Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size

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- Most studies find a negative *correlation* between fertility and female labor supply.
- It is difficult to show the *causality* from fertility to labor supply.
- Use sibling sex mix as the instrumental variable (IV).

Data

- (1970,) 1980, 1990 Census Public Use Micro Samples (PUMS).
  Data source: IPUMS-USA, 1850-2000, (Integrated Public Use Microdata Series), http://www.ipums.umn.edu
- Women aged 21-35 to get information about all the children.
- Women who have 2 or more children.
- Twins-2, second birth was a twin.

TABLE 1—FERTILITY AND LABOR-SUPPLY MEASURES

Sample	1970 PUMS	1980 PUMS	1990 PUMS
Women aged 21–35			
Mean children ever born	1.78	1.27	1.18
Percent with 2 or more children	52.10	40.40	37.60
Percent worked last year	60.00	73.40	79.30
Observations	203,918	1,326,631	1,478,546
Women aged 36–50			
Mean children ever born	2.85	2.86	2.15
Percent with 2 or more children	73.40	78.50	68.90
Percent worked last year	57.30	66.70	78.50
Observations	181,502	852,204	1,253,095
Women aged 21–35 with 2 or more children			
Mean children ever born	3.06	2.61	2.57
Percent with more than 2 children	55.60	39.90	39.10
Percent worked last year	44.80	58.00	66.60
Observations	106,239	535,587	577,397
Married women aged 21–35 with 2 or more children			
Mean children ever born	3.02	2.58	2.53
Percent with more than 2 children	54.90	39.00	37.50
Percent worked last year	41.80	55.80	67.50
Observations	91,286	436,483	439,408

Notes: The 1970 PUMS data are from the 1/100 state file. The 1980 and 1990 data are from the 5-percent PUMS. Calculations from the 1990 PUMS use sample weights. The married samples include women married at the time of the Census.

TABLE 2—DESCRIPTIVE STATISTICS, WOMEN AGED 21–35 WITH 2 OR MORE CHILDREN

	Means and (standard deviations)					
	1980 PUMS			1990 PUMS		
	All	Married couples		All	Married couples	
Variable	women	Wives	Husbands	women	Wives	Husbands
Children ever born	2.55 (0.81)	2.51 (0.77)	—	2.50 (0.76)	2.48 (0.74)	—
More than 2 children (=1 if mother had more than 2 children, =0 otherwise)	0.402 (0.490)	0.381 (0.486)	—	0.375 (0.484)	0.367 (0.482)	—
Boy 1st (s_1) (=1 if first child was a boy)	0.511 (0.500)	0.514 (0.500)	—	0.512 (0.500)	0.514 (0.500)	—
Boy 2nd (s_2) (=1 if second child was a boy)	0.511 (0.500)	0.513 (0.500)	—	0.511 (0.500)	0.512 (0.500)	—
Two boys (=1 if first two children were boys)	0.264 (0.441)	0.266 (0.442)	—	0.264 (0.441)	0.265 (0.441)	—
Two girls (=1 if first two children were girls)	0.242 (0.428)	0.239 (0.427)	—	0.241 (0.428)	0.239 (0.426)	—
Same sex (=1 if first two children were the same sex)	0.506 (0.500)	0.506 (0.500)	—	0.505 (0.500)	0.503 (0.500)	—
Twins-2 (=1 if second birth was a twin)	0.0085 (0.0920)	0.0083 (0.0908)	—	0.012 (0.108)	0.011 (0.105)	—
Age	30.1 (3.5)	30.4 (3.4)	33.0 (4.6)	30.4 (3.5)	30.7 (3.3)	33.4 (4.8)
Age at first birth (parent's age in years when first child was born)	20.1 (2.9)	20.8 (2.9)	24.0 (4.0)	21.8 (3.5)	22.4 (3.5)	25.1 (4.7)
Worked for pay (=1 if worked for pay in year prior to census)	0.565 (0.496)	0.528 (0.499)	0.977 (0.150)	0.662 (0.473)	0.667 (0.471)	0.968 (0.175)
Weeks worked (weeks worked in year prior to census)	20.8 (22.3)	19.0 (21.9)	48.0 (10.5)	26.2 (22.9)	26.4 (22.9)	47.1 (12.0)
Hours/week (average hours worked per week)	18.8 (18.9)	16.7 (18.3)	43.5 (12.3)	22.5 (19.1)	22.2 (18.9)	44.0 (13.3)
Labor income (labor earnings in year prior to census, in 1995 dollars)	7,160 (10,804)	6,250 (10,211)	38,919 (25,014)	9,550 (13,071)	9,616 (13,238)	36,623 (30,283)
Family income (family income in year prior to census, in 1995 dollars)	42,342 (26,563)	47,646 (25,821)	—	42,558 (34,692)	49,196 (34,740)	—
Non-wife income (family income minus wife's labor income, in 1995 dollars)	—	41,635 (24,734)	—	—	39,580 (31,892)	—
Number of observations	394,835	254,654	254,654	380,007	301,588	301,588

