The Global Economic Implications of China's Sex Ratio Imbalance

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Based on joint research work with Dr. Xiaobo Zhang

Consequences of high saving rate
Greenspan, Wall Street Journal, March 12, 2009
"The Fed Didn't Cause the Housing Bubble"

- "… a surge in growth in China and a large number of other emerging market economies … led to an excess of global intended savings relative to intended investment. That ex ante excess of savings propelled global long-term interest rates progressively lower between early 2000 and 2005."

- "The decline in long-term interest rates … statistically explains, and is the most likely major cause of, real-estate capitalization rates that declined and converged across the globe, resulting in the global housing price bubble."
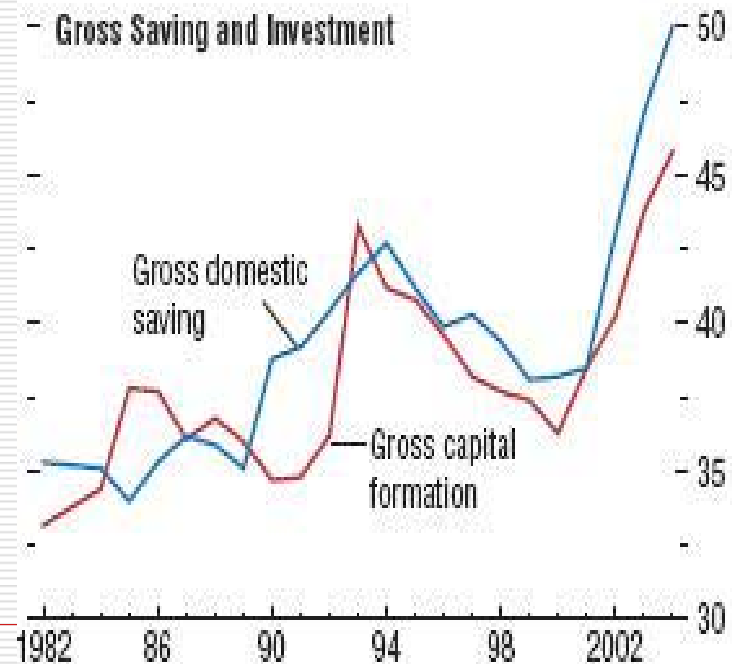
Chinese savings rate today is extraoridnary high

It is high

- ☐ relative to other countries

- ☐ relative to its own past

- ☐ relative to its already high investment rate

China's Saving and Investment by Sector
(Percent of GDP)

Gross Saving and Investment

Gross domestic saving

Gross capital formation

1982   86   90   94   98   2002

Consequences of high savings rate

- High savings rates -> global current account imbalances

    ??? -> housing price bubbles -> global financial crisis

- Growth is driven by the high investment, and therefore indirectly driven by the high savings rate

Why do the Chinese save so much?

- ☐ Inadequate social safety net
  - ■ + rising uncertainty
- ☐ Low level of financial development
- ☐ Life-cycle hypothesis
- ☐ Culture
- ☐ Habit
- ☐ Corporate savings
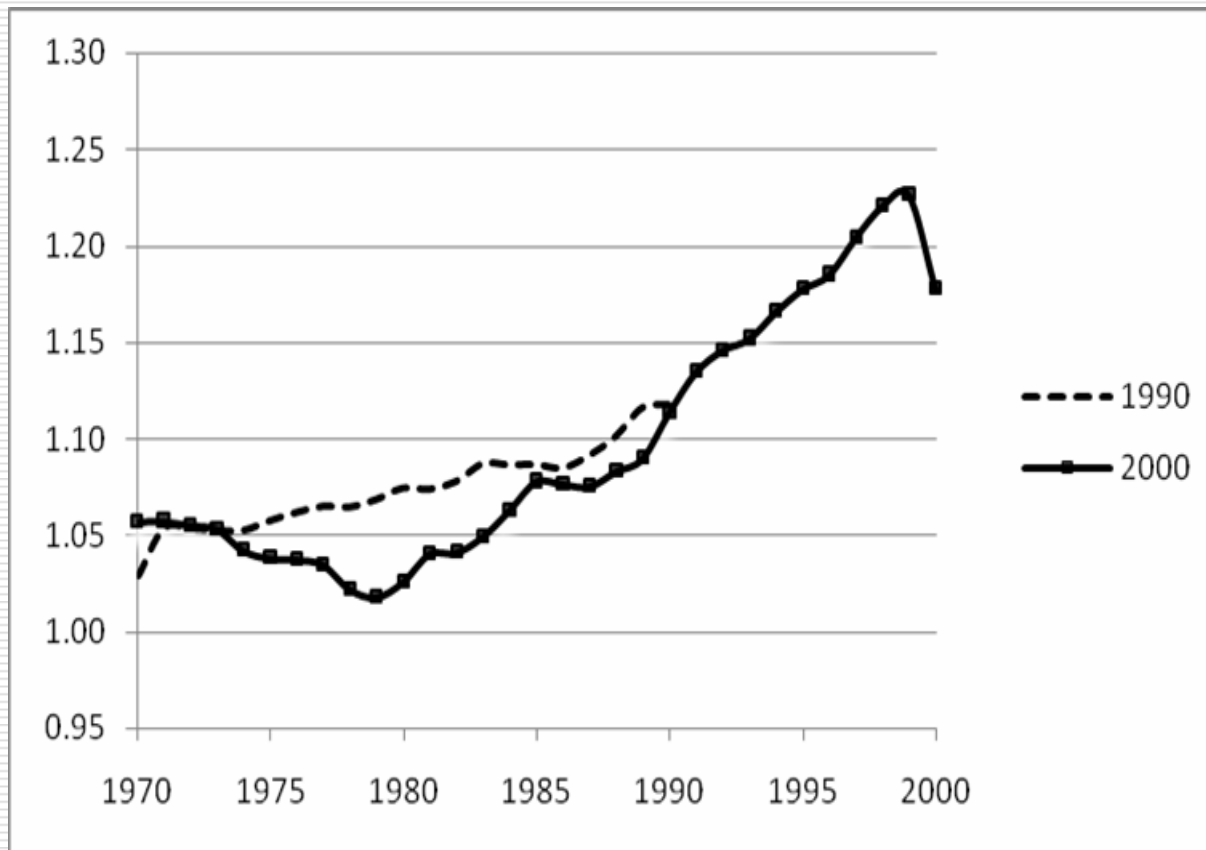- ☐ Unintended consequence of social policies?

New explanation?

