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Sex Selection in China and its Demographic Causes

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Sex selection plagues large swaths of the world's societies, including its most populous country, China. Demographers have been able to see the maturation of the skewed cohorts coming, and the range of the disaster is well analyzed: increased sex trafficking, increased child-marriage, and an excess of chronically single men.[2]

We now know the onset of the skewed sex ratios requires the alignment of several components, and that if even one is missing, societies can escape the blight. A society with drastic sex selection must first have a cultural preference for males, as well as low fertility, easy access to prenatal sex-determination tests, and abortion (especially after the first trimester).[3] These three conditions parallel the classic framework posited by Ansley Coale regarding voluntary fertility reduction: that it must be seen by the individual as advantageous, feasible, and "within the calculus of conscious choice."[4]

For instance, Tajikistan has preferential male bias—they are ranked 57 on the Gender Inequality Index (GII) and have disproportionately high mortality rates for girls under 5—and has widespread access to abortion and sex-determination test, but has high fertility (3.3 children). Iran has a low cultural respect for women (ranked 98 with the GII), and low fertility (1.87 children), but lacks widespread access to abortion and sex-determination tests. Sweden also has low fertility (1.67), and access to abortion and sex-determination tests, but has a high cultural respect for women, topping the charts of the Gender Inequality Index.[5] These three countries differ greatly, but they each lack at least one component required for sex selection, and therefore all have exactly natural sex ratios at birth.

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2 Hesketh, T. and Wei Xing Zhu (2006).

3 Sex determination via ultrasound is only possible after the 12th or 13th week of gestation, and amniocentesis is generally available for sex determination after the 14th week of gestation.

4 See Ansley Coale (1973). Guilmoto (2009) also includes a discussion of Coale's framework applied to sex selection.

5 Retrieved from the CIA World Factbook (2013).

The relevant question for many countries, however, is no longer how to avoid this catastrophe, but rather, once a society has a history of sex selection, which of the original conditions must be removed to stop the gendercide?

Because of its highly skewed sex ratio, China represents an important case study. China's sex selection cannot be explained by gender discrimination alone. The male-preferential culture is not new to the Chinese society, yet their highly skewed sex ratios are. Their sex disparities have plateaued in different regions, at different times, and at different rates within the country.[6] Moreover, gender inequality has declined rapidly in China in the last decade from a GII of 0.579 in 2000 to 0.213 in 2012.[7] In addition, sex-related differences in Chinese schooling and in the workforce decreased in the last quarter century.[8] Part of their rapid leap forward can be explained by the country's recent modernization as well broad political changes.

Using the example of China, we can then attempt to answer the question asked by an increasing number of recent articles: why "sex ratios have risen markedly over the time when women's status has been improving."[9]

Methodology

As a guiding biological principle, the conceptions and births of males and females should rise or fall equally as fertility changes. That is, as the number of children born decreases, the fraction of females at birth (f_{fab}) should not change. In China, however, female births have decreased disproportionately, and we can track the relationship using the Total Fertility Rate (TFR) and the Gross Reproduction Rate (GRR). The TFR measures the expected number of *children* born to a woman in a cohort if current age specific rates were to continue. The GRR, however, measures the expected number of *daughters* born to a woman. The Gross Reproduction Ratio is exactly the same as the Total Fertility Rate except the GRR only measures daughters, whereas the TFR measures both daughters and sons.