Notes: The samples include women aged 21–35 with two or more children except for women whose second child is less than a year old. In the 1980 PUMS, the married women sample refers to women who were married at the time of their first birth, married at the time of the survey, and married once. In the 1990 PUMS, the married women are those married at the time of the Census.

TABLE 3—FRACTION OF FAMILIES THAT HAD ANOTHER CHILD BY PARITY AND SEX OF CHILDREN

Sex of first child in families with one or more children	All women				Married women			
	1980 PUMS (649,887 observations)		1990 PUMS (627,362 observations)		1980 PUMS (410,333 observations)		1990 PUMS (477,798 observations)	
	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child
(1) one girl	0.488	0.694 (0.001)	0.489	0.665 (0.001)	0.485	0.720 (0.001)	0.487	0.698 (0.001)
(2) one boy	0.512	0.694 (0.001)	0.511	0.667 (0.001)	0.515	0.720 (0.001)	0.513	0.699 (0.001)
difference (2) − (1)	—	0.000 (0.001)	—	0.002 (0.001)	—	0.000 (0.001)	—	0.001 (0.001)
Sex of first two children in families with two or more children	All women				Married women			
	1980 PUMS (394,835 observations)		1990 PUMS (380,007 observations)		1980 PUMS (254,654 observations)		1990 PUMS (301,588 observations)	
	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child
one boy, one girl	0.494	0.372 (0.001)	0.495	0.344 (0.001)	0.494	0.346 (0.001)	0.497	0.331 (0.001)
two girls	0.242	0.441 (0.002)	0.241	0.412 (0.002)	0.239	0.425 (0.002)	0.239	0.408 (0.002)
two boys	0.264	0.423 (0.002)	0.264	0.401 (0.002)	0.266	0.404 (0.002)	0.264	0.396 (0.002)
(1) one boy, one girl	0.494	0.372 (0.001)	0.495	0.344 (0.001)	0.494	0.346 (0.001)	0.497	0.331 (0.001)
(2) both same sex	0.506	0.432 (0.001)	0.505	0.407 (0.001)	0.506	0.414 (0.001)	0.503	0.401 (0.001)
difference (2) − (1)	—	0.060 (0.002)	—	0.063 (0.002)	—	0.068 (0.002)	—	0.070 (0.002)

Notes: The samples are the same as in Table 2. Standard errors are reported in parentheses.

TABLE 4—DIFFERENCES IN MEANS FOR DEMOGRAPHIC VARIABLES BY *SAME SEX* AND *TWINS-2*

	Difference in means (standard error)		
	By *Same sex*		By *Twins-2*
Variable	1980 PUMS	1990 PUMS	1980 PUMS
Age	−0.0147 (0.0112)	0.0174 (0.0112)	0.2505 (0.0607)
Age at first birth	0.0162 (0.0094)	−0.0074 (0.0114)	0.2233 (0.0510)
Black	0.0003 (0.0010)	0.0021 (0.0011)	0.0300 (0.0056)
White	0.0003 (0.0012)	−0.0006 (0.0013)	−0.0210 (0.0066)
Other race	−0.0006 (0.0005)	−0.0014 (0.0009)	−0.0090 (0.0041)
Hispanic	−0.0014 (0.0009)	−0.0007 (0.0010)	−0.0069 (0.0047)
Years of education	−0.0028 (0.0076)	0.0100 (0.0074)	0.0940 (0.0415)

Notes: The samples are the same as in Table 2. Standard errors are reported in parentheses.

