Wealth, Marriage, and Sex Selection

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Introduction

- Sex selection, through feticide, infanticide, or neglect, is a serious problem in many parts of the world
- Economic development has been associated with greater gender equality on many dimensions; e.g. Geddes and Lueck (2002), Doepke and Tertilt (2009)
- However, the sex selection problem in countries like India has worsened with economic progress

Child Sex Ratios

	Census Year			
	1991		2011	
Worst states				
	Haryana	114	Haryana	120
	Punjab	114	Punjab	118
	Delhi	109	Delhi	115
All India		106		109
South India		105		108

Note: Sex ratio for children aged 0-6 measured by the number of boys per 100 girls. Natural sex ratio 102.5 (based on South Indian statistics prior to 1980)

Research Contribution

- Much attention has been devoted to sub-populations with severe sex selection and to explaining changes over time

- The first contribution of our research is to document substantial variation in sex ratios on a new dimension; within castes or *jatis*, which are the building blocks of Indian society

- The second contribution is to provide an explanation for this variation, which is based on the structure of the marriage institution in India

A Marriage Market Explanation for Sex Selection

- It is widely believed that dowries are the main cause of sex selection in India and that the wealthy are more likely to practice sex selection because they must pay higher dowries
    - However, wealthy girls match with wealthy boys who provide them with greater resources during marriage (with resulting benefits)
- Our theory formalizes the link between wealth, marriage, and sex selection
    - The root cause of sex selection is specific imperfections in the marriage market that arise due to the structure of the marriage institution

Relation to the Literature

- The family economics literature links exogenous macroeconomic changes to changes in marriage, fertility, investment in children, and female labour force participation (Greenwood, Guner, and Vandenbroucke; 2007)
- Within this literature, there is a body of work that examines the role of the marriage market in mediating this relationship (Browning, Chiappori, and Weiss; 2014)

Relation to the Literature

- In the marriage models, family decisions determine the sorting equilibrium in the marriage market, which feeds back into these decisions; e.g. education (Chiappori et al. 2009, 2017), fertility (Chiappori and Orrefice, 2008), and parenting style (Doepke and Zilibotti, 2017)
- In our model, the two-way interaction is between the assortative matching equilibrium and sex selection
  - Sex selection changes the distribution of wealth on the two sides of the market, which affects the equilibrium outcome and, hence, the incentive for sex selection

Institutional Setting

- The emergence of sex selection in South India in the 1980's is useful for understanding why this phenomenon is linked to marriage in India
- Although Indians have married within their castes or *jatis* for centuries, marriages in South India were, in addition, between close-kin (Dyson and Moore 1983)
  - The two families effectively functioned as a cooperative unit
  - There were no marriage payments, having a girl did not put parents at a disadvantage, and thus there was no sex selection

Institutional Setting

- With economic development, families that had matched for generations no longer had the same level of wealth (Caldwell, Reddy, and Caldwell 1983, Srinivas 1984)
  - Close-kin marriage declined and a marriage market emerged within each caste, with dowries clearing the market (Kapadia 1993)
  - Dowries are now as high in South India as they are in North India (Rahman and Rao 2004, Anderson 2007)
  - Sex selection also emerged, which we will link to imperfections in the marriage market

The Marriage Institution in India

1. Marriages are endogamous, within the caste or *jati*
2. Marriages are patrilocal
3. Marriages are arranged, with family wealth being a major consideration
4. Marriages involve a dowry payment
5. The social norm is that all girls must marry

A Model of Wealth, Marriage, and Sex Selection

- The model isolates those elements of the Indian marriage institution that are responsible for sex selection
- The model is set up to be as parsimonious as possible, abstracting away from many features of the family and the marriage market that are not directly relevant for the analysis

Population

- Each family consists of one parent and one child
- Denote the boy's family wealth by x and the girl's by y
- The measure of families with boys and girls will be endogenous as will be the distribution of their wealth, $F(x)$ and $G(y)$, respectively
  - Without sex selection, $F(\cdot) = G(\cdot)$