☐ Sex ratio imbalance:

   ■ Too many men, too few women

☐ Nature intended ratio:

   ■ 105 boys / 100 girls

☐ A surge in sex ratio in China

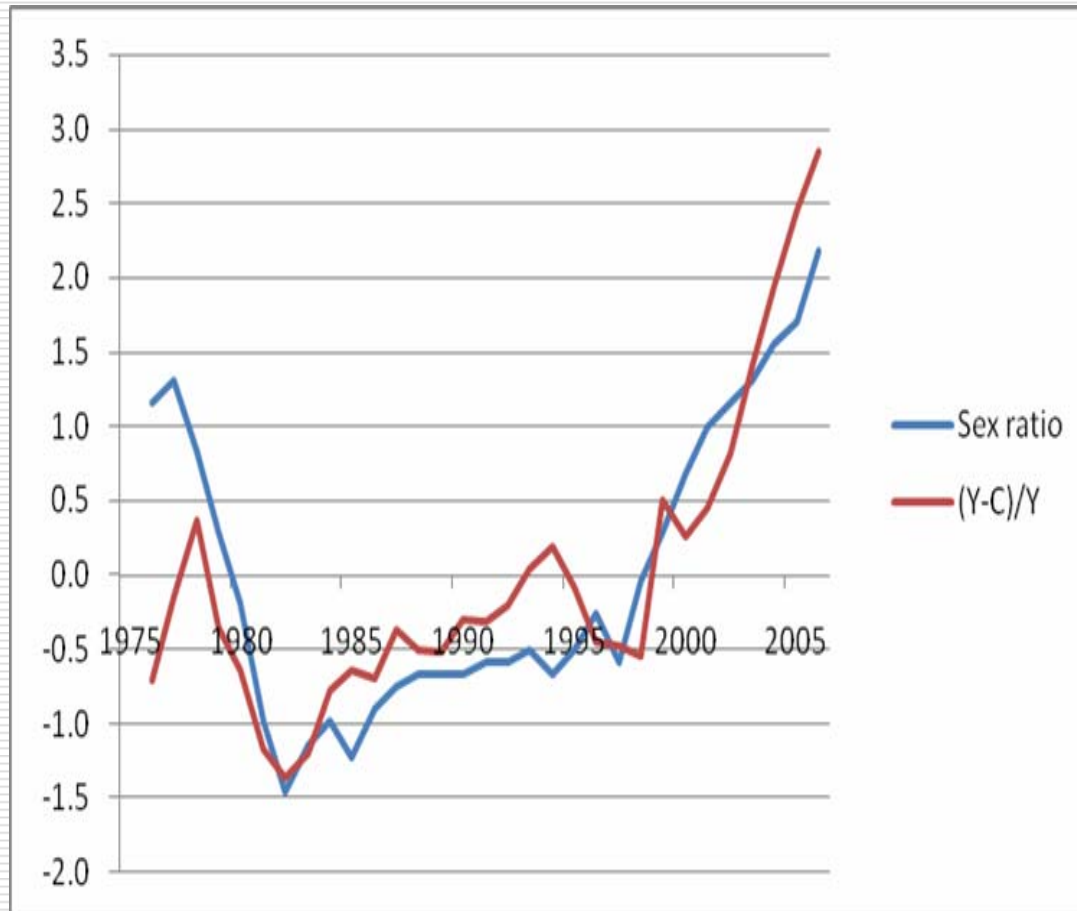   ■ From 107/100 in 1986 to about 122/100 today.
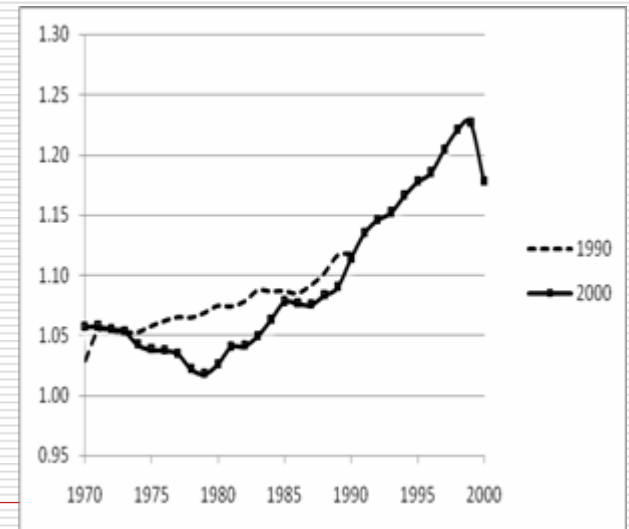
Sex ratio by birth year
sources: 1990 and 2000 China population censuses

Sex ratio and saving rate in China:1975- 2005
Sex ratio at birth lagged by 20 years

Age distribution of first marriage in China in 2000

source: authors calculation based on *China Population Census 2000.*
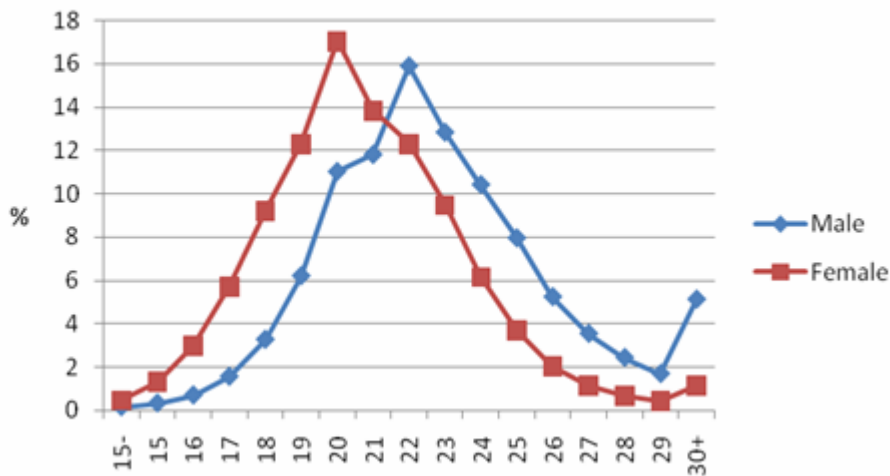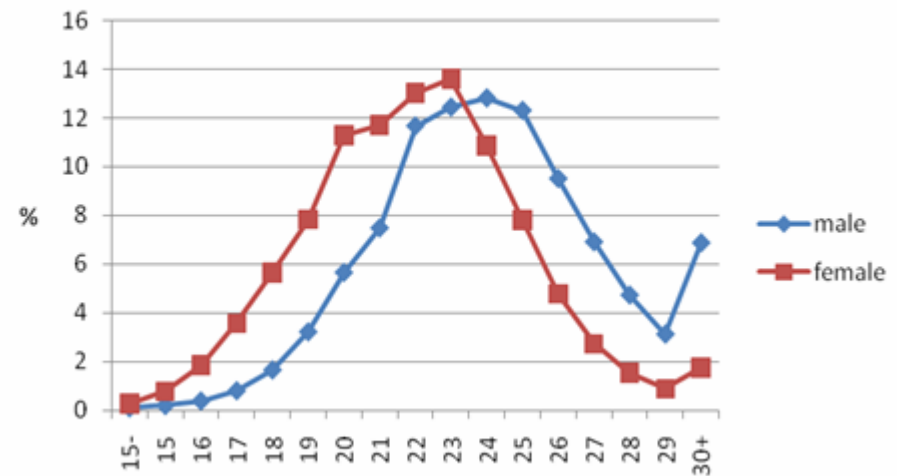
Initial inspiration

