Revisiting the Dilemma of Fertility and Female Labor Supply

New Evidence and Explanations from Japan

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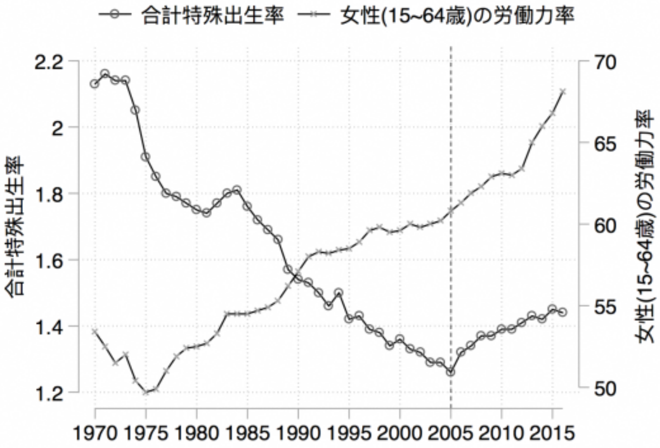
Highlight

- This paper estimates the **causal effect** of fertility on female labor supply.
- The effect of fertility on labor supply is **not always negative in Japan**. Fertility no longer reduces female labor supply for mothers who have two or more deliveries.
- The results have important policy implications in terms of raising fertility rate and female labor supply **simultaneously**.
- The results are **robust** to different identification strategies and specifications. (IV, Sub-sample reduced form estimation, Matchting estimator)

Motivations

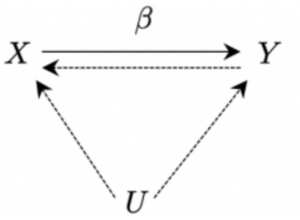
- Fertility has negative effect on female labor supply (IV studies)
    - Mixed sibling-sex compostion
      See Angrist and Evans (1998), Chun and Oh (2002), Ebenstein (2009)
    - Twin birth
      See Bronars and Grogger(1994), He and Zhu (2015)
- If so, would childbirth subsidy and maternity benefits harm female labor supply?
- Is it possible make fertility and female labor supply increase simultaneously?
    - Whose labor supply are not affected by number of children? And whose are?

Time Trend of Fertility and Female Labor Supply in Japan



注：労働力調査と人口動態調査に基づき、申請者が作成した。

Identification problems

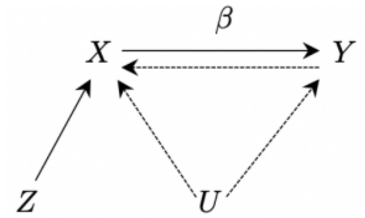


- Using RCT(if randomization is properly implemented), we can simply estimate the average treatment effects by comparing the outcomes between treatment and control groups, or by linear regression.

$$y_i = \beta_0 + \beta_1 x_i + u_i$$

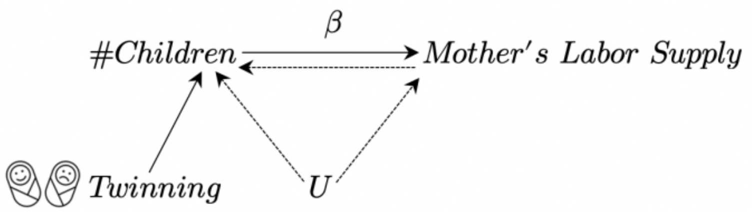
- However, $Cov(x_i, u_i) = 0$ condition is probably not satisfied in most cases of policy studies. Treatment variable x_i is not independent to the error term u_i. With confounder U, β_1 reflects simple correlation rather than causality.

Identification strategy



- Empirically, we need an exogenous Z, which can only affect Y through X, to identity the causal parameter β.
- Z should **randomly assign people into treament and control**.
- Identification of quasi-experiment design relies on rare events(sudden policy changes, weather events, natural disasters, etc.).
  - Regression Discontinuity
  - Difference-in-Difference
  - Instrumental Variable, etc.

Identification strategy



- To identity the causal parameter β, we use **twinning** as the instrument variable.
- Twinning naturally assigns mothers into **treamtment and control**.
- Note that twinning rate is only 1-2%, this strategy relies on very **huge sample size**.

Data

Population Census of Japan 2015

- 100% sample of Japanese population including migrants.
- Individual characteristics: birth information, sex, marital status, education, work status, nationality, ethnicity, etc.

Advantages of this data set:

- We can identify twinning using birth information.
- Large sample size makes it possible to detect the heterogeneity even when twinning is used for causal inference.
- More strict restrictions can be applied to hold other factors constant.

Sample Restrictions

- Following Angrist & Evans (1998), only children of the household head are used to construct the fertility information.
- Mothers who are between 16 and 35 years of age and whose eldest child is no more than 18 years of age.
- We exclude single mother households because information on fathers can not be obtained.
- The final sample contains 2,474,487 females, 33,838 of whom have given birth to twins. Because the census does not include an exact identifier for twins, we define twins as children who were born in the same month in a year within a household.