Preferences, Payoffs, and Consumption

- Denote the wealth-contingent consumption of parents by C_x, C_y and that of the children by c_x, c_y

- All individuals have logarithmic preferences over consumption and parents, in addition, have altruistic preferences over the consumption of their children (regardless of their gender)

$$U = \log(C_i) + \log(c_i), \qquad \forall i = \{x, y\}$$

- Denote the maximized utility of the groom's family with wealth x marrying a bride with wealth y by $u(x)$, and that of the bride's family by $v(y)$

The Marriage Institution

- Marriage is patrilocal; i.e. women move into their husbands' homes
- The cost of patrilocal marriage is that the boy's parent is only willing to accept the match if the girl's parent pays a dowry d
- The benefit of patrilocal marriage is that if a girl matches with a wealthy boy she will get to consume a fraction of the wealth her husband receives as a transfer from his parent
  - Denote the transfer by t
  - The boy obtains a fraction $\alpha \geq \frac{1}{2}$ of the transfer, while the wife cannot be stopped from consuming a fraction $1 - \alpha$ of what her husband receives

Consumption

- The consumption of all agents of a married groom-bride pair (x, y) can be written as

$$c_x = \alpha t$$
$$C_x = x - t + d$$
$$c_y = (1 - \alpha)t$$
$$C_y = y - d$$

  - The transfer, t, and the dowry, d, are determined endogenously
  - Based on the solution to the model, parents and their children end up consuming at different levels
  - Altruistic parents would like to share their wealth equally with their children
  - This mismatch plays a key role in determining sex selection in our model

Analytical Solution

- We solve the model in three steps
    1. We show how families on the two sides of the market match on wealth
    2. We show that there is sex selection and, nevertheless, that dowries are positive at every wealth level
    3. We show that sex selection increases higher up the wealth distribution

Matching

- Matching in this marriage market is frictionless with the dowry d determined competitively
- The timing of decisions is as follows
  1. Participants in the marriage market choose their best partner given a "Walrasian" schedule of prices and the market clears with a resulting equilibrium price d
  2. Parents of boys subsequently choose the transfer t
- We solve for d and t by backward induction
  - Derive an expression for t as a function of d and x
  - Then derive an expression for the hedonic price, $u(x)$, such that the matching is stable

Matching

Lemma 1. There is Positive Assortative Matching on wealth

- Wealthy parents are willing to pay a higher dowry to match with wealthy families to ensure higher consumption for their daughters
- All girls' parents would like them to match with the wealthiest boys; the dowry must thus be increasing sufficiently steeply in wealth to ensure that the matching is stable
- The dowry thus serves as a bequest (Botticini 1999) and as a price to clear the marriage market (Becker 1973); see also Anderson and Bidner (2015)

Sex Selection

- The social norm that all girls must marry plays a key role in generating sex selection
    - If the boy stays single, his family's wealth is divided equally between the parent and the child (given its objective of maximizing total utility)
    - This is not an option for the girl
- These differences in outside options shift the surplus from marriage in favour of the boy's family
- For the resulting endogenous preference for sons to translate into sex selection, a suitable technology must be available
    - At utility cost k a family can have a boy with probability one
    - k is bounded below at zero

Sex Selection

Proposition 1. In equilibrium, there is sex selection and dowries are positive at every wealth level

- Suppose that a girl's family with wealth y matches with a boy's family with wealth x
  - The total wealth available for consumption is $x + y$
- If the boy did not marry, he and his parent would both consume $\frac{x}{2}$
  - Thus, the outside option for the boy's family (in utility units) is $2 \log \left(\frac{x}{2} \right)$
- There is no such outside option on the girl's side because of the social norm that all girls must marry