- ☐ Visits to the National Zoo

- ☐ Sexual dimorphism – evolutionary biology: Males try to be more attractive to potential mates by making themselves physically larger

- ☐ Men have tried that before …

- ☐ Now they think making their bank accounts larger might be a little bit more effective

Our hypothesis, critiques, and responses

- Assuming most men want to be married
- An increase in male/female ratio -> increase competition for mate

-> men (/their parents) may try harder, including putting a greater weight on accumulating wealth and raising savings rate.

- Conspicuous consumption vs wealth accumulation

- Why don't women (parents of girls) decrease savings to completely offset the extra savings by men (parents of a boy)?
- Possible spillover in the need for savings
  - Local housing prices and cost of education may have gone up
  - Is the spillover strong enough? Empirical question.

Philosophers

Madonna Louise Ciccone Ritchie (1958-)

http://www.youtube.com/watch?v=tpAcz2tKaSM

Philosophers

Madonna Louise Ciccone Ritchie (1958-)

"We are living in a material world, and I am a material girl.

Some boys try and some boys lie, but I don't let them play.

Only boys who save their pennies, make my rainy day"

From Material Girl

Philosophers

Marilyn Monroe (1926-1962)

"The French are bred to die for love, they delight in fighting duels;

But I prefer a man who lives and gives expensive jewels"

From Diamonds are a girl's best friend

Philosophers

Adam Smith (1723-1790)

"It is not wealth that men desire, but the consideration and good opinion that wait upon riches."

From <u>The theory of moral sentiments</u>

Empirical support?

Core evidence:

- ☐ Panel regressions on regional aggregate savings
- ☐ Household savings

Additional evidence:

- ☐ Time profile of savings w.r.t wedding
- ☐ bank deposits
- ☐ housing size
- ☐ preliminary international evidence

How important are the estimates economically?

- ☐ From 1990 to 2006, the sex ratio increased from 1.11 to 1.20. The savings rate increased from 0.14 in 1990 to 0.32 in 2006.

- ☐ Using the panel coeffi. estimates, this would raise the savings rate by 0.09*0.75 = 0.08.

- ☐ Therefore, the change in sex ratio alone, holding other factors constant, could explain 0.08/0.18 = 44% of the actual increase in the saving rate.

- ☐ The effect is bigger using the instrumental variable coefficients

Household-level evidence

- Urban vs. rural
  - Urban: saving by 3-person households with a boy vs. those with a girl
  - Rural: saving by 3-person household with a boy, vs. those with a girl, vs. those with 2 girls

- Not informative to compare savings by two types of households

- Need to look at relationship betn household savings and local sex ratios

How important are the estimates economically?

- From 1986 to 2006, the sex ratio for the cohort of 5-19 increased from 1.063 (1.069) to 1.139 (1.127) in the rural (urban) areas.

- Based on the coefficient estimates, this would raise the saving rate in the rural (urban) areas by 4.5 (3.3) percentage points (or from 15.8 (11.2) in 1986 to 20.3 (14.5) in 2006 for rural and urban residents, respectively, in 2006).

- The actual saving rate was 15.8 (11.2) in rural (urban) areas in 1986, and rose to 21.1 (26.0) in 2006. Therefore, the change in sex ratio alone, holding other factors constant, could explain 68% (18%) of the actual increase in the saving rate.

Concluding remarks

- A rising sex ratio imbalance appears to be a driver for a rising savings rate

- Relaxation of one-child policy may lead to a reduction in saving rate

- Parental preference for a son is likely to reverse itself, but only slowly

- Future work:
  - From sex ratio imbalance to current account imbalance
    - Should the IMF pay attention to the one-child policy?
  - Sex ratio and crime (Edlund et al)
  - Sex ratio and entrepreneurship?

Sex ratios and savings rate across provinces

- ☐ Panel fixed effects regressions, 31 provinces, 1978-2006

- ☐ LHS = Local savings rate
    - ■ = log (net income/living expenditures)

- ☐ RHS: Local sex ratio, log income, age profile of population, proxies for access to social safety net, province fixed effects,

- ☐ Local sex ratio is either for age cohort 6-25 inferred from the 2000 population census, or for age cohort 16-25 inferred from the 1990 census.