Wald Estimate

Consider the bivariate regression model

$$y_i = \alpha + \beta x_i + \epsilon_i$$

Let z_i denote the binary instrument, $Same\ sex$, then IV estimator of β in this equation is

$$\hat{\beta}_{IV} = \frac{\bar{y}_1 - \bar{y}_0}{\bar{x}_1 - \bar{x}_0}$$

where $\bar{y}_1$ is the mean of y_i for those observations with $z_i = 1$, and other terms are similarly defined.

Derivation of $\hat{\beta}_{IV}$, $\hat{\beta}_{IV} = \frac{s_{yz}}{s_{xz}}$

Suppose there are n observations, n_1 of them with $z_i = 1$, n_0 of them with $z_i = 0$, $n_1 + n_0 = n$, then

$$
\begin{aligned}
s_{yz} &= \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \bar{y})(z_i - \bar{z}),\ \bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i \\
&= \frac{1}{n-1}\sum_{i=1}^{n} y_i z_i - n\bar{y}\bar{z} \\
&= \frac{1}{n-1}\left(n_1\bar{y}_1 - n\frac{n_1\bar{y}_1 + n_0\bar{y}_0}{n}\frac{n_1}{n}\right) \\
&= \frac{1}{n(n-1)}\left((n_0 + n_1)n_1\bar{y}_1 - (n_1\bar{y}_1 + n_0\bar{y}_0)n_1\right)
\end{aligned}
$$

Therefore,

$$
\begin{aligned}
s_{yz} &= \frac{n_0 n_1}{n(n-1)}(\bar{y}_1 - \bar{y}_0) \\
s_{xz} &= \frac{n_0 n_1}{n(n-1)}(\bar{x}_1 - \bar{x}_0) \\
\hat{\beta}_{IV} &= \frac{\bar{y}_1 - \bar{y}_0}{\bar{x}_1 - \bar{x}_0}
\end{aligned}
$$

- z_i: instruments, $Same\ sex$, $twins - 2$.
- x_i: fertility, *More than 2 children*, *Numeber of children*.
- y_i: labor supply, *Work for pay*, *Weeks worked*, *Hours/week*, *Labor income*, ln(*Family income*).
- Results shown in Table 5.

TABLE 5—WALD ESTIMATES OF LABOR-SUPPLY MODELS

	1980 PUMS			1990 PUMS			1980 PUMS		
		Wald estimate using as covariate:			Wald estimate using as covariate:			Wald estimate using as covariate:	
Variable	Mean difference by *Same sex*	*More than 2 children*	*Number of children*	Mean difference by *Same sex*	*More than 2 children*	*Number of children*	Mean difference by *Twins-2*	*More than 2 children*	*Number of children*
More than 2 children	0.0600 (0.0016)	—	—	0.0628 (0.0016)	—	—	0.6031 (0.0084)	—	—
Number of children	0.0765 (0.0026)	—	—	0.0836 (0.0025)	—	—	0.8094 (0.0139)	—	—
Worked for pay	−0.0080 (0.0016)	−0.133 (0.026)	−0.104 (0.021)	−0.0053 (0.0015)	−0.084 (0.024)	−0.063 (0.018)	−0.0459 (0.0086)	−0.076 (0.014)	−0.057 (0.011)
Weeks worked	−0.3826 (0.0709)	−6.38 (1.17)	−5.00 (0.92)	−0.3233 (0.0743)	−5.15 (1.17)	−3.87 (0.88)	−1.982 (0.386)	−3.28 (0.63)	−2.45 (0.47)
Hours/week	−0.3110 (0.0602)	−5.18 (1.00)	−4.07 (0.78)	−0.2363 (0.0620)	−3.76 (0.98)	−2.83 (0.73)	−1.979 (0.327)	−3.28 (0.54)	−2.44 (0.40)
Labor income	−132.5 (34.4)	−2208.8 (569.2)	−1732.4 (446.3)	−119.4 (42.4)	−1901.4 (670.3)	−1428.0 (502.6)	−570.8 (186.9)	−946.4 (308.6)	−705.2 (229.8)
ln(*Family income*)	−0.0018 (0.0041)	−0.029 (0.068)	−0.023 (0.054)	−0.0085 (0.0047)	−0.136 (0.074)	−0.102 (0.056)	−0.0341 (0.0223)	−0.057 (0.037)	−0.042 (0.027)

Notes: The samples are the same as in Table 2. Standard errors are reported in parentheses.

