional child compared to those who their first two children have different sex (with the sex-sameness instrument).

- I must accomplish the exclusion restriction. It must be confirmed that to have a children of the same sex in the first two births does not directly affect the subsequent labor supply of either parent except through its effect on having an additional birth. This seems plausible since parents cannot control or manipulate their children's sex.

With this in mind, the following regression models is proposed:

$$Y_i = \alpha + w'\delta + \beta x_i + \epsilon_i \tag{1}$$

Where:

Y_i is a measure of labor supply, w' is a covariates vector: age of women, age at first birth, indicators for the sex of first and second child, dummies by indigenous and urban status.

x_i is the endogenous fertility measure of interest. In this case it is the third child variable or number of children variable. It is replaced in (1) by the predicted value of the following regression to obtain 2SLS estimates.

$$x_i = \rho + w'\lambda + \gamma(Samesex) + \eta_i \tag{2}$$

Where *Samesex* is a dummy for whether the sex of the second child matches the sex of the first child.

2.2   Theoretical Model

In a simple static model, women or families choose the levels of consumption (C), time of leisure t_l and number of children (N) that solves the maximization of a utility function[2] $U = u(C, t_l, N)$

$$U = u(C, t_l, N) \tag{3}$$

Equation 3 is subject to following time and money constraints:

$$T = t_m + t_h + t_l \tag{4}$$

$$I + wt_m = p_c C + p_n n \tag{5}$$

Where: the time restriction has a total time(T) distributable for market (t_m), work at home (including housework and childcare(t_h)) and leisure (t_l); the money restriction has a non-labor income(I), hour-paid wage (w), price of goods (p_c) and cost of child rearing (p_n). Here the female labor supply (L) is a function of number of children (N) and other variables (Y) *vector*, namely $L = f(Y, N)$.

The effect of interest is the labor supply response to changes in fertility. But as fertility can be correlated with omitted variables related with labor supply (as professional ambition, etc.), to identify the direct effect of fertility is necessary to use an instrument (Z) that takes into account the exogenous variation of fertility but is not related with labor supply. Thus, the effect of interest can be identified as follows:

$$\partial L/\partial Z = f_y \partial Y/\partial Z + f_N \partial N/\partial Z \tag{6}$$

Since Z is exogenous with respect to Y, then $\partial/\partial Z = 0$. Therefore, the response of labor supply to changes in fertility is identified as:

$$f_N = (\partial L/\partial Z)/(\partial N/\partial Z) \tag{7}$$

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[2]This Utility is increasing in all this arguments

3 Data, Summary Statistics and Variables

This research uses data on labor supply, fertility and characteristics of household members from the Ecuadorian Population Census of 2010 conducted by the National Institute of Statistics and Census (Instituto Nacional de Estadísticas y Censos INEC).

The main motivation of this paper can be seen in Figure 1,where fertility (measured as percentage of women with more than two children) and female labor supply move in opposite directions. Within the group of women aged from 21 to 35 years old and with two or more children, labor supply has increased by 13 percentage points (i.e. variation of 50% in paid work) while the percentage of women in the group with more than two children decreased by 14 percentage points (variation of 21%), all from 1990 to 2010.

Table 1 presents some labor force participation rates and probabilities of additional children for women of different ages and different marital status for 1990, 2001 and 2010 Censuses.

For the sex-mix instrument, the sample is limited to women between 21 and 35 years old with at least two children and whose oldest child was, at most, 18 years old at the moment of the census[3]. Following Angrist and Evans (1998), in order to match women with their own children, the sample used is conformed by females who are "heads" or "spouses" in each household, then the reported number of children alive is checked to coincide with the number of children in the household matched to the women, restraining the sample to women for whom both numbers were the same.

This is performed for two samples: all women and those married at the time of the census 455.125 observations for the first one and 404.795 observations for the last. Table 2 shows some descriptive statistics and variable definitions for covariates, instruments and dependent variables.

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[3]As Angrist and Evans argue census does not track children across households; therefore, the sample is limited to mothers aged 21-35 whose oldest child was less than 18 years of age at the moment of the census.

Table 1: Fertility and Labor Supply Measures in Ecuador.