Sex ratio by birth year
sources: 1990 and 2000 China population censuses
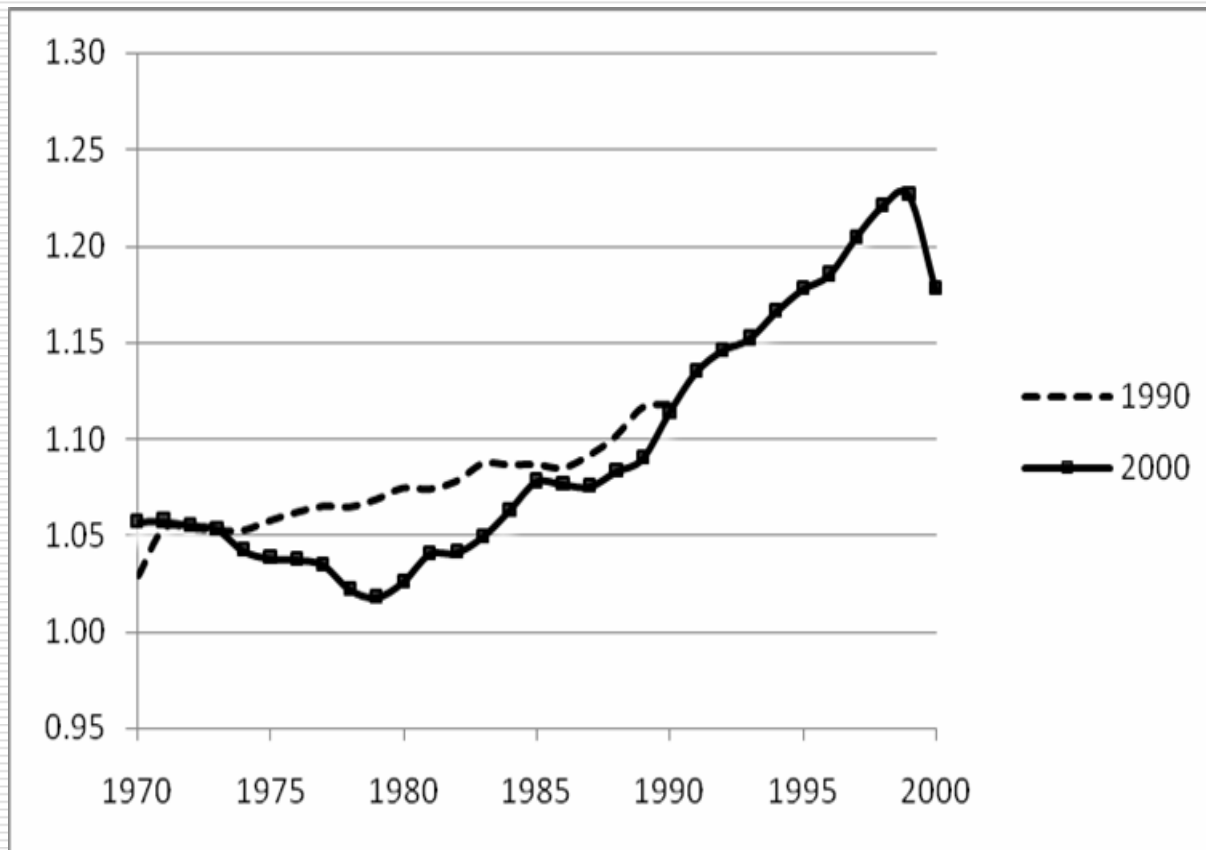
Regional sex ratios by birth year:
Henan and Inner Mongolia
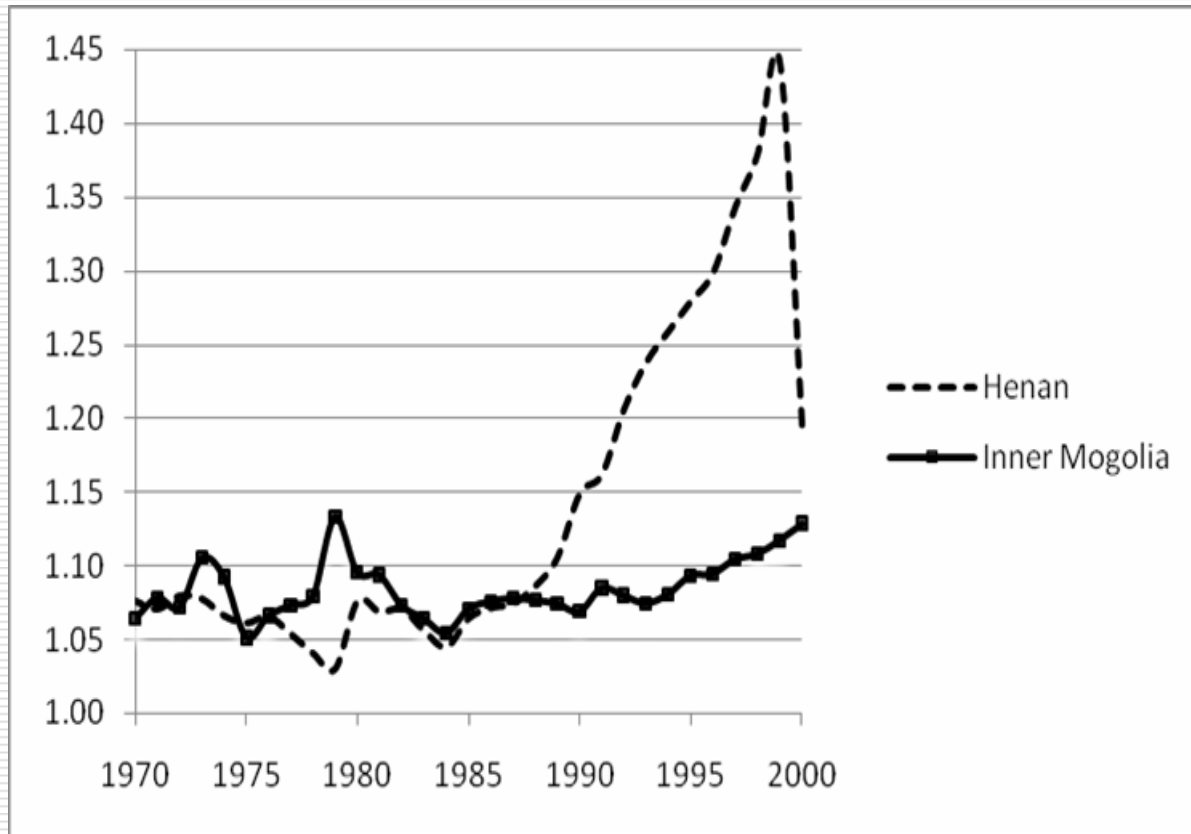
Panel Fixed Effects Regressions across Provinces 1978-2006: Dependent variable = savings rate

	Sex ratio inferred from the 2000 census		Sex ratio inferred from the 1900 census	
Sex ratio	0.73* (0.11)	0.83* (0.13)	0.47* (0.08)	0.62* (0.10)
Log income/capita	0.48* (0.10)	0.59* (0.11)	0.61* (0.11)	0.74* (0.12)
Share of pop aged 0-17	-0.13 (0.13)	-0.02 (0.12)	-0.28* (0.15)	-0.20 (0.13)
Share of pop employed in SOE		-0.21* (0.08)		-0.28* (0.09)
Other controls (SOE, soc sec)	No	Yes	no	yes
Year/region fixed effects	yes	yes	yes	yes

Panel Fixed Effects Regressions Across Provinces: 1978-2006: Dependent variable = saving rate

	Rural	Rural	Urban	Urban
Per capita income	0.674***	0.200***	0.382***	-0.181**
	(0.12)	(0.06)	(0.09)	(0.08)
Sex ratio	0.716***	0.686***	0.369***	0.286***
	(0.15)	(0.19)	(0.12)	(0.08)
Share of pop at the age of 25-60	0.836	-1.394**	0.339	-0.249***
	(0.57)	(0.56)	(0.27)	(0.10)
Provincial fixed effects	yes	yes	yes	yes
Year fixed effect	yes		yes	
Adjusted R-squared	0.439	0.283	0.384	0.333
N	811	811	803	803

Instrumental variable regression:

- ☐ First stage specification
  - ■ Thanks to Avi Ebenstein (2008)

- ☐ Sex ratio = a
  - ■ + b1 fine on violating family planning
  - ■ + b2 dummy for extra fines on a higher-order child
  - ■ + b3 share of population not subject to birth quota
  - ■ + residual

- ☐ Hausman-Durbin-Wu test + over-identification test
- ☐ Alternative IV: without minority share