Descriptive Statistics 1: Basic characteristics

Table 1: Descriptive Statistics for Married Women

		Mothers of	
	(1)	(2)	(3)
VARIABLES	Overall	Twins	Non-twins
Labor force participation	0.448	0.463	0.448
	(0.497)	(0.499)	(0.497)
Number of children	1.666	2.568	1.654
	(0.703)	(0.687)	(0.695)
Age	31.646	32.371	31.636
	(3.354)	(2.985)	(3.357)
Age squared/100	10.127	10.568	10.121
	(2.027)	(1.839)	(2.029)
Education			
Middle school or below	0.047	0.042	0.047
	(0.212)	(0.200)	(0.212)
High school	0.383	0.377	0.383
	(0.486)	(0.485)	(0.486)
Junior colledge	0.368	0.383	0.368
	(0.482)	(0.486)	(0.482)
University or above	0.203	0.198	0.203
	(0.402)	(0.398)	(0.402)

Descriptive Statistics 1: Basic characteristics

Husband			
Education			
Middle school or below	0.069	0.062	0.069
	(0.254)	(0.241)	(0.254)
High school	0.409	0.417	0.409
	(0.492)	(0.493)	(0.492)
Junior colledge	0.153	0.148	0.153
	(0.360)	(0.355)	(0.360)
University or above	0.369	0.374	0.369
	(0.483)	(0.484)	(0.483)
Labor force participation	0.997	0.997	0.997
	(0.055)	(0.057)	(0.055)
Elderly			
Co-resident	0.041	0.048	0.041
	(0.199)	(0.214)	(0.199)
Observations	2,474,487	33,838	2,440,649

Notes: Standard deviations in parentheses.

Descriptive Statistics 2: Parental labor supply

Table 2: Parental Labor Force Participation by Number of Children

	Number of children			
VARIABLES	(1) One	(2) Two	(3) Three	(4) Four
Panel A: Unconditioned sample				
Mother's LFP	0.423	0.467	0.478	0.466
Father's LFP	0.996	0.998	0.997	0.995
Observations	1,133,167	1,063,700	248,475	28,761
Panel B: No more than 3 years since last child birth				
Mother's LFP	0.362	0.350	0.383	0.401
Father's LFP	0.997	0.998	0.998	0.995
Observations	785,201	586,497	154,135	20,490
Panel C: No more than 1 year since last child birth				
Mother's LFP	0.319	0.267	0.291	0.308
Father's LFP	0.996	0.998	0.997	0.995
Observations	315,224	224,805	60,753	8,966
Panel D: No more than 3 months since last child birth				
Mother's LFP	0.325	0.238	0.233	0.239
Father's LFP	0.996	0.998	0.997	0.997
Observations	79,982	59,733	16,632	2,599

Baseline model

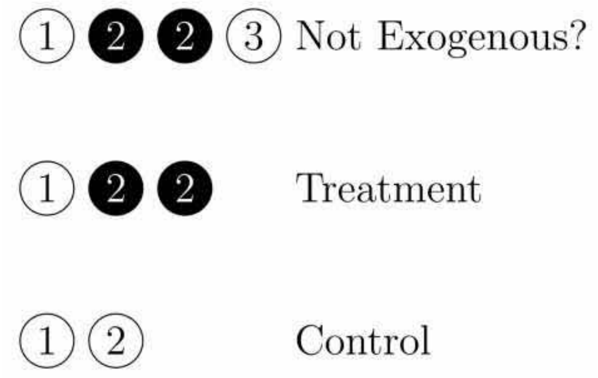
The baseline model is specified as follows:

$$LFP_i = \beta_0 + \beta_1 Children_i + \boldsymbol{X}_i^{'}\delta_1 + \boldsymbol{Z}_i^{'}\delta_2 + \epsilon_i \quad (1)$$

$$Children_i = \gamma_0 + \gamma_1 Twins_i + \boldsymbol{X}_i^{'}\rho_1 + \boldsymbol{Z}_i^{'}\rho_2 + \varepsilon_i \quad (2)$$

- LFP_i is a dummy variable indicating labor force participation.
- $Children_i$ indicates number of children, which is an endogenous variable.
- $Twins_i$ is a binary instrumental variable that equals 1 if a woman has given birth to twins at *n*th delivery.
- $\boldsymbol{X_i}$ is a vector of individual characteristics including age, age squared, education.
- $\boldsymbol{Z_i}$ is a vector of husband's characteristics and living arrangement, which includes husband's education and labor supply, and a binary variable indicating co-residence with elder parent.

Estimation Issue (1): Does twinning really exogenous?