Sex Selection

- The boy's side requires at least x to satisfy the outside option $2\log\left(\frac{x}{2}\right)$
- Given that $C_x \neq c_x$ because $\alpha < 1$, it requires more than x; hence, a positive dowry
- This leaves less than y for the girl's family

$$v(y) < 2\log\left(\frac{y}{2}\right) \leq u(y)$$

- A girl's parent with wealth y will manipulate the sex of the child if $k < u(y) - v(y)$
    - Given that k is bounded below at zero, there is sex selection at every wealth level

Wealth and Sex Selection
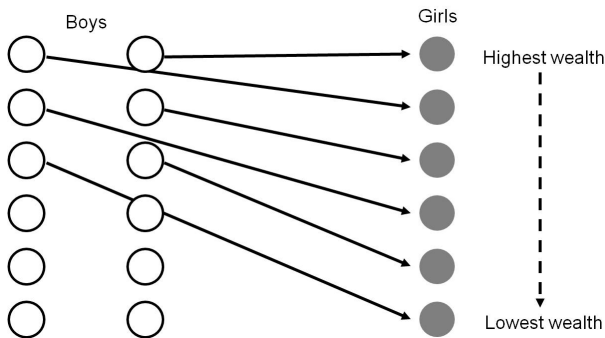
- The wealth-gap increases as we move down the wealth distribution, making it more attractive for poorer parents to have a girl
- In equilibrium, the sex ratio will adjust and improve as we move down the wealth distribution

Wealth and Sex Selection

- Once there is sex selection, the wealth distribution on the two sides of the market (which determines the pattern of matching) becomes endogenous
  - Sex selection, the wealth distribution, and the dowry must be solved simultaneously
  - The expression for the dowry, in addition, holds a fixed point
  - We can, nevertheless, show analytically that $\frac{dk^*}{dy} > 0$ at the top of the wealth distribution, where the matching is exogenously determined; $\overline{y} = \overline{x}$, and at the lowest wealth level at which boys match, x^*, where $u(x^*) = 2 \log\left(\frac{x^*}{2}\right)$
  - To characterize sex selection across the wealth distribution, we solve the model numerically

Matching Patterns
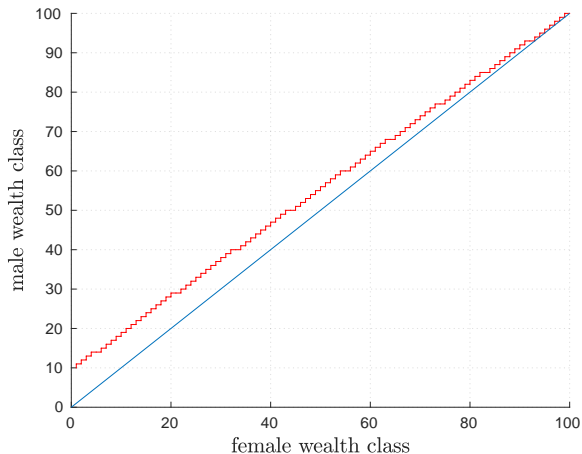
Dowries and Sex Ratios
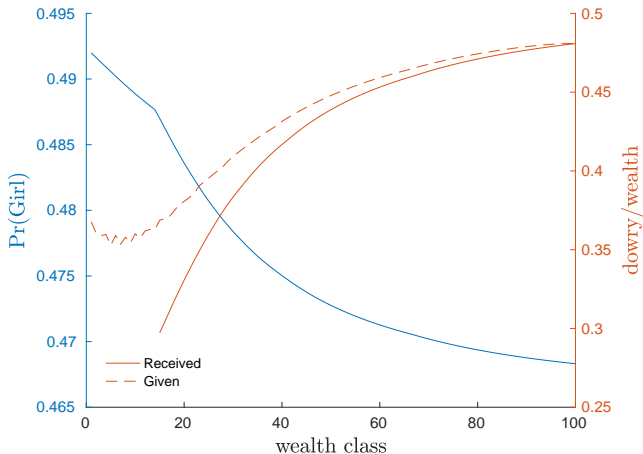
Dowries and Sex Ratios - varying α
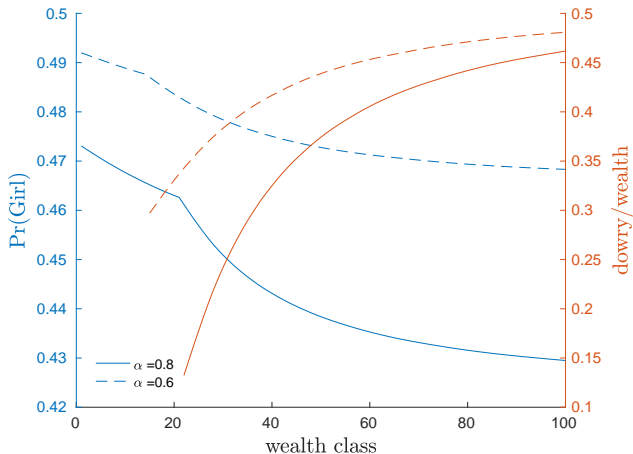
Alternative Models