First stage regression:
LHS = local sex ratio

		Sex ratio Fr 2000 census	Sex ratio Fr 1990 census
Penalty for not conforming with one-child policy		0.03 (0.02)	0.04* (0.02)
Dummy for years of an extra fine for higher-order births		0.04* (0.01)	0.03* (0.01)
Share of non-Han in population		-0.49* (0.16)	-0.78** (0.15)
Other controls?		yes	Yes
Region/year dummies		Yes/yes	Yes/yes

IV regressions 1978-2006:
Dependent variable = savings rate;

	Sex ratio inferred from the 2000 census		Sex ratio inferred from the 1900 census	
Sex ratio	1.25*		1.28*	
	(0.47)		(0.57)	
Log income/capita	0.61*		0.74*	
	(0.10)		(0.11)	
Share of pop aged 0-17	-0.04		-0.07	
	(0.17)		(0.17)	
Share of pop in SOEs	-0.09		-0.69*	
	(0.04)		(0.38)	
Other controls (SOE, soc sec)	yes		yes	
P-value for HDW / Over-id tests	0.26/0.69		0.11/0.37	

First stage regression :

Excluding non-Han share as an IV; LHS = local sex ratio

		Sex ratio Fr 2000 census	Sex ratio Fr 1990 census
Penalty for not conforming with one-child policy		0.03 (0.02)	0.04* (0.02)
Dummy for years of an extra fine for higher-order births		0.04* (0.01)	0.03* (0.01)
Log (income / capita)		0.29* (0.01)	0.18** (0.03)
Other controls?		yes	Yes
Region/year dummies		Yes/yes	Yes/yes

IV regressions 1978-2006:

Dependent variable = savings rate; IV without non-Han share

	Sex ratio inferred from the 2000 census		Sex ratio inferred from the 1900 census	
Sex ratio	1.01*		3.53	
	(0.52)		(2.89)	
Log income/capita	0.56*		0.73*	
	(0.10)		(0.16)	
Share of pop aged 0-17	0.03		0.09	
	(0.17)		(0.32)	
Share of pop in SOEs	-0.24*		-1.22	
	(0.12)		(1.01)	
Other controls (SOE, soc sec)	yes		Yes	
P-value for HDW / Over-id tests	0.71/0.61		0.08/0.89	

First stage regression:
LHS = local sex ratio

		rural	urban
Share of non-Han in local population		-0.21* (0.04)	-0.25* (0.06)
Penalty for not conforming with one-child policy		0.03* (0.01)	0.02* (0.01)
Dummy for years of an extra fine for higher-order births		0.03* (0.01)	0.02* (0.01)
Log (income / capita)		0.03* (0.01)	-0.08* (0.01)
Provincial dummies		yes	yes
Year dummies		yes	yes

IV Regressions: 1978-2006
Dependent variable = savings rate

	Rural	Rural	Urban	Urban
Per capita income	0.664***	0.193***	0.501***	-0.165**
	(0.12)	(0.07)	(0.08)	(0.07)
Sex ratio	1.309**	1.017	1.452**	0.481
	(0.56)	(0.75)	(0.59)	(0.34)
Share of pop at the age of 25-60	1.115*	-1.361**	0.791**	-0.246**
	(0.66)	(0.60)	(0.33)	(0.11)
Provincial fixed effects	yes	yes	yes	yes
Year fixed effect	yes		yes	
Adjusted R-squared	0.434	0.281	0.275	0.328
Endogenity test	0.389	0.283	0.055	0.929
Over indentification test	0.509	0.643	0.051	0.56
N	811	811	803	803

Fails to reject the null hypothesis of exogeneity and over-identification.

How important are the estimates economically?

- From 1986 to 2006, the sex ratio for the cohort of 5-19 increased from 1.063 (1.069) to 1.139 (1.127) in the rural (urban) areas.

- Based on the coefficient estimates, this would raise the saving rate in the rural (urban) areas by 4.5 (3.3) percentage points (or from 15.8 (11.2) in 1986 to 20.3 (14.5) in 2006 for rural and urban residents, respectively, in 2006).

- The actual saving rate was 15.8 (11.2) in rural (urban) areas in 1986, and rose to 21.1 (26.0) in 2006. Therefore, the change in sex ratio alone, holding other factors constant, could explain 68% (18%) of the actual increase in the saving rate.

LHS= rural household saving rate in 2002
Data source: Rural Household Survey, 2002

	Having a son		Having a daughter		Having two daughters	
Per capita income (log)	0.502***	3.468***	0.647***	3.302***	0.562***	2.344**
	(0.06)	(0.61)	(0.09)	(0.70)	(0.07)	(1.01)
Per capita income squared		-0.187***		-0.176***		-0.116*
		(0.04)		(0.04)		(0.07)
Sex ratio at the county level	1.410**	1.526***	0.461	0.617	0.099	0.083
	(0.59)	(0.59)	(0.81)	(0.71)	(0.69)	(0.68)
Household head age	-0.024***	-0.019***	-0.006	-0.003	-0.005	-0.005
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Household head sex (1=female)	-0.116	-0.13	-0.343	-0.31	-0.195	-0.223
	(0.13)	(0.13)	(0.21)	(0.22)	(0.15)	(0.15)
Year of schooling	0.008	0.009	-0.032**	-0.024*	-0.02	-0.018
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Household as a miniorty	-0.121	-0.176	-0.245**	-0.225*	-0.062	-0.074
	(0.14)	(0.12)	(0.11)	(0.12)	(0.11)	(0.12)
Share of pop at the age of 25-59	0.004	0.003	0.035***	0.023**	0.024	0.024
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Adj. R-squared	0.255	0.3	0.464	0.535	0.321	0.33
AIC	663.2	636.2	297.9	266.2	337.8	335.4
N	449	449	230	230	231	231

LHS= Urban household savings rate in 2002
Data source: Urban Household Survey, 2002

|	Having a son		Having a daughter	
Per capita income (log)	0.157***	1.181	0.200***	1.096*
	(0.04)	(0.90)	(0.04)	(0.60)
Per capita income squared		-0.058		-0.051
		(0.05)		(0.03)
Sex ratio at the county level	1.736***	1.732***	1.691***	1.647***
	(0.51)	(0.51)	(0.53)	(0.52)
Household head age	0.003	0.004	-0.008	-0.008
	(0.01)	(0.01)	(0.01)	(0.01)
Household head sex (1=female)	-0.055	-0.061*	-0.124***	-0.121***
	(0.04)	(0.04)	(0.04)	(0.04)
Year of schooling	-0.006	-0.007	-0.002	-0.003
	(0.01)	(0.01)	(0.01)	(0.01)
Household as a miniorty	0.094	0.092	0.02	0.021
	(0.08)	(0.08)	(0.10)	(0.09)
Share of pop at the age of 25-59	0.008	0.008	-0.022*	-0.021*
	(0.01)	(0.01)	(0.01)	(0.01)
Adj. R-squared	0.09	0.093	0.148	0.154
AIC	103.4	103.6	206.4	205.3
N	277	277	311	311

How important are the estimates economically?