Sub-Sample reduced-form estimation

$$LFP_i = \beta_0^* + \beta_1^* Twins_i + \boldsymbol{X}_i^{'}\delta_1^* + \boldsymbol{Z}_i^{'}\delta_2^* + u_i$$

Table 3: Descriptions of Sub-Samples

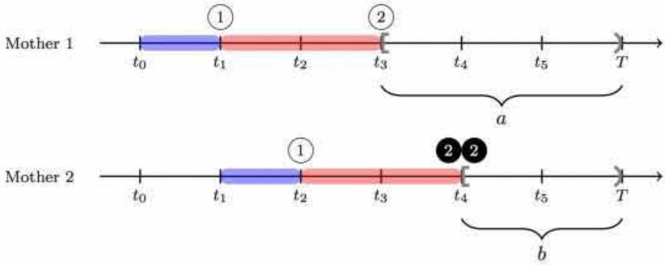
	(1) Sub-Sample A	(2) Sub-Sample B	(3) Sub-Sample C
Mothers of non-twins	①	① ②	① ② ③
vs			
Mothers of twins	❶ ❶	① ❷ ❷	① ② ❸ ❸
Number of children	1 *vs* 2	2 *vs* 3	3 *vs* 4

Notes: ◯ indicates non-twin, and ● indicates twins. Numbers in circles show the birth order. Sum of circles shows the total number of children mothers have.

Estimation Issus (2): Potential Bias in Cross-Sectional Data

We estimate our models **by time elapsed since last child birth** to take account for the time-variant effects of fertility.

Figure 3: An Example of Potential Bias



Notes: ◯ indicates non-twin, and ● indicates twins. Numbers in circles show the birth order. Braces are durations from last childbirth to the survey time T, where $a = T - t_3$ for mother 1 and $b = T - t_4$ for mother 2.

Baseline results (selected OLS and IV results)

Table 5: Estimated Coefficients of OLS and IV Conditioned on Birth Order and Time Since Last Child Birth

	Since the last childbirth							
	Unconditioned		No more than 3 years		No more than 1 year		No more than 3 months	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	OLS	IV	OLS	IV	OLS	IV	OLS	IV
*Panel A: Mothers of twins at the first delivery **vs** Mothers of non-twins*								
#Children	-0.003***	0.000	-0.005***	-0.047***	-0.027***	-0.031***	-0.056***	0.004
	(0.000)	(0.004)	(0.001)	(0.005)	(0.001)	(0.007)	(0.002)	(0.015)
Observations	2,469,185	2,469,185	1,543,366	1,543,366	608,578	608,578	158,626	158,626
*Panel B: Mothers of twins at the second delivery **vs** Mothers of non-twins with 2 or more births*								
#Children	-0.027***	-0.002	0.012***	0.004	0.015***	0.009	-0.008***	-0.001
	(0.001)	(0.007)	(0.001)	(0.009)	(0.002)	(0.014)	(0.003)	(0.025)
Observations	1,312,372	1,312,372	746,864	746,864	289,393	289,393	77,718	77,718
*Panel C: Mothers of twins at the third delivery **vs** Mothers of non-twins with 3 or more births*								
#Children	-0.037***	0.050**	0.002	0.066**	0.012**	0.026	0.010	0.072
	(0.003)	(0.023)	(0.004)	(0.029)	(0.005)	(0.041)	(0.009)	(0.077)
Observations	262,272	262,272	166,472	166,472	66,567	66,567	18,443	18,443

Notes: Robust standard errors in parentheses. All specifications control for age, age squared, education attainment, husband's education attainment, husband's labor force participation, co-residence with elder parents, and prefecture dummies. In all panels, upper bounds on the number of children are not imposed. *** p<0.01, ** p<0.05, * p<0.1.

Sub-Sample Reduced-Form (selected results)

Table 6: Estimated Coefficients of Sub-Sample Reduced-Form Using an Efficient Instrument

		Since the last childbirth		
	Unconditioned (1)	No more than 3 years (2)	No more than 1 year (3)	No more than 3 months (4)
*Panel A: Mothers of twins at the first delivery **vs** Mothers of single child(2 **vs** 1)*				
Twins	0.010***	-0.052***	-0.042***	-0.017
	(0.004)	(0.005)	(0.008)	(0.017)
Observations	1,151,223	793,959	318,266	80,737
*Panel B: Mothers of twins at the second delivery **vs** Mothers of two non-twins children(3 **vs** 2)*				
Twins	-0.003	0.014	0.017	-0.006
	(0.008)	(0.010)	(0.015)	(0.026)
Observations	1,049,727	580,158	222,718	59,238
*Panel C: Mothers of twins at the third delivery **vs** Mothers of three non-twins children(4 **vs** 3)*				
Twins	0.055**	0.075**	0.025	0.072
	(0.025)	(0.030)	(0.046)	(0.086)
Observations	236,129	147,592	58,258	16,000

Notes: Robust standard errors in parentheses. Specifications with controls include variables of age, age squared, education attainment, husband's education attainment, husband's labor force participation, co-residence with elder parents, and prefecture dummies. *** p<0.01, ** p<0.05, * p<0.1.

Concluding Remarks

- The effect of fertility on female labor supply is not monotonically decreasing in the number of children. (Due to unobserved marriage-specific human capital?)
- The effect of fertility **varies substantially** with the time elapsed since the last childbirth, which would cause bias in OLS and IV if omitted.
- Surprisingly, for a first time mother, the negative effect **increases in magnitude as time goes by**, which is different from our previous findings using Taiwanese data.
  - We are tring to use causal mediation analysis to isolate the direct and indirect effects.
- Policy implication: Government should target women with **higher-parity**?