- Exogenous son preference will also generate increasingly biased sex ratios as we move up the wealth distribution; e.g. Edlund (1999), Bhaskar (2011)
    1. But then there will be bride-price in equilibrium, because girls are on the short side of the market (as in China)
    2. Recent research provides evidence on the causal relationship between marriage and sex selection in India (Bhalotra, Chakravarty, and Gulesci 2016)
    3. If parents want at least one son, then sex ratios for first-born children will be unbiased

Descriptive Evidence

Demographic and Socioeconomic Characteristics

- The South India Community Health Study (SICHS) covers a rural population of 1.1 million individuals residing in Vellore district in the state of Tamil Nadu
- There are 298,000 households drawn from 57 castes in the study area
- The study area is representative of rural Tamil Nadu and rural South India with respect to demographic and socioeconomic characteristics
  - Age distribution, marriage patterns, literacy rates, and labour force participation

Marriage Patterns

Generation	Parents	Children	
		Males	Females
	(1)	(2)	(3)
Same caste	0.97	0.95	0.95
Related	0.48	0.35	0.35
Arranged	0.86	0.80	0.88
Female moved outside natal village	0.75	0.78	0.81
Mean dowry (in thousand Rupees)	–	138.32	187.46
Mean fraction of annual income	–	2.94	3.83
Observations	3,524	421	611

Source: SICHS household survey.

Evidence on Hypergamy

Sex of the child	Males (1)	Females (2)
Partner's parental household		
Wealthier	0.09	0.18
Same wealth	0.62	0.64
Less wealthy	0.29	0.17
Kolmogorov-Smirnov test of equality	P-value = 0.001	
Observations	421	611

Source: SICHS household survey; sample: marriages of children in the last 5 years.

Sex Ratios

Population	Rural South India		Rural Vellore SICHS census
Data Source	DHS2005	IHDS2005	
First-born children	105	106	106
All children	109	108	108
Observations	5,750	3,057	79,027

Note: Sex ratios are computed for children 0-6. The unbiased child sex ratio, based on pre-1980 population census data from South India, is 102.5.

Measuring Wealth

- To test the model's predictions, we must measure each family's position in its caste's wealth distribution
- Account for variation in family size in the data by using *per capita* wealth to determine the family's relative wealth
- The additional challenge for measurement is that both the SICHS census and the SICHS survey record the household's income in the preceding year
  - Use multiple observations or historical wealth to purge measurement error
- The relevant marriage market must also be defined
  - Relative wealth based on all households in the caste or the set of households that are included in the estimation sample for a given outcome

Evidence on Hypergamy

Dependent variable	Relative wealth of groom		Relative education of groom
	(1)	(2)	(3)
Relative wealth of bride	0.541***	0.540***	-0.057
	(0.033)	(0.033)	(0.031)
Relative education of bride	–	0.011	0.479***
		(0.034)	(0.031)
Constant	0.227***	0.222***	0.422***
	(0.018)	(0.024)	(0.022)
Observations	708	708	708