- From 1986 to 2006, the sex ratio for the cohort of 5-19 increased from 1.063(1.069) to 1.139 (1.127) in the rural (urban) areas, respectively.

- Based on the coefficient estimates, this would raise the saving rate in the rural (urban) areas by 3.2 (3.5) percentage points (or from 15.8 (11.2) in 1986 to 19.0 (14.7) in 2006 for rural and urban residents, respectively.

- Therefore, the change in sex ratio alone, holding other factors constant, could explain 43% (18%) of the actual increase in the saving rate in rural areas and cities.

- The above simulation is based on the proportion of one-child family, which is low in rural areas. If using the proportion of families with at least a son, the contribution increases to 67% in rural areas.

Other evidence?

- ☐ Household savings rate in relation to timing of wedding

- ☐ Deposits

- ☐ Housing size

- ☐ international
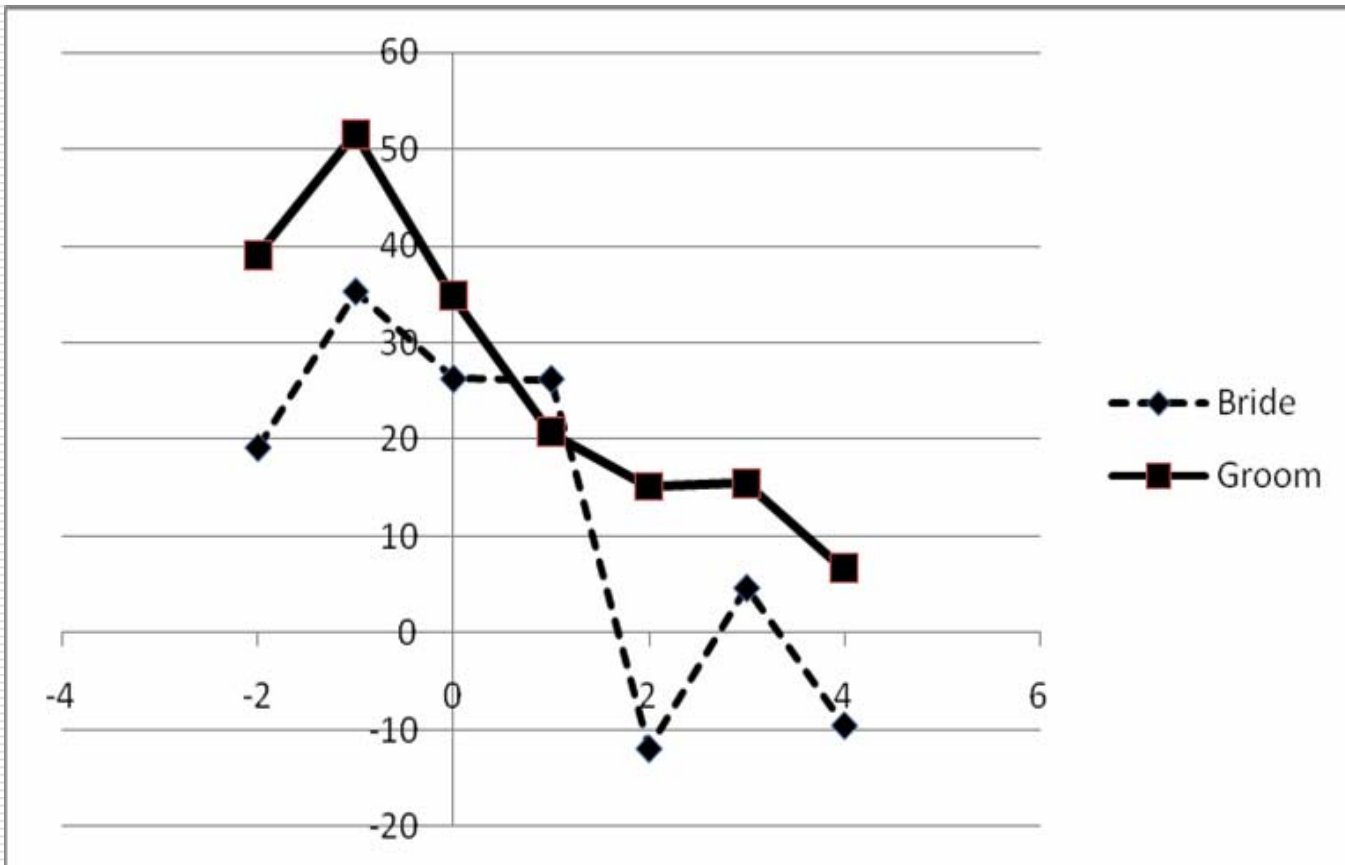
Household savings rate in relation to the timing of a wedding in the family in rural Guizhou Province
Source: Authors' calculation based on household surveys conducted by IFPRI in 2005 and 2007

Evidence across counties

- Bank deposits and sex ratio across counties

Change in Bank Deposits at the County Level: 1992-2002

	R1	R2	R3	R4
Initial deposit (log)			-0.130***	-0.186***
			(0.02)	(0.02)
Change in sex ratio (15-24)	0.724***	0.536**	1.655***	1.146***
	(0.22)	(0.25)	(0.23)	(0.23)
Change in the share of population (25-59)	0.289	0.066	0.098	-0.214
	(0.33)	(0.38)	(0.32)	(0.38)
Change in the share of population (60 and above)	-0.097	-0.138	0.973	0.726
	(0.70)	(0.81)	(0.69)	(0.78)
Provincial fixed effects	no	yes	no	yes
Adjusted R-squared	0.008	0.072	0.094	0.18
AIC	2586.4	2489.2	2415.5	2256.2
N	1886	1886	1886	1886

Evidence across counties

- Size of housing living space and sex ratio

Housing Size at the County Level, 2000

	0-24	0-14	15-24	25-34
Per capita GDP in 1999 (log)	0.081***	0.078***	0.083***	0.081***
	(0.01)	(0.01)	(0.01)	(0.01)
Household size (log)	0.033***	0.039***	0.037***	0.043***
	(0.01)	(0.01)	(0.01)	(0.01)
Sex ratio at different ages	0.629***	0.312***	0.558***	-0.049
	(0.13)	(0.10)	(0.21)	(0.06)
Share of pop at the age of 15-24	-6.572***	-6.170***	-6.689***	-6.814***
	(0.52)	(0.58)	(0.52)	(0.53)
Share of pop at the age of 25-34	-3.445***	-3.290***	-3.608***	-3.738***
	(0.42)	(0.48)	(0.42)	(0.43)
Share of pop at the age of 35-59	-6.490***	-6.194***	-6.667***	-6.784***
	(0.71)	(0.77)	(0.71)	(0.73)
R-squared	0.261	0.259	0.258	0.255
AIC	1178.4	1183.4	1187.4	1194.8
N	2087	2087	2087	2087

Cross-country evidence?