Fertility and Labor-Supply Measures	1990 Census	2001 Census	2010 Census
Women aged 21-35			
Mean children ever born	2.8	2.45	2.17
Percent with 2 or more children	74.1	68.61	65.12
Percent work	32.9	40.77	44.91
Percent paid work	29.6	35.1	44.17
Percent work outside the home			37.93
Percent paid employment outside the home			37.55
Observations	744321	898771	1072870
Women aged 36-50			
Mean children ever born	5.19	4.08	3.38
Percent with 2 or more children	90.28	87.85	85.79
Percent work	36.07	45.71	52.15
Percent paid work	32.38	39.77	51.43
Percent work outside the home			42.21
Percent paid employment outside the home			41.89
Observations	580660	832587	1052847
Women aged 21-35 with 2 or more children			
Mean children ever born	3.55	3.13	2.94
Percent with 2 or more children	66.28	57.87	52.17
Percent work	29.61	36.77	40.28
Percent paid work	26.28	31.19	39.53
Percent work outside the home			32.64
Percent paid employment outside the home			32.28
Observations	551520	616683	698674
Married women aged 21-35 with 2 or more children			
Mean children ever born	3.55	3.13	2.94
Percent with 2 or more children	66.42	57.92	52.14
Percent work	27.84	34.47	36.85
Percent paid work	24.5	28.97	36.15
Percent work outside the home			29.22
Percent paid employment outside the home			28.9
Observations	520635	568594	617362

Note: 1990 and 2001 census did not asked about work inside or outside from home. The married samples include women married or "common law marriage" at the time of the Census.

The variable used as a measure of fertility is the indicator of more than two children. The first instrumental variable for fertility is the indicator Same sex. Other possible instruments are Two boys and Two girls.

The labor supply variables are:

- Work: equals 1 when a mother worked at least one hour last week. This includes those mothers who: a) worked at least one hour prior to the census week, b) did not work but had a work for which she was absent, c) created a product or provided a service for one hour at least, d) helped in some business or work in the family for one hour at least or e) performed agriculture for one hour at least.

- Paid work: equals to 1 when the mother worked for pay and is not a family worker without remuneration. It includes: employees (private or public), self-employed, owners and managers (employers, partner), laborers or peons and domestic servants.

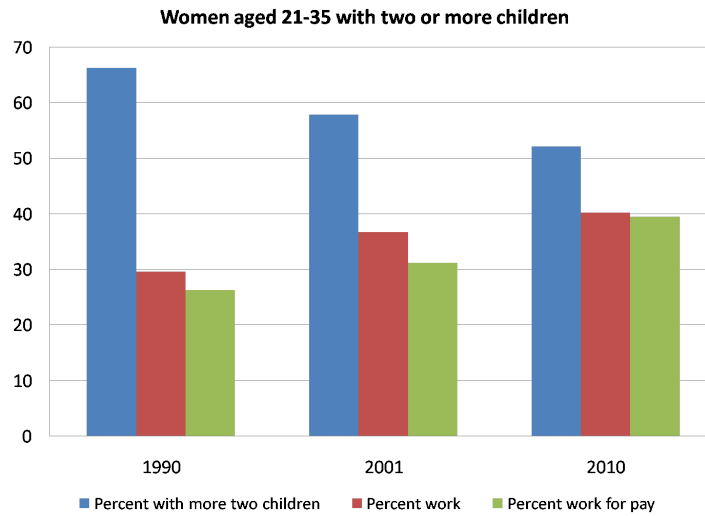- Worked away from home: equals 1 when the mother's job is out of home.

