Son Preference, Fertility Decline and the Non-Missing Girls of Turkey

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  1. The population sex ratio (number of males per female) at birth: [1.02 - 1.08] (Hesketh and Xing, 2006).

  2. Within a family: $f(female; p) = \begin{cases} 0.49 \text{ if } female = 1 \\ 0.51 \text{ if } female = 0 \end{cases}$

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  - Gender discrimination in relative care → "missing" women (Sen, 1990).

  - Son-biased fertility stopping rules.

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    - South Korea (Chung and Gupta, 2007).
    - China (Qian, 2008).
    - India (Jayachandran, 2014).
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  Parents continue to bear children until reaching a desired number of sons.

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    - Central Asia (Filmer et al., 2009).
    - North Africa (Yount et al. 2000, Basu and de Jong, 2010).
  - Co-exists with sex selective abortion:
    - China and India (Ebenstein, 2007).
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  - Does **not** alter the population sex ratio.
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- **Preview of findings:**
  - Parents in Turkey exhibit strong son preference in fertility:
    - Exclusively through son-biased differential stopping.
    - No evidence of sex-selective abortion.
  - Demand for sons leads to skewed sibling sex ratios:
    - Girls grow up larger families than boys.
    - Girls are born earlier than their male siblings.
    - Sex-differential contraceptive use.
  - Persistency over time and across households with different fertility levels.
  - Important gender disparities in health:
    - Female infant mortality is lower than male infant mortality if the proportion of males is relatively high in the household.
    - Female survival advantage disappears if the proportion of females is relatively high.

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- Simple fertility decision model:
  - Three periods (Maximum number of children $= 3$).
  - N couples and every couple has a target of having one son.
  - $f(female; p) = \begin{cases} 0.5 \text{ if } female = 1 \\ 0.5 \text{ if } female = 0 \end{cases}$
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Implications of a Simple Son-Biased Differential Stopping Rule

	Sibling Sex Composition				
Birth Parity	B	GB	GGB	GGG	Sex Ratio
First	$\frac{N}{2}$ Boys	$\frac{N}{4}$ Girls	$\frac{N}{8}$ Girls	$\frac{N}{8}$ Girls	1.00
Second		$\frac{N}{4}$ Boys	$\frac{N}{8}$ Girls	$\frac{N}{8}$ Girls	1.00
Third			$\frac{N}{8}$ Boys	$\frac{N}{8}$ Girls	1.00
Family Size	1 Child	2 Children	3 Children		
Sex Ratio	Only male	1.00	0.20		
SRLB	Only male	Only male	1.00		
# Children	Boys			Girls	
	$\frac{7N}{8}$		=	$\frac{7N}{8}$	

- **Population:**
  - 1985, 1990 and 2000 Censuses.
  - 2008-2013 annual population data: Address Based Population Registration System (ABPRS).
  - 2001-2013 annual birth statistics: Central Population Administrative System (MERNIS).
- **Household:**
  - Turkish Demographic and Health Survey (TDHS): 1993, 1998, 2003, 2008 Waves.
  - Nationally representative survey of 28,151 ever-married women, aged 15-49.
  - Include complete fertility histories, family planning prevalence and demographic characteristics.
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Sex Ratios by Birth Order (Women aged 15 to 49)

Number of births	Birth Order 1	2	3	4	5	6	7
1	**1.21**						
2	1.19	**1.19**					
3	1.08	1.06	**1.26**				
4	0.92	0.89	0.93	**1.20**			
5	0.98	0.89	0.94	1.07	**1.23**		
6	0.84	0.98	0.89	0.91	1.00	**1.23**	
7+	0.97	0.94	0.81	0.90	0.94	0.98	0.98
Average birth order		$Boys = 2.75$		$Girls = 2.78$			

- Robustness checks. Sex ratios for:
  - Second-born children conditional on a first-born daughter: 1.04.
  - Third-born children after two females: 1.02.
  - Second-, third-, and fourth-born children: 1.05, 1.02, 1.02.

- Summary of descriptive analysis:
  1. DSB is the only mechanism by which couples in Turkey pursue son preference.
  2. Despite fertility decline, skewed sex ratio distribution conditional on family size is persistent over time.