TSLS Estimation

$$y_i = \alpha_o' w_i + \alpha_1 s_{1i} + \alpha_2 s_{2i} + \beta x_i + \epsilon_i$$

where w_i are a set of exogenous variables— mother's age, age at first birth, race and Hispanic indicaors, s_{1i} and s_{2i} are sex of the first and second child respectively.

Two sets of instruments are used.

- *Same sex.*
- *Two boys, Two girls.*

The first-stage results are in Table 6.

TABLE 6—OLS ESTIMATES OF *MORE THAN 2 CHILDREN* EQUATIONS

	All women			Married women		
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
1980 PUMS						
Boy 1st	—	−0.0080 (0.0015)	0.0001 (0.0021)	—	−0.0111 (0.0018)	−0.0016 (0.0026)
Boy 2nd	—	−0.0081 (0.0015)	—	—	−0.0095 (0.0018)	—
Same sex	0.0600 (0.0016)	0.0617 (0.0015)	—	0.0675 (0.0019)	0.0694 (0.0018)	—
Two boys	—	—	0.0536 (0.0021)	—	—	0.0598 (0.0026)
Two girls	—	—	0.0698 (0.0021)	—	—	0.0789 (0.0026)
With other covariates	no	yes	yes	no	yes	yes
R^2	0.004	0.084	0.084	0.005	0.078	0.078
1990 PUMS						
Boy 1st	—	−0.0081 (0.0015)	−0.0083 (0.0022)	—	−0.0097 (0.0017)	−0.0086 (0.0024)
Boy 2nd	—	0.0002 (0.0015)	—	—	−0.0011 (0.0017)	—
Same sex	0.0628 (0.0016)	(0.0623) (0.0015)	—	0.0702 (0.0018)	0.0703 (0.0017)	—
Two boys	—	—	0.0624 (0.0021)	—	—	0.0692 (0.0023)
Two girls	—	—	0.0621 (0.0022)	—	—	0.0714 (0.0024)
With other covariates	no	yes	yes	no	yes	yes
R^2	0.004	0.082	0.082	0.005	0.082	0.082

Notes: Other covariates in the models are indicators for *Age, Age at first birth, Black, Hispanic,* and *Other race.* The variable *Boy 2nd* is excluded from columns (3) and (6). Standard errors are reported in parentheses.

- Table 7 reports a set of OLS estimates and two sets of TSLS estimates using *Same sex* and the pair of dummies *Two boys* and *Two girls* as instruments for 1980.
- Results for 1990 are shown in Table 8.