Women aged 21-35 with two or more children

■ Percent with more two children ■ Percent work ■ Percent work for pay

Figure 1: Ecuadorian Fertility and Female Labor Supply. Census 1990-2001-2010

Table 2: Descriptive Statistics.Women aged 21-35 with 2 or more children. 2010 Census data

Variables	All Women	Married
Children ever born	2.731	2.739
	(0.967)	(0.974)
More than 2 children	0.481	0.484
	(0.5)	(0.5)
Boy first	0.512	0.513
(=1 if first child was a boy)	(0.5)	(0.5)
Boy second	0.509	0.509
(=1 if second child was a boy)	(0.5)	(0.5)
Two boys	0.263	0.263
(=1 if first two children were boys)	(0.44)	(0.44)
Two girls	0.242	0.241
(=1 if first two children were girls)	(0.429)	(0.428)
Same sex	0.505	0.505
(=1 if first two children were the same sex)	(0.5)	(0.5)
Age	29.477	29.42
	(3.786)	(3.8)
Age at first birth	19.327	19.378
	(3.08)	(3.101)
Schooling	8.855	8.85
	(4.36)	(4.37)
Work	0.411	0.378
(=1 if worked at least an hour in last week to census)	(0.492)	(0.485)
Paid work	0.403	0.371
(=1 if worked for pay in last week to census)	(0.491)	(0.483)
Worked outside the home	0.333	0.300
(=1 if worked outside the home)	(0.471)	(0.458)
Paid employment outside the home	0.329	0.297
(=1 if worked for pay and outside the home)	(0.47)	(0.457)
Number of observations	455125	404795

Note: The samples include women aged 21-35 with two or more children except for women whose second child is less than a year old. Standard deviations in parentheses

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- Worked for pay outside the home: equals 1 when the mother's job is paid and outside the home.

The dimensions that can be explored with these definitions are: location of job in relation to home, remuneration and labor participation.

4 Main Results

Following Angrist and Evans, table 3 shows estimates of the impact of child sex and sexmix on fertility, where 48.9% of all women have one girl and 51.1% have one boy at the first birth. The fraction of women with at least one child and who had a second child, conditional on the sex of the first child is 67% in both cases. This presents evidence that there is no impact of the sex of the firstborn on fertility. It is important to mention that, in married women, there are differences conditionals on the sex of the first child but this difference disappears when including controls in the regression at the first stage.

For the second analysis, table 3 presents the fraction of women who have a third child conditional on the sex composition of the first two children, where 46.4% of women with one boy and one girl have a third child, compared to 49.9% for women with two girls or two boys. That is a significant difference of 3.6 percentage points. These results are confirmed in table 4 which shows the first stage of the instrument for all and for married women, including controls, and results for the other possible instrument (two boys and two girls). The difference of 3.6 and 3.8 percentage points for all and for married women found here means that Ecuadorian women with two children of the same sex are 3.6 and 3.8 percentage points more likely to have a third child than mothers of one boy and one girl. For the United States in 1980 this difference was 6 percentage points for all women (Angrist and Evans). Cruces and Galiani found a difference of 3.5 and 3.2 percentage points (subsample of all women) for Argentina and Mexico, respectively. On the other hand, the instrument of two boys and two girls is also significant for explaining fertility.

To check a random assignment of Same-sex instrument, table 5 compares demographic characteristics of the mother among those who had a composition of same-sex (treated group) and mixed-sex (control) sibling compositions. This table includes the following variables: age of woman, age at first birth, indigenous ethnicity, years of education and residence area. None of these variables presents significant difference

For 2SLS estimates the control variables are: age of women, age at first birth, a dummy variable to indicate the sex of first and second children, a dummy variable for ethnic identification and a dummy for urban area. For the cases of two boys and two girls as instrument, the covariates exclude the sex of the second children. Table 6 shows that OLS estimates present a negative and significant impact for all measurements of work and all groups of women. The 2SLS estimates indicate there is an impact on labor supply when moving from 2 to 3 children for all women grouped in two work measurements (working outside from home and

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paid work outside home) with a negative impact of 8 percentage points. Finally, for married women there is a negative impact of 8 to 9 percentage points in all work measurement[4].