Source: SICHS survey. Sample restricted to primary respondents born after 1980 and children who married in the past 5 years. Relative wealth measured by rank in the caste wealth distribution, from 0 (poorest) to 1 (wealthiest). Education measured relative to all females/males in the SICHS census in the same caste who are no more than 5 years younger or older. *** $p < 0.01$

Hypergamy and Relative Wealth

Figure axes: Bride's rank in caste wealth distribution (x-axis), Groom's rank in caste wealth distribution (y-axis)

Legend:
— Rank based on all households in the caste
- - - Rank based on households with marriages
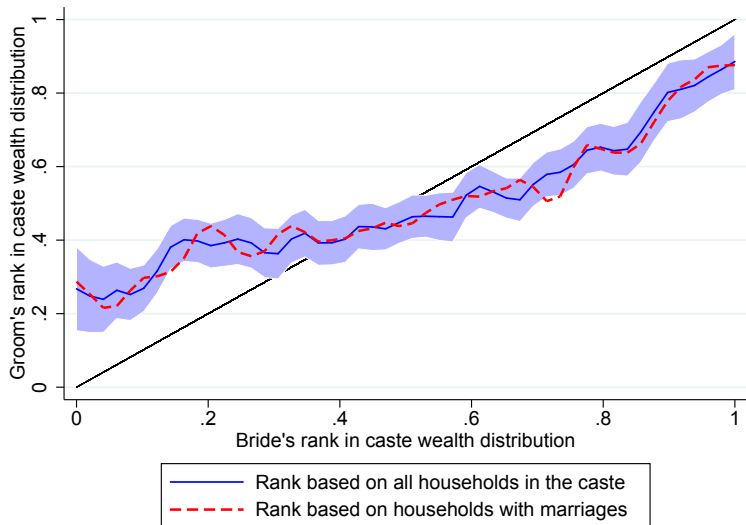
Evidence on Dowries

Dependent variable	Dowry		
Wealth measure	SICHS survey	Average of SICHS survey and census	Average per capita
	(1)	(2)	(3)
Relative wealth	37.045**	79.761***	98.716***
	(15.675)	(16.137)	(15.814)
Mean of dependent variable	167.63	167.63	167.63
Female dummy	Yes	Yes	Yes
Caste FE	Yes	Yes	Yes
Observations	991	991	991

Source: SICHS survey. Sample based on all children's marriages in the past 5 years. Dowry measured in thousands of Rupees. Relative wealth measured by rank in the caste wealth distribution, from 0 (poorest) to 1 (wealthiest). *** $p<0.01$, ** $p<0.05$

Dowry and Relative Wealth
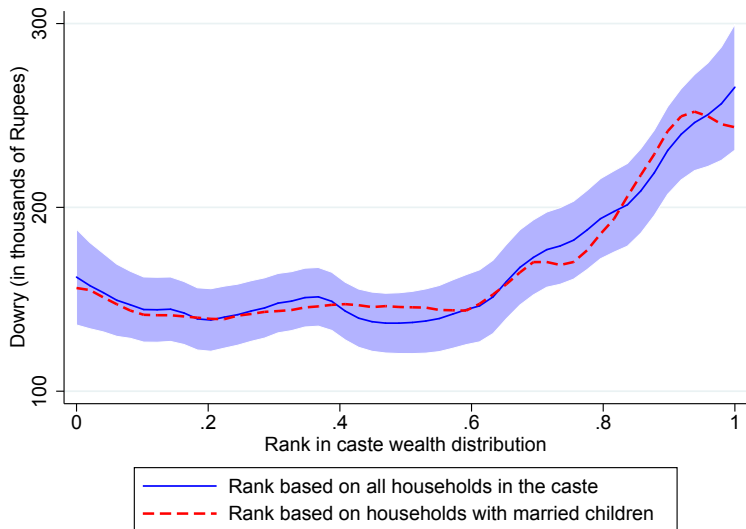
Dowry and Relative Wealth (by gender)
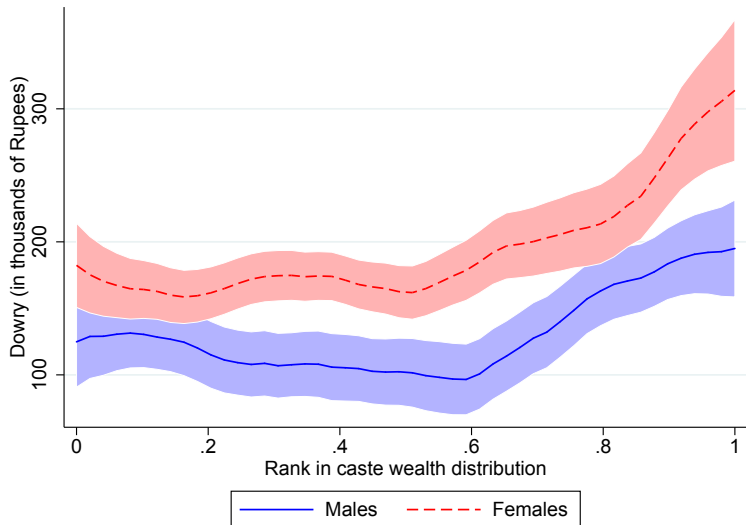
Evidence on Sex Selection