TABLE 7—OLS AND 2SLS ESTIMATES OF LABOR-SUPPLY MODELS USING 1980 CENSUS DATA

	All women			Married women			Husbands of married women		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimation method	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
Instrument for *More than 2 children*	—	*Same sex*	*Two boys, Two girls*	—	*Same sex*	*Two boys, Two girls*	—	*Same sex*	*Two boys, Two girls*
Dependent variable:									
Worked for pay	−0.176	−0.120	−0.113	−0.167	−0.120	−0.113	−0.008	0.004	0.001
	(0.002)	(0.025)	(0.025)	(0.002)	(0.028)	(0.028)	(0.001)	(0.009)	(0.008)
			[0.013]			[0.013]			[0.013]
Weeks worked	−8.97	−5.66	−5.37	−8.05	−5.40	−5.16	−0.82	0.59	0.45
	(0.07)	(1.11)	(1.10)	(0.09)	(1.20)	(1.20)	(0.04)	(0.60)	(0.59)
			[0.017]			[0.071]			[0.030]
Hours/week	−6.66	−4.59	−4.37	−6.02	−4.83	−4.61	0.25	0.56	0.50
	(0.06)	(0.95)	(0.94)	(0.08)	(1.02)	(1.01)	(0.05)	(0.70)	(0.69)
			[0.030]			[0.049]			[0.71]
Labor income	−3768.2	−1960.5	−1870.4	−3165.7	−1344.8	−1321.2	−1505.5	−1248.1	−1382.3
	(35.4)	(541.5)	(538.5)	(42.0)	(569.2)	(565.9)	(103.5)	(1397.8)	(1388.9)
			[0.126]			[0.703]			(0.549)
ln(*Family income*)	−0.126	−0.038	−0.045	−0.132	−0.051	−0.053	—	—	—
	(0.004)	(0.064)	(0.064)	(0.004)	(0.056)	(0.056)			
			[0.319]			[0.743]			
ln(*Non-wife income*)	—	—	—	−0.053	0.023	0.016	—	—	—
				(0.005)	(0.066)	(0.066)			
						[0.297]			

Notes: The table reports estimates of the coefficient on the *More than 2 children* variable in equations (4) and (6) in the text. Other covariates in the models are *Age, Age at first birth,* plus indicators for *Boy 1st, Boy 2nd, Black, Hispanic,* and *Other race.* The variable *Boy 2nd* is excluded from equation (6). The *p*-value for the test of overidentifying restrictions associated with equation (6) is shown in brackets. Standard errors are reported in parentheses.

TABLE 8—OLS AND 2SLS ESTIMATES OF LABOR-SUPPLY MODELS USING 1990 CENSUS DATA

	All women			Married women			Husbands of married women		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimation method	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
Instrument for *More than 2 children*	—	*Same sex*	*Two boys, Two girls*	—	*Same sex*	*Two boys, Two girls*	—	*Same sex*	*Two boys, Two girls*
Dependent variable:									
Worked for pay	−0.155	−0.092	−0.092	−0.147	−0.104	−0.104	−0.102	0.017	0.017
	(0.002)	(0.024)	(0.024)	(0.002)	(0.024)	(0.024)	(0.001)	(0.009)	(0.009)
			[0.743]			[0.576]			[0.989]
Weeks worked	−8.71	−5.66	−5.64	−8.25	−5.76	−5.76	−1.03	1.01	1.01
	(0.08)	(1.16)	(1.16)	(0.09)	(1.15)	(1.15)	(0.05)	(0.63)	(0.63)
			[0.391]			[0.670]			[0.708]
Hours/week	−6.80	−4.08	−4.10	−6.39	−3.94	−3.95	−0.06	0.85	0.83
	(0.07)	(0.98)	(0.98)	(0.07)	(0.96)	(0.96)	(0.05)	(0.69)	(0.69)
			[0.489]			[0.665]			[0.180]
Labor income	−3984.4	−2099.6	−2096.2	−3753.9	−2457.5	−2456.3	929.7	1348.7	1354.8
	(44.2)	(664.0)	(663.8)	(50.7)	(669.7)	(669.7)	(114.9)	(1536.0)	(1535.9)
			[0.830]			[0.893]			[0.711]
ln(*Family income*)	−0.119	−0.124	−0.122	−0.103	−0.054	−0.054	—	—	—
	(0.005)	(0.071)	(0.071)	(0.004)	(0.051)	(0.051)			
			[0.270]			[0.878]			
ln(*Non-wife income*)	—	—	—	−0.004	0.020	0.020	—	—	—
				(0.005)	(0.068)	(0.068)			
						[0.452]			

Notes: The table reports the coefficient on the *More than 2 children* variable in equations (4) and (6) in the text estimated with 1990 Census data. Other covariates in the models are *Age, Age at first birth,* plus indicators for *Boy 1st, Boy 2nd, Black, Hispanic,* and *Other race.* The variable *Boy 2nd* is excluded from equation (6). The *p*-value for the test of overidentifying restrictions associated with equation (6) is shown in brackets. Standard errors are reported in parentheses.

- The effect of children on labor supply by *husband's earnings* and *wife's education*.
- Instrument used is *Same sex*.