- **Identification:** without prenatal manipulation, the gender of the first-born child is a random drawn.

$$y_{irt} = \alpha + \tau Z_{irt} + X_i'\Gamma + \theta_r + \delta_t + \omega_{rt} + u_{irt}$$

  - y_i: Number of pregnancies, children ever born, and children alive. Indicators for current contraceptive use and having any induced abortion in the past.
  - Z_i: Indicator of a female first-born child.
  - X_i: Each parent's age, education, mother's ethnicity, age at first birth, rural residence, patrilocality, arranged marriage, bride price payment.
  - θ_r: Region dummies.
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- **Key identifying assumption:** $E[Z_{irt}|u_{irt}] = 0$
  Difficult to justify if:
  - First-born child's sex is a prenatal choice.
  - Excess maternal mortality might change the sample composition.
- Test on observables:
  - Compare family characteristics by first child's sex.
  - $Z_{irt} = \gamma + X_i'\Phi + \theta_r + \delta_t + \epsilon_{irt}$ (logit)
- Data restriction: women with at least one birth history with a singleton first birth (99.1 % of the original sample).
- τ is estimated by:
  - OLS: Change in y induced by a first-born female.
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Baseline Characteristics of Families by First Child's Sex

	First child's sex			t-test	
	Boy	Girl	Difference	p-value	N
Mother					
Age	34.07	34.13	-0.053	0.61	25366
Age at first birth	20.66	20.59	0.067	0.17	25366
Years of education	4.93	4.99	-0.062	0.19	25366
Non-Turkish	0.20	0.19	0.005	0.32	25366
Husband					
Age	38.61	38.72	-0.115	0.33	23140
Years of education	7.02	7.07	-0.047	0.33	25269
Patrilocal residence	0.12	0.12	-0.005	0.21	25366
Household					
Rural	0.30	0.30	0.003	0.61	25366
Arranged by families	0.61	0.61	0.005	0.44	25355
Paid bride price	0.23	0.24	-0.005	0.38	24956

p-value, joint χ^2-test $= 0.53$

N=25366 pseudo-R^2=0.0006

Effect of First Child's Sex on Parents' Fertility Behavior

Women aged 15 to 49

	Number of Pregnancies	Number of Births	Number of Living Children	Contraceptive Use	Pregnancy Termination
$\hat{\tau}^{OLS}$	0.204***	0.189***	0.184***	-0.016***	-0.001
	(0.023)	(0.017)	(0.015)	(0.005)	(0.005)
$\hat{\tau}^{MLE}$	0.053***	0.062***	0.067***		
	(0.006)	(0.005)	(0.005)		
$\bar{y}\|Z_i = 0$	3.82	3.02	2.73	0.70	0.26

Women aged 15 to 29

	Number of Pregnancies	Number of Births	Number of Living Children	Contraceptive Use	Pregnancy Termination
$\hat{\tau}^{OLS}$	0.087***	0.058***	0.061***	-0.026***	-0.001
	(0.022)	(0.016)	(0.015)	(0.010)	(0.007)
$\hat{\tau}^{MLE}$	0.039***	0.031***	0.034***		
	(0.010)	(0.008)	(0.008)		
$\bar{y}\|Z_i = 0$	2.29	1.93	1.82	0.70	0.12

- Relationship between fertility level and son preference is not obvious. e.g. higher education $\rightarrow$ fertility decline.
    - Dincer et al. (2013): Compulsory schooling reform in 1997 raised the proportion of women using modern family planning methods by 8% - 9%.
    - Kirdar et al. (2012): The new compulsory schooling law increased the average age at first birth substantially.
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- Endogenous Stratification (Abadie et al. 2014):

1. Only use sample of women with a first-born son, i.e. $Z_i = 0$, estimate $y_i = \pi_0 + W_i'\pi_1 + \epsilon_i$
   - y_i: Number of living children.
   - W_i: Mother's age at first birth, father's and mother's education, region, rural residence.
2. Predict $W_i'\hat{\pi}$ for the full sample and define the quantiles of predicted fertility:
   $c_{k-1} < W_i'\hat{\pi} \leq c_k$ for $k = \{1, 2, 3, 4, 5\}$
3. Estimate the treatment effect for each quantile using $\hat{\tau}^{RSS}$ and $\hat{\tau}^{LOO}$

$$\hat{\tau}_k = \frac{\sum_{i=1}^{N} y_i I_{[Z_i=1, c_{k-1} < W_i'\hat{\pi} \leq c_k]}}{\sum_{i=1}^{N} I_{[Z_i=1, c_{k-1} < W_i'\hat{\pi} \leq c_k]}} - \frac{\sum_{i=1}^{N} y_i I_{[Z_i=0, c_{k-1} < W_i'\hat{\pi} \leq c_k]}}{\sum_{i=1}^{N} I_{[Z_i=0, c_{k-1} < W_i'\hat{\pi} \leq c_k]}}$$

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Table 6. Endogenous Stratification Results on the Number of Living Children