Table 3: Fraction of families that had another child

	All women		Married Women	
Sex of first child in women with one or more children				
	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child
(a) one girl	0.489	0.674	0.488	0.685
		[0.0008]		[0.00087]
(b) one boy	0.511	0.676	0.512	0.688
		[0.00079]		[0.00084]
difference (b)-(a)		0.0018		0.0025
		[0.001141]		[0.0012]
Sex of first two children in women with two or more children				
	All women		Married Women	
	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child
two girls	0.242	0.502	0.242	0.506
		[0.0015]		[0.0016]
two boys	0.263	0.497	0.263	0.4999
		[0.00144]		[0.0015]
(a) one boy, one girl	0.495	0.464	0.496	0.466
		[0.00105]		[0.0011]
(b) both same sex	0.505	0.499	0.504	0.503
		[0.00104]		[0.0011]
difference (b)-(a)		0.036		0.037
		[0.0015]		[0.00157]

Note: 2010 Census data (Census-INEC). The samples are the same as in Table 2. Standard errors in brackets.

Table 4: First Stage: Fertility measure is third child variable

	All Women		Married Women	
	(1)	(2)	(1)	(2)
same_sex	0.0365		0.0382	
	[0.0014]***		[0.0014]***	
two_boys		0.0331		0.0347
		[0.0019]***		[0.0020]***
two_girls		0.0401		0.0417
		[0.0020]***		[0.0021]***
R^2	0.14	0.14	0.15	0.15
N	455125	455125	404795	404795

Note: 2010 Census data (Census-INEC). * p<0.1; ** p<0.05; *** p<0.01 Robust standard errors in brackets. Covariates: age of women, age at first birth, indicators for Boy 1st, Boy 2nd and dummies by indigenous and urban status. The variable Boy 2nd is excluded from columns (2).

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[4]The results considering the number of children as a measure of fertility, also show a reduction in labor supply. These results are available if required

Table 5: Random assignment of the same sex

	By Same Sex				
Variable	Controls	sd	Treated	Sd	p-valu
Age	29.482	(3.785)	29.471	(3.788)	[0.320]
Age at first birth	19.321	(3.079)	19.321	(3.081)	[0.927]
Indigenous	0.081	(0.274)	0.08	(0.272)	[0.191]
Urban area	0.608	(0.488)	0.609	(0.488)	[0.687]
Years of education	8.853	(4.365)	8.857	(4.358)	[0.832]
N	225180		229945		

Note: Data source: 2010 Census. The sample is all women. Standard errors are reported in parentheses.

It is important to mention that work measurement are relevant in the sample of all women since there is an impact only when the definition of work involves characteristics incompatible with child rearing. On the other hand, for married women there is an impact using all measurement of work. Perhaps this happens since married women are supported with their spouses' revenues.

Table 6: OLS and 2SLS. Estimates of Labor-Supply Models Using 2010 Census Data

	All Women			All Women		
	OLS	2SLS (1)	2SLS (2)	OLS	2SLS (1)	2SLS (2)
Instrument for More than 2 children		Same sex	Twoboys, Twogirls		Same sex	Twoboys, Twogirls
Dependent Variable						
Work	-0.1120	-0.0569	-0.0527	-0.1078	-0.0800	-0.0788
	[0.0015]***	[0.0393]	[0.0392]	[0.0016]***	[0.0391]**	[0.0391]**
Work for pay	-0.1118	-0.0599	-0.0549	-0.1076	-0.0834	-0.0809
	[0.0015]*** [	[0.0392]	[0.0391]	[0.0016]***	[0.0390]**	[0.0389]**
Work outside home	-0.1084	-0.0847	-0.0815	-0.1036	-0.0934	-0.0921
	[0.0015]***	[0.0378]**	[0.0377]**	[0.0015]***	[0.0372]**	[0.0371]**
Paid Work outside the home	-0.1080	-0.0893	-0.0860	-0.1031	-0.0988	-0.0974
	[0.0015]***	[0.0376]**	[0.0375]**	[0.0015]***	[0.0370]***	[0.0369]***

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Robust standard errors in brackets. Covariates: age of women, age at first birth, indicators for Boy 1st, Boy 2nd and dummies by indigenous and urban status. In (2) the variable Boy 2nd is excluded.

Also, the OLS estimates and 2SLS are similar for married women but for all women depend on the definition of work. The results are confirmed by the two boys and two girls' instrument.

These results are local for the compliers, that is, for women whose fertility decision is changed for the instrument, which is used for identifying the impact of labor supply when children move from 2 to 3, but don't identify other increases in fertility as 0 to 1 child[5].