Dependent variable	Girl dummy		
Wealth measure	Reported wealth	Predicted wealth	
Family size measure	Observed		Predicted
	(1)	(2)	(3)
Rank in caste per capita wealth distribution	-0.00554 (0.00847)	-0.0455*** (0.00682)	-0.0453*** (0.00674)
Mean of dependent variable	0.480	0.480	0.480
Observations	78,979	78,979	78,979
Caste FE	Yes	Yes	Yes

Source: SICHS census. Sample restricted to children aged 0-6 years. Relative wealth measured by rank in the caste per capita wealth distribution, from 0 (poorest) to 1 (wealthiest). Predicted wealth is based on historical agricultural productivity in the village and the household's caste. Predicted family size is based on household wealth and parental characteristics. Standard errors (in parentheses) are calculated on the basis of 500 bootstrap replications. All standard errors are clustered at the panchayat level. *** $p < 0.01$

Sex Selection and Relative Wealth
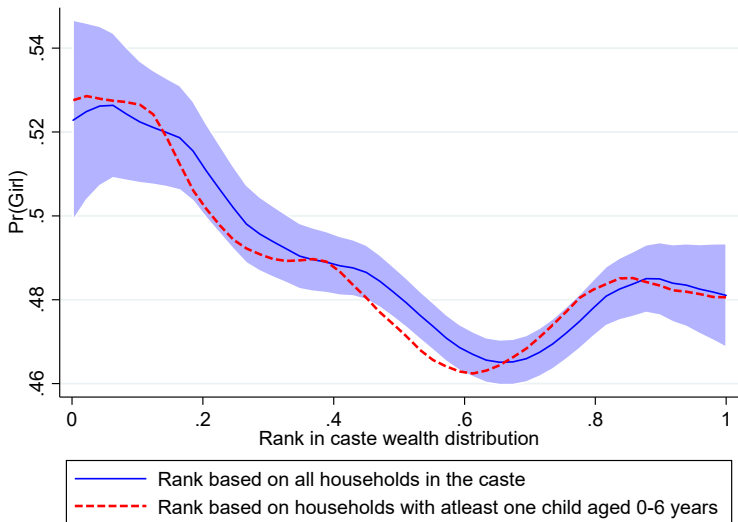
Sex Selection and Wealth: Identification

- Factors that contributed to the increase in sex selection over time could also generate cross-sectional variation:
  1. Reduced fertility coupled with the need for at least one son (Basu 1999)
  2. Improved access to sex selection technology (Arnold, Kishor, and Roy 2002, Bhalotra and Cochrane 2010)
  3. Relative increase in the economic returns to boys versus girls (Rosenzweig and Schultz 1982, Foster and Rosenzweig 2001)