	Repeated Split Sample		*Leave-One-Out*				
Quantile	Unadjusted	Adjusted	Unadjusted	Adjusted	$\bar{y}_k \mid Z_i = 0$	$\%\Delta$	N_k
$\hat{\tau}_1$	0.096***	0.076**	0.095***	0.077***	1.69	0.046	5073
	(0.021)	(0.019)	(0.021)	(0.019)			
$\hat{\tau}_2$	0.152***	0.144***	0.137***	0.128***	2.12	0.060	5067
	(0.027)	(0.022)	(0.029)	(0.024)			
$\hat{\tau}_3$	0.234***	0.218***	0.256***	0.229***	2.44	0.094	5081
	(0.034)	(0.026)	(0.039)	(0.028)			
$\hat{\tau}_4$	0.213***	0.215***	0.209***	0.219***	2.99	0.073	5073
	(0.046)	(0.031)	(0.047)	(0.035)			
$\hat{\tau}_5$	0.283***	0.259***	0.295***	0.265***	4.41	0.060	5072
	(0.071)	(0.044)	(0.071)	(0.044)			

1. DSB shows a relatively flat response to decline in fertility.
2. The relationship follows an inverse U-shaped path reaching a peak at the medium fertility level.
3. Strong demand for at least one son for all fertility levels.
4. Fertility decline predicted by better education, more income and urbanization does not necessarily eliminate the gender-biased fertility preference.

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- Rosenblum (2013):
  - Sons provide a future differential economic gain to parents.
  - Economic gain from an extra son is larger if the existing proportion of sons is relatively small in the family.
  - The smaller the proportion of boys, the greater the incentive for households to favor boys in health investment.
- Difference-in-differences approach:
  - Child's gender is random at any birth parity.
  - If the previous sibling is a girl, however, families have an incentive to differentially invest in boys.
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    - Child's gender is random at any birth parity.
    - If the previous sibling is a girl, however, families have an incentive to differentially invest in boys.
    - Gender difference in health should lead to a relative male advantage if the previous sibling is female.

- Difference-in-differences estimator:
  $y_i = \mu_0 + \mu_1 Z_{i1} + \mu_2 Z_{i2} + \mu_3 (Z_{i1} \times Z_{i2}) + \eta_i$
  - y_i: Infant mortality, stunting, and being underweight (as defined by WHO).
  - Z_{i1}: Female indicator for child i.
  - Z_{i2}: Female indicator if the older sibling is female.
- e.g., mortality differences among second-borns:
  - $\mu_1 = E[Y|Z_{i1} = 1, Z_{i2} = 0] - E[Y|Z_{i1} = 0, Z_{i2} = 0]$
  - $\mu_1 + \mu_3 = E[Y|Z_{i1} = 1, Z_{i2} = 1] - E[Y|Z_{i1} = 0, Z_{i2} = 1]$
  - $\mu_3 > 0$ if a first-born female sibling causes the boys to be more valuable.

The Effects of the Previous Sibling's Sex on Gender Gap in Infant Mortality

	(1) First-born				(2) Second-born				(3) Third-born			
	Boy		Girl		Boy		Girl		Boy		Girl	
	Second-born		Second-Born		Third-born		Third-born		Fourth-born		Fourth-born	
	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl
Mean	0.069	0.066	0.067	0.062	0.077	0.068	0.066	0.076	0.093	0.078	0.076	0.082
Girl-Boy diff.	-0.003		-0.005		-0.009		0.009		-0.015		0.005	
	(0.005)		(0.005)		(0.007)		(0.006)		(0.009)		(0.011)	
DID	-0.002				0.018**				0.020			
	(0.007)				(0.009)				(0.013)			
Covariate Adjusted DID	-0.004				0.020**				0.019			
	(0.007)				(0.009)				(0.013)			
N	20,397				12,701				7,676			

The Effects of the Previous Sibling's Sex on Gender Gap in Health

Pooled sample estimates ($n \geq 3$)	(1) Infant Mortality Birth order, $n-1$				(2) Stunting Birth order, $n-1$				(3) Underweight Birth order, $n-1$			
	Boy		Girl		Boy		Girl		Boy		Girl	
	Birth order, n		Birth order, n		Birth order, n		Birth order, n		Birth order, n		Birth order, n	
	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl
Mean	0.094	0.080	0.080	0.085	0.216	0.231	0.201	0.229	0.089	0.090	0.087	0.103
Girl-Boy diff.	-0.015*** (0.005)		0.005 (0.004)		0.015 (0.017)		0.028* (0.016)		0.001 (0.012)		0.016 (0.011)	
DID	0.020*** (0.006)				0.013 (0.023)				0.015 (0.016)			
Covariate adjusted DID	0.020*** (0.006)				0.018 (0.022)				0.022 (0.016)			
N	33,039				5,064				5,064			

1. No improvement in male mortality compared to female mortality after a female birth among second-borns (most generalizable result).
2. Among higher birth parities, female infant mortality < male infant mortality by 1.5% points if the previous sibling is male.
3. The biological female advantage disappears if the previous sibling is female.
4. No gender gap in vaccination rates (BCG, DPT, Polio, and MMR).
5. Limited HH resources seems to be the driving mechanism:
    - Child vaccination is free of charge, and is part of routine procedure in public hospitals.
    - Gender gap in health emerges in high fertility (poor) households while all households exhibit son preference.

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