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[5]With the 2001 Census, the first stage is similar to 2010 for both samples. The 2SLS estimates present

Table 7: Exclusion restriction: Women aged 21-35 with two children

| Expenditure | All women | | | | |
	Controls	sd	Treated	sd	p-value
Per-Child Clothing and shoes expenditure	35.57	(35.663)	36.63	(35.798)	[0.408]
Per-Child clothing expenditure	25.68	(27.476)	26.29	(26.986)	[0.534]
Per-Child shoes expenditure	10.41	(10.287)	10.84	(10.943)	[0.268]
Per-Child spending on clothing children 3 to 12 years	8.26	(9.887)	8.29	(9.432)	[0.930]
Per-Child spending on shoes children 3 to 12 years	4.06	(4.006)	4.08	(3.976)	[0.908]
N	1648		1506		

Note: National Household Survey of Income and Expenditure 2011-2012 INEC. Treated group is samesex equals 1 and control group is same sex equals 0.

5   Exclusion restriction

One concern in relation to the instrument applied in this paper is raised by Rosenzweig and Wolpin (2000), who say that the same sex instrument can affect labor supply through economies of scale, and thereby reducing the cost of childcare. To evaluate this, I used data from the Ecuadorian survey of income and expenses and I found that expenses that may involve some form of economies of scale do not have difference between households with two children of the same sex compared to households with two children of different sexes (Table 7).

6   Conclusions

The OLS estimates indicate that women with more than two children are 8 and 9 percentage points less likely to work than women with two children for the sample of all women and married women, respectively.

To estimate the causal effect of fertility on female labor supply I use sex composition of first two children as instrumental variable. The first stage shows that families with two boys or two girls are 3.6 and 3.8 percentage points more likely to have a third child than families with one boy and one girl, for the sample of all and married women respectively.

The 2SLS results show a causal impact 8 and 9 percentage points of decrease of female labor supply by having a third child in all and married women respectively.

Two aspects are important here: first, the results apply for the "compliers". This means that the result is local (Local Average Treatment Effect-LATE), that is, for women who changed their fertility decision due to the instrument. Second, these results refer for moving

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a negative and significant impact (at 10% of confidence level) of about 7 percentage points on the outcome "paid work" and don't present impact on the "work" for both samples (Annex 1).

from 2 to 3 children but do not refer to other increases in fertility as in going from 0 to 1 child.

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Annex: 2001 Census Data

First Stage: Fertility measure is third child variable

	All Women		Married Women	
	(1)	(2)	(1)	(2)
same_sex	0.0375		0.0380	
	[0.0015]***		[0.0016]***	
two_boys		0.0355		0.0362
		[0.0022]***		[0.0022]***
two_girls		0.0395		0.0399
		[0.0022]***		[0.0023]***
R^2	0.16	0.16	0.17	0.17
N	354272	354272	329712	329712

Note: * p<0.1; ** p<0.05; *** p<0.01. Robust standard errors in brackets. Covariates: age of women, age at first birth, indicators for Boy 1st, Boy 2nd and dummies by indigenous and urban status. In (2) the variable Boy 2nd is excluded.

OLS and 2SLS. Estimates of Labor-Supply Models Using 2001 Census Data

	All Women			Married Women		
	OLS	OLS	2SLS	OLS	2SLS	2SLS
		(1)	(2)		(1)	(2)
Instrument for		Same sex	Twoboys,		Same sex	Twoboys,
More than 2 children			Twogirls			Twogirls
Dependent Variable						
Work	-0.0901	-0.0504	-0.0491	-0.0830	-0.0448	-0.0438
	[0.0018]***	[0.0430]	[0.0430]	[0.0018]***	[0.0433]	[0.0433]
Paid work	-0.0882	-0.0710	-0.0702	-0.0819	-0.0685	-0.0676
	[0.0017]***	[0.0408]*	[0.0408]*	[0.0017]***	[0.0410]*	[0.0410]*

Note: * p<0.1; ** p<0.05; *** p<0.01. Robust standard errors in brackets. Covariates: age of women, age at first birth, indicators for Boy 1st, Boy 2nd and dummies by indigenous and urban status. In (2) the variable Boy 2nd is excluded.