TABLE 9—2SLS ESTIMATES OF LABOR-SUPPLY MODELS WITH INTERACTION TERMS USING 1980 CENSUS DATA

Sample/variables	*More than 2 children* First stage	*Worked for pay* Mean of dependent variable	*Worked for pay* OLS	*Worked for pay* 2SLS	*Weeks/year* Mean of dependent variable	*Weeks/year* OLS	*Weeks/year* 2SLS
A. Results for wives by *husband's earnings:*							
Bottom third of husband's earnings distribution	0.057 (0.003)	0.570	−0.186 (0.003)	−0.122 (0.060)	21.1	−9.23 (0.15)	−7.55 (2.60)
Middle third of husband's earnings distribution	0.072 (0.003)	0.569	−0.165 (0.004)	−0.185 (0.047)	20.8	−8.31 (0.15)	−7.11 (2.04)
Top third of husband's earnings distribution	0.079 (0.003)	0.448	−0.152 (0.003)	−0.078 (0.042)	15.2	−6.76 (0.15)	−3.17 (1.82)
B. Results for wives by *wife's education:*							
Wife < high-school graduate	0.071 (0.004)	0.468	−0.150 (0.005)	−0.121 (0.064)	16.1	−7.30 (0.20)	−7.12 (2.80)
Wife high-school graduate	0.073 (0.003)	0.524	−0.156 (0.003)	−0.147 (0.038)	19.2	−7.74 (0.13)	−6.42 (1.65)
Wife > high-school graduate	0.063 (0.003)	0.567	−0.179 (0.004)	−0.082 (0.054)	20.4	−8.33 (0.15)	−2.93 (2.33)
C. Results for wives by *wife's education* for women whose *husband's earnings* are in middle third:							
Wife < high-school graduate	0.079 (0.008)	0.481	−0.138 (0.009)	−0.275 (0.109)	16.7	−7.10 (0.38)	−10.2 (4.83)
Wife high-school graduate	0.076 (0.004)	0.551	−0.157 (0.003)	−0.189 (0.060)	20.3	−8.33 (0.21)	−7.78 (2.64)
Wife > high-school graduate	0.062 (0.006)	0.640	−0.184 (0.006)	−0.125 (0.098)	23.7	−9.07 (0.28)	−3.98 (4.30)
D. Results for husbands by *wife's education:*							
Wife < high-school graduate	0.071 (0.004)	0.945	−0.014 (0.001)	−0.013 (0.020)	44.5	−1.36 (0.10)	−0.21 (1.37)
Wife high-school graduate	0.074 (0.003)	0.981	−0.005 (0.001)	0.005 (0.012)	48.4	−0.53 (0.06)	0.92 (0.81)
Wife > high-school graduate	0.063 (0.003)	0.987	−0.002 (0.001)	0.009 (0.016)	49.2	−0.23 (0.08)	0.25 (1.14)

Notes: The table reports estimates of the coefficient on *More than 2 children* in equation (4) in the text, modified to allow interactions with wives' schooling and husbands' education as indicated. Main effects for each interaction variable (*husband's earnings distribution* and *wife's education*) are included in the equation. Other covariates in the models are those listed in the notes to Table 7. Data are from the 1980 married women and husband samples. Standard errors are reported in parentheses.