☐ Could the story be generalized outside China?

☐ Preliminary evidence: 131 countries in 2006

$Log((Y-C)/Y)= a+ b1 \log(Y) +b2 [\log(Y)]^2+ b3 \log(\text{sex ratio}) +e$

Y (C)- per capita GDP (Consumption)

☐ Panel regressions to be done

Preliminary Cross-Country Evidence I:
Saving in 2005 against Sex Ratio at Birth in 1985

Log((Y-C)/Y)= a+ 0.91 log(Y) -0.06[log(Y)]^2+9.32log(sex ratio)
            (0.25)*   (0.02)*   (0.80)*

R-squared = 0.66; N=131; Y (C)- per capita GDP (Consumption)

Partial scatter plot
of log((Y-C)/Y)
against log sex
ratio, conditioning
on log(inc) and its
squared.

Sex Ratio at Birth in 1985, Males to 100 Females, Source: Gender Info 2007

| 95% CI | predicted r |

Preliminary Cross-Country Evidence II:
Saving in 2005 against Sex Ratio at Birth in 1985

Log(inc/exp)=
a+0.69 log(inc) -0.04[log(inc)]^2+25.44|sex ratio-1.05|-17.4D(SR<1.05)
  (0.16)*   (0.02)*   (2.15)*   (3.42)

R-squared = 0.91; N=140

Partial scatter plot of log(inc/exp) against log sex ratio, conditioning on log(inc) and its squared.

Sex Ratio at Birth in 1985, Males to 100 Females, Source: Gender Info 2007

95% CI   predicted saving   Residuals
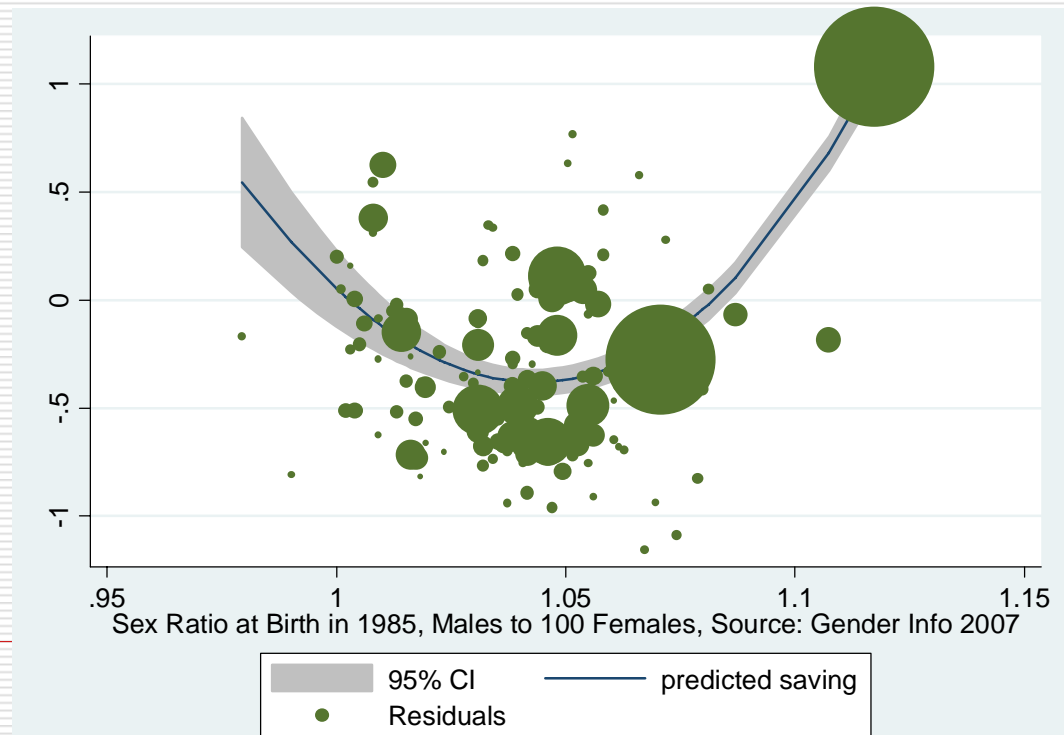
- [ ] The coefficient on sex ratio still positive and statistically significant after excluding China

- [ ] The point estimate about the same size

Is there a non-linearity

- Would deviation from norm from either direction raise saving rate?

$$Log(inc/exp)= a+b1 \; log(inc)+b2[log(inc)]^{2}+ b3|sex \; ratio-1.05| +e$$

- Is there an asymmetry?

$$Log(inc/exp)=$$

$$a+b1 \; log(inc)+b2[log(inc)]^{2}+ b3|sex \; ratio-1.05| +b4D(SR<1.05)+e$$

- Conclusions
  - Sex ratio imbalance -> higher savings rate
  - Quantitatively important

- Future work
  - Sex ratio imbalance -> entrepreneurship and growth

Marriage cost and sex ratio: Is there a connection?

Internet complaint by men about
   costs of getting a wife

"   ,   "

Expose of costs of getting a wife
in nine Chinese cities

:   2008-06-04

Example: Shanghai

- (　　　　　，　　　　，　　　　)

- 1.　　　　　　10000　　10000×100　100
- 2.　　　　　　100　　　15
- 3.　　　　　10
- 4.　(　　　　)　10　　　　　　　　　　　　1500
- 5.　(　　　　　　　　　　):　　　　6000　　6000×2　1.2

- 6.　　　　　　　　　　　　　　　　　　1800
  　　2　　1800×12×2　4.32

- Total cost: 100　15　10　10-0.5　1.2　4.32　140.02

- 　　　50　　　　　　6　　(140.02-50)/6　15

Estimated cost of getting a wife

- Beijing （　　）: 　　　1.068 million yuans
- Shanghai （　　　）: 　1.4002 million
- Suzhou （　）: 　　　0.7495 million
- Shenzhen （　） : 　　0.858 million
- Nanjing （　　）: 　　0.7 million
- Taizhou （　）: 　　　0.464 million
- Hangzhou （　　）: 　1.278 million
- Guangzhou （　　）: 1.048 million
- Wuhan （　）: 　　　　no total given

- What explains cross-city differences in the cost of getting a wife?

- Obviously, local income has to be a key determinant.

- But what about local sex ratio imbalance?