Sex Selection and Wealth: Identification

- We take advantage of two features of the theory and the data to identify the marriage market mechanism
    1. Sex selection is determined by the family's relative position in its caste's per capita wealth distribution in the model
    2. Data from multiple castes are available

- Once caste fixed effects are included, the only threat to identification is that household wealth and household size, which we use to construct per capita wealth, could be correlated with independent determinants of sex selection
    - We thus include a flexible control function with wealth and size as arguments in the estimating equation
    - This allows us to effectively compare two households with the same wealth and size but at different positions in their caste per capita wealth distribution
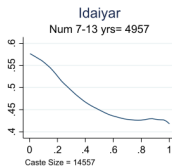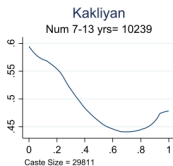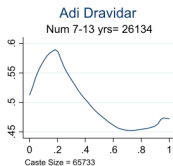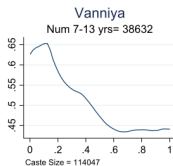
Sex Selection and Relative Wealth (control function)
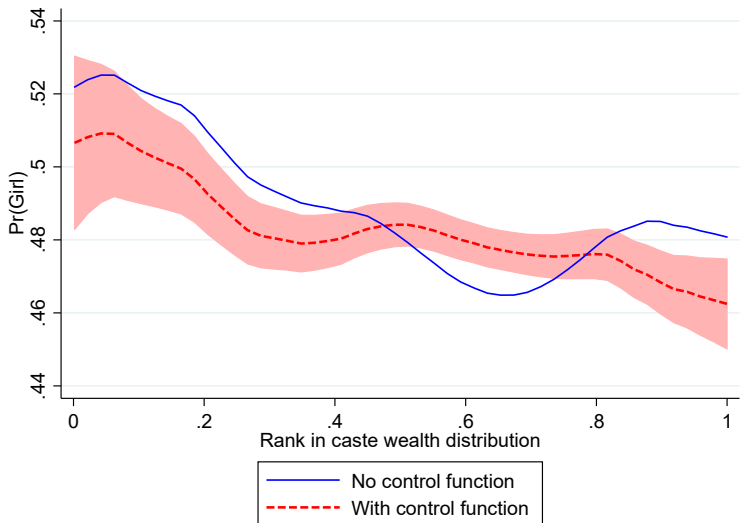
Sex Selection and Wealth, by Caste (aged 0-6)
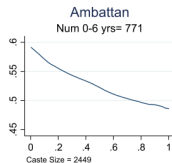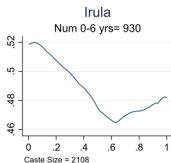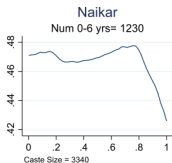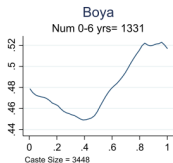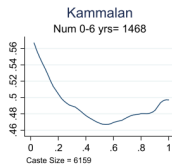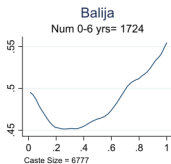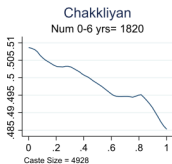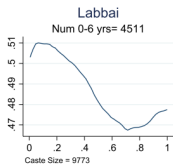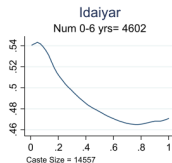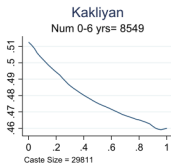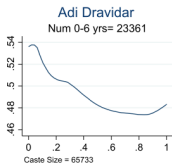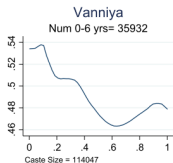
# Sex Selection and Wealth, by Caste (aged 7-13)
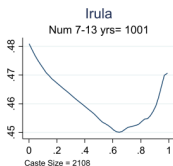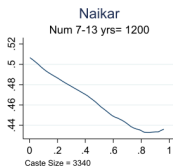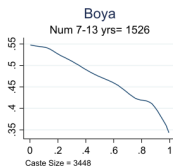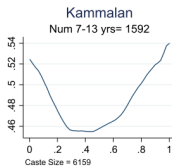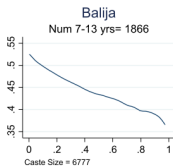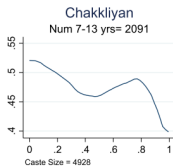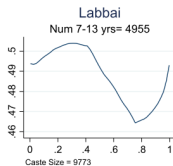
Magnitude of Within-Caste Variation