TABLE 10—2SLS ESTIMATES OF LABOR-SUPPLY MODELS WITH INTERACTION TERMS USING 1990 CENSUS DATA

Sample/variables	*More than 2 children* First stage	*Worked for pay* Mean of dependent variable	*Worked for pay* OLS	*Worked for pay* 2SLS	*Weeks/year* Mean of dependent variable	*Weeks/year* OLS	*Weeks/year* 2SLS
A. Results for wives by *husband's earnings:*							
Bottom third of husband's earnings distribution	0.064 (0.003)	0.668	−0.160 (0.003)	−0.129 (0.045)	26.3	−8.8 (0.15)	−5.99 (2.18)
Middle third of husband's earnings distribution	0.076 (0.003)	0.728	−0.133 (0.003)	−0.151 (0.039)	29.8	−8.09 (0.15)	−8.37 (1.88)
Top third of husband's earnings distribution	0.071 (0.003)	0.61	−0.137 (0.003)	−0.029 (0.040)	23.6	−7.27 (0.14)	−2.74 (1.93)
B. Results for wives by *wife's education:*							
Wife < high-school graduate	0.069 (0.004)	0.531	−0.145 (0.004)	−0.257 (0.061)	19.2	−7.34 (0.20)	−12.9 (2.91)
Wife high-school graduate	0.078 (0.003)	0.661	−0.140 (0.003)	−0.100 (0.035)	26.3	−8.07 (0.14)	−5.57 (1.67)
Wife > high-school graduate	0.064 (0.002)	0.718	−0.147 (0.003)	−0.058 (0.038)	29.1	−8.43 (0.13)	−3.60 (1.84)
C. Results for wives by *wife's education* for women whose *husband's earnings* are in middle third:							
Wife < high-school graduate	0.073 (0.008)	0.579 —	−0.128 (0.008)	−0.279 (0.097)	21.7	−6.92 (0.37)	−15.4 (4.85)
Wife high-school graduate	0.082 (0.004)	0.707 —	−0.122 (0.005)	−0.204 (0.052)	28.8	−7.62 (0.23)	−9.20 (2.58)
Wife > high-school graduate	0.071 (0.004)	0.795 —	−0.130 (0.005)	−0.071 (0.060)	33.3	−8.40 (0.28)	−6.05 (2.98)
D. Results for husbands by *wife's education:*							
Wife < high-school graduate	0.069 (0.004)	0.919 —	−0.033 (0.002)	0.053 (0.023)	42.3	−2.36 (0.11)	1.68 (1.57)
Wife high-school graduate	0.076 (0.003)	0.971 —	−0.007 (0.001)	0.031 (0.013)	47.3	−0.70 (0.07)	3.05 (0.91)
Wife > high school graduate	0.064 (0.002)	0.982 —	−0.004 (0.001)	−0.014 (0.014)	48.7	−0.41 (0.07)	−1.53 (0.99)

Notes: The table reports estimates of the coefficient on *More than 2 children* in equation (4) in the text, modified to allow interactions with wives' schooling and husbands' education as indicated. Main effects for each interaction variable (*husband's earnings distribution* and *wife's education*) are included in the equation. Other covariates in the models are those listed in the notes to Table 8. Data are from the 1990 married women and husband samples. Standard errors are reported in parentheses.

TABLE 11—COMPARISION OF 2SLS ESTIMATES USING *SAME SEX* AND *TWINS-2* INSTRUMENTS IN 1980 CENSUS DATA

	All women		Married women		Husbands	
Model	(1)	(2)	(1)	(2)	(1)	(2)
Instrument for *More than 2 children*	*Same sex*	*Twins-2*	*Same sex*	*Twins-2*	*Same sex*	*Twins-2*
Dependent variable:						
Worked for pay	−0.125	−0.079	−0.123	−0.087	0.004	−0.001
	(0.026)	(0.013)	(0.028)	(0.017)	(0.009)	(0.005)
Weeks worked	−5.82	−3.64	−5.47	−4.21	0.65	−0.35
	(1.15)	(0.60)	(1.23)	(0.72)	(0.61)	(0.36)
Hours/week	−4.76	−3.33	−4.91	−3.49	0.57	−0.49
	(0.98)	(0.51)	(1.03)	(0.61)	(0.71)	(0.42)
Labor income	−1961.7	−1262.2	−1329.8	−1453.1	−1194.8	616.8
	(560.5)	(292.8)	(579.1)	(339.8)	(1421.4)	(836.9)
ln(*Family income*)	−0.021	−0.071	−0.049	−0.025	—	—
	(0.067)	(0.035)	(0.057)	(0.033)		
ln(*Non-wife income*)	—	—	0.026	0.051	—	—
			(0.068)	(0.040)		

Notes: The table reports 2SLS estimates of the coefficient on *More than 2 children* in equation (4) in the text using *Same sex* and *Twins-2* as instruments. Other covariates in the models are *Age, Age at first birth,* ages of the first two children, plus indicators for *Boy 1st, Boy 2nd, Black, Hispanic,* and *Other race.* Data are from the 1980 Census. Standard errors are reported in parentheses.