- Regression:

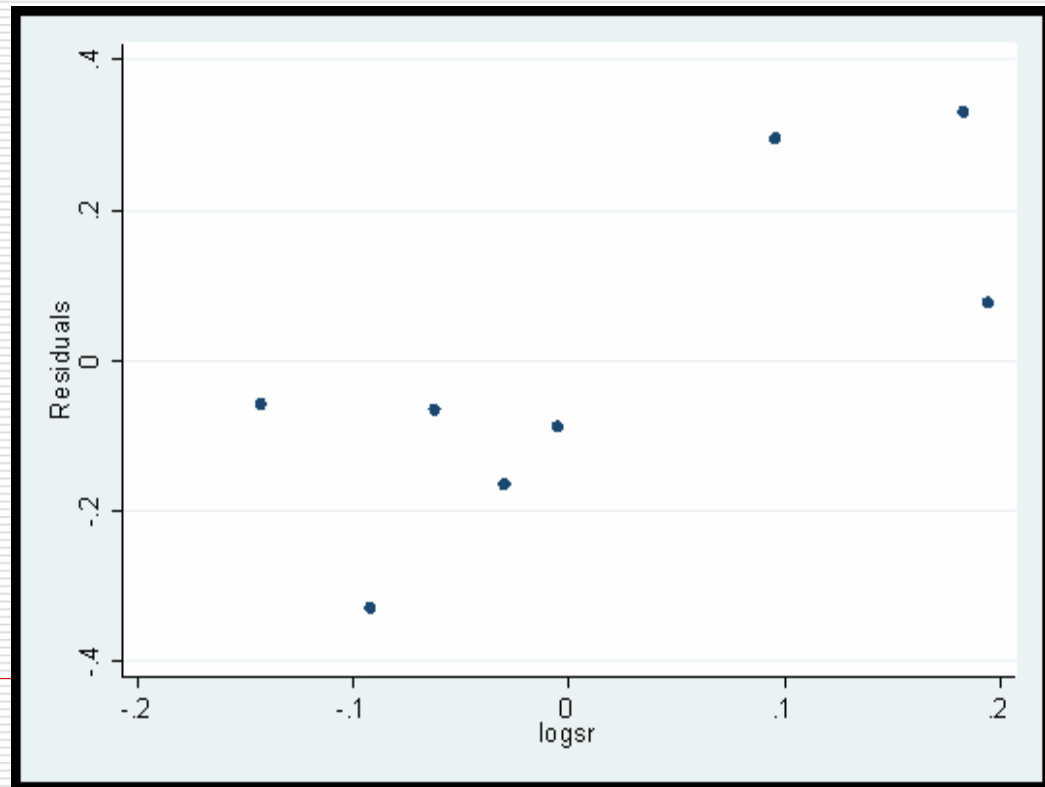$$Log(cost) = a + b1 \log(income) + b2 \log(sex\ ratio) + e$$

Higher sex ratio is indeed associated with a higher marriage cost, conditioning on local income !

Log(cost)= a+ 1.05 log(income) + 1.66 log(sex ratio) + e
             (0.33)*   (0.47)*

Adj. R-squared = 0.84

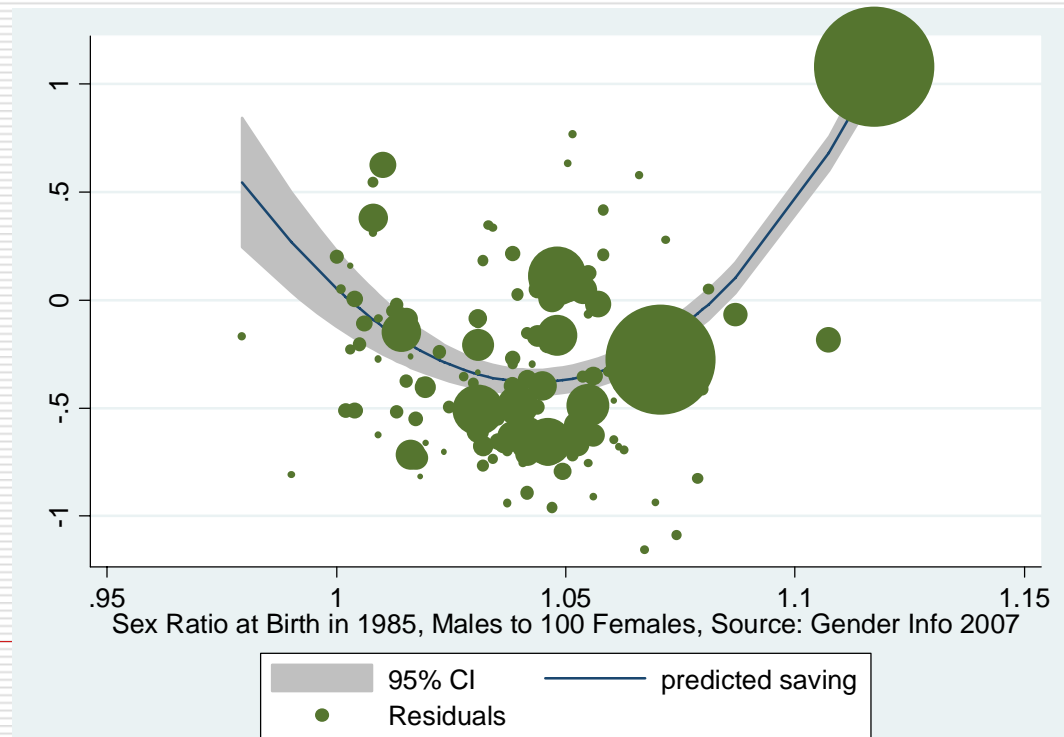Partial scatter plot of log cost against log sex ratio, conditioning on log income

Preliminary Cross-Country Evidence II:
Saving in 2005 against Sex Ratio at Birth in 1985

Log(inc/exp)=
a+0.69 log(inc) -0.04[log(inc)]^2+25.44|sex ratio-1.05|-17.4D(SR<1.05)
  (0.16)*   (0.02)*   (2.15)*   (3.42)

R-squared = 0.91; N=140

Partial scatter plot
of log(inc/exp)
against log sex
ratio, conditioning
on log(inc) and its
squared.

Sex Ratio at Birth in 1985, Males to 100 Females, Source: Gender Info 2007

95% CI   predicted saving

Residuals

Other evidence?

Concluding remarks

- A rising sex ratio imbalance appears to be a driver for a rising savings rate

- Relaxation of one-child policy may lead to a reduction in saving rate

- Parental preference for a son is likely to reverse itself, but only slowly

- Future work:
  - From sex ratio imbalance to current account imbalance
    - Should the IMF pay attention to the one-child policy?
  - Sex ratio and crime (Edlund et al)
  - Sex ratio and entrepreneurship?