- To quantify the magnitude of the within-caste variation, we partition each caste into eight equally sized wealth classes
- Compare R^2 with and without caste fixed effects to decompose variation
  - Within-caste variation accounts for 70% of explained variation with 30 largest castes
  - 87% with 12 largest castes
- Measure the range of sex ratios across wealth classes within castes
 - 97 to 117

Evaluating Alternative Policies

- The estimated structural parameters can be used to conduct counter-factual policy experiments

1. Gift tax on the dowry
2. Conditional Cash Transfer Schemes; e.g. Anukriti (forthcoming)
    - Parents receive transfers at different points in childhood, conditional on having a girl
    - An insurance cover is provided, which matures when the girl turns 18 or 20
    - Some schemes are restricted to low income families

Policy 1: Gift Tax
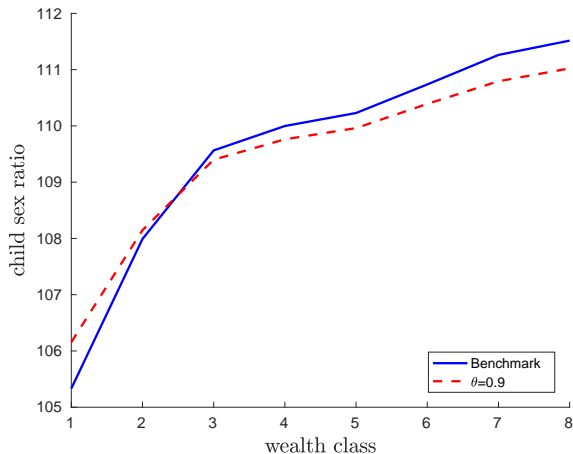
Policy 2: Conditional Cash Transfers
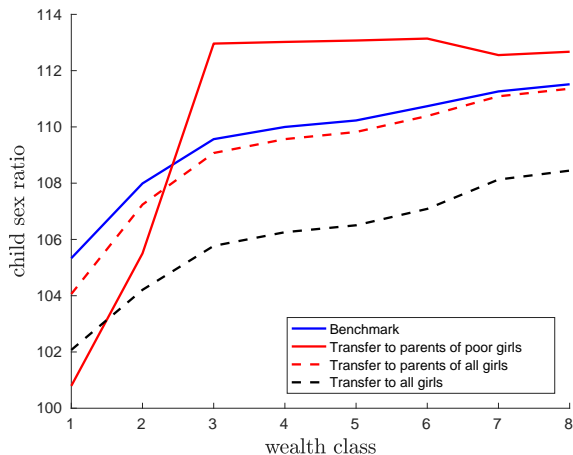
Conclusion

- The public debate on sex selection in India has largely focussed on changes over time and on sub-populations where the problem is especially severe
- The new evidence we have collected indicates that sex selection increases steeply with relative wealth within all castes
  - Within-caste variation in a relatively unexceptional district is as large as the variation across states in the country
  - The marriage market is organized the same way in all castes and so the problem may be more pervasive than we think

- What can we do to reduce the problem?
  - Taking the marriage market imperfections as given, the optimal policy would target transfers directly to married women
  - Female employment programs would address the root cause of the problem by breaking the norm that all girls must marry and by increasing their bargaining power in their marital homes