- The estimates of female labor-supply effects produced using *Twins-2* are consistently smaller than the corresponding estimates using *Same sex*. This suggests these two shocks have different effects.
- A likely explanation for the smaller *Twins-2* effects is that, conditional on the age of the second child, a third child who is born as twins are exactly the same as the second child, while at least a year and usually longer must go by between the second child's birth and the birth of a non-twin third child.

Check whether difference in *Same sex* and *Twins-2* TSLS estimates can be explained by differences in the ages of the third children.

$$\begin{aligned} y_i &= \alpha_0' w_i + \alpha_i s_{1i} + \alpha_2 s_{2i} + \alpha_3 a_{1i} \\ &\quad + \alpha_4 a_{2i} + \beta_i x_i + \epsilon_i \end{aligned}$$

where a_{1i} and a_{2i} are the ages of the first two children. The coefficient β_i depends on the age of the third child.

$$\beta_i = \beta_0 + \beta_1 a_{3i}$$

The estimating equation is

$$\begin{aligned} y_i &= \alpha_0' w_i + \alpha_i s_{1i} + \alpha_2 s_{2i} + \alpha_3 a_{1i} \\ &\quad + \alpha_4 a_{2i} + \beta_0 x_i + \beta_1 (a_{3i} x_i) + \epsilon_i \end{aligned}$$

Two instruments *Same sex* and *Twins-2* are used for the two endogenous variables (x_i and $a_{3i}x_i$).
Next, we impose a restriction that $\beta_1 a^* = -\beta_0$, then substituting $\beta_1 = -\beta_0/a^*$ into the model, we have

$$\begin{aligned} y_i &= \alpha_0' w_i + \alpha_i s_{1i} + \alpha_2 s_{2i} + \alpha_3 a_{1i} \\ &\quad + \alpha_4 a_{2i} + \beta_0 (1 - a_{3i}/a^*) x_i + \epsilon_i \end{aligned}$$

One of the two instruments *Same sex* and *Twins-2* can be used for the endogenous variable $(1 - a_{3i}/a^*)x_i$.

TABLE 12—2SLS AND 3SLS ESTIMATES OF TWO-PARAMETER LABOR-SUPPLY MODELS USING 1980 CENSUS DATA

	Worked for pay		*Weeks/year*		*Hours/week*		*Labor income*	
Variable	Not restricted	Restricted	Not restricted	Restricted	Not restricted	Restricted	Not restricted	Restricted
A. Instruments: *Same sex* and *Twins-2*								
β_0	−0.191	−0.178	−8.94	−8.24	−6.79	−7.22	−2959	−2827
	(0.066)	(0.059)	(2.91)	(2.72)	(2.48)	(2.38)	(1423)	(1002)
β_1	0.015	0.013	0.724	0.616	0.473	0.540	232	211
	(0.096)	(0.009)	(0.429)	(0.398)	(0.366)	(0.348)	(210)	(139)
a^*	12.4	13.4	12.3	13.4	14.4	13.4	12.8	13.4
	(3.69)	(4.38)	(3.42)	(4.38)	(6.03)	(4.38)	(5.62)	(4.38)
B. Instrument: *Same sex* (restricted $a^* = 13.4$)								
β_0	—	−0.184	—	−8.58	—	−7.01	—	−2891
		(0.038)		(1.69)		(1.44)		(827)
C. Instrument: *Twins-2* (restricted $a^* = 13.4$)								
β_0	—	−0.174	—	−8.02	—	−7.35	—	−2787
		(0.030)		(1.32)		(1.13)		(646)

Notes: Panel A of the table reports 2SLS and 3SLS parameter estimates for equation (10) in the text. *Same sex* and *Twins-2* are both used as instruments. The restricted models in Panel A force the parameter a^* (the age at which labor-supply effects decay to zero) to be the same for all four dependent variables in joint estimation using nonlinear 3SLS. Panels B and C report 2SLS estimates of equation (11) using the *Same sex* and *Twins-2* instruments separately. Other covariates in the models are listed in the notes to Table 11. The data are from the 1980 Census all-women sample. Standard errors are reported in parentheses.