Equation 1: $GRR = TFR * f_{fab}$

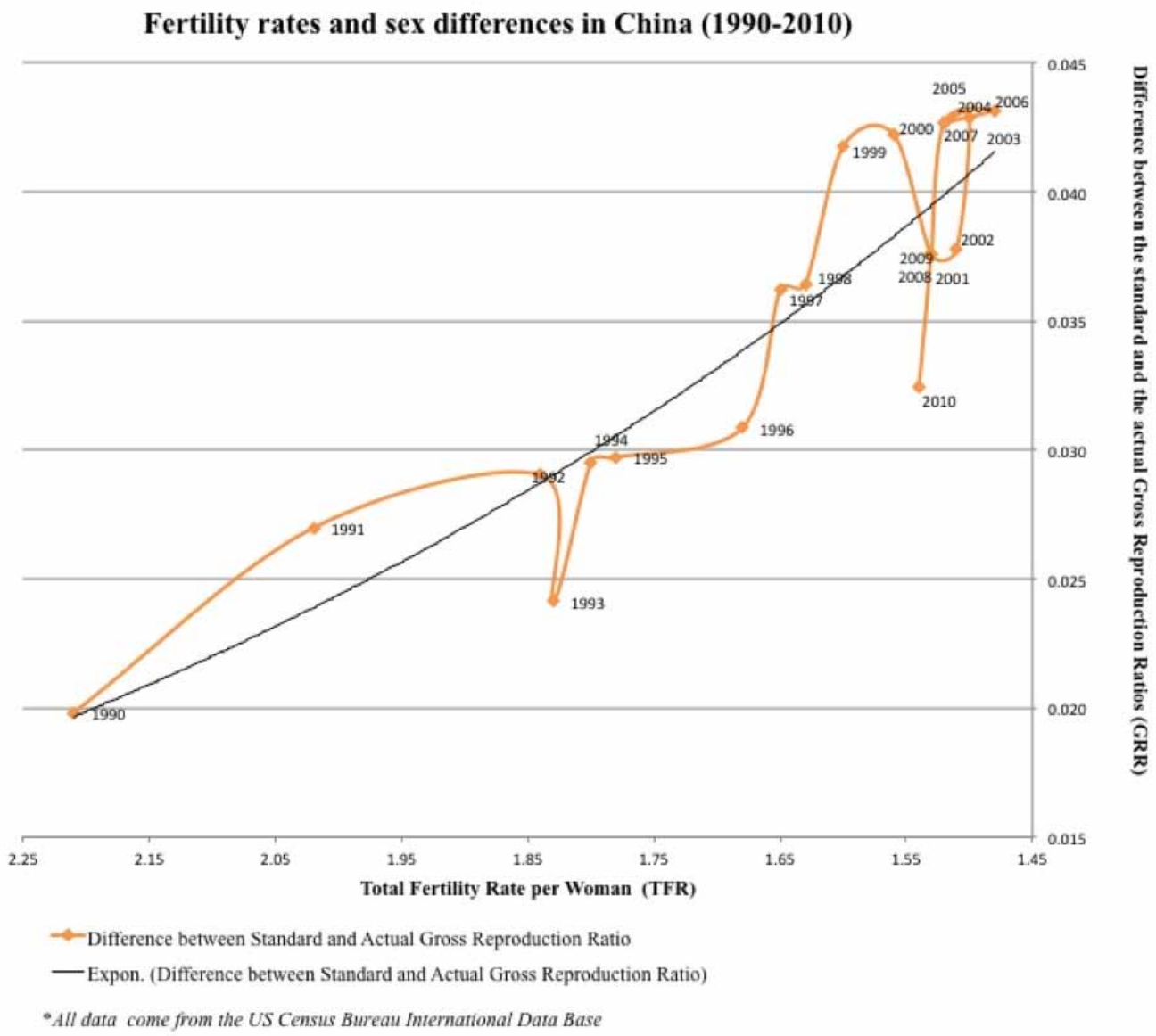
The natural sex ratio at birth is about 105 males for every 100 females born. This ratio can be purposefully altered by human action—in which case it is no longer considered "natural." The sex ratio also changes naturally with general health standards. Two things make this possible: first, the general health of the mother affects her child's chances of spontaneous abortion, and second, males have generally higher rates of mortality in the womb. As general health increases, spontaneous abortions occur less frequently, and this disproportionately benefits males. The effects of this on sex ratios can be seen amongst the least developed countries. For example: Haiti's sex ratio at birth has been at exactly 101:100 for over a decade. Malawi and Mozambique's ratio are consistently 102:100. In contrast, Luxembourg and Spain have sex ratios at 107:100. Australia, Canada,

6 See Guilmoto (2009).

7 For comparison, a 0.579 score in 2012 would rank a country between present-day Pakistan and Malawi, whereas China's current GII score places them between the United Kingdom and Bulgaria.

8 See Zeng et al (2013).

9 See Zhou Chi, et al. (2013), Xiaolei, Wang, et al. (2013) and Zhou, Chi, et al. (2012).



and Denmark's are 106:100. This phenomenon has been studied and analyzed by Klasen and Wink, who, in 2002 proposed a formulaic relationship between life expectancy at birth (f_{fab}) in which they used as a proxy for general health and the natural sex ratio at birth.[10] The analysis for this paper uses their regression estimates for non-African countries to estimate the natural sex ratio at birth. Because life expectancy in China increased by seven years over the period analyzed, I calculated the expected sex ratio for each year taking life expectancy into account.

Equation 2: $\textit{Natural sex ratio} = l_0 * 0.00087 + 0.991$

Equation 3: $f_{fab} = 1 - \left(\frac{\textit{sex ratio}}{\textit{sex ratio} + 1}\right)$

Firstly, the variable, *general health of the mother at time of pregnancy* is a continuous and

10 The sensitivity of the outcomes to small numerical changes necessitates a discussion of the appropriateness of using life expectancy as a proxy variable for general health at the time of pregnancy. For instance, if when calculating the number of missing girls for 1990, I used 69 years as the life expectancy instead of 68 years, the difference in the final count of girls missing from sex selection would differ by 9,933 girls. When dealing with quantities in the millions, slight changes greatly affect the final outcome.

qualitative measure, but the proxy variable, *life expectancy*, is used as a discrete and quantitative measure. This distinction adds jumps in the supposed natural sex ratio that, in reality, would change gradually with general health changes.

Secondly, life expectancy works best as a proxy variable for the general health of the mother if pregnancy does not disproportionately affect health compared to other countries. Klasen's model presumes general health changes affect all persons equally. While Klasen's model considered broad racial changes in sex ratios, it does not note that a mother's general health at the time of pregnancy can vary greatly from country to country. As a result of their stringent one-child policy, China women endure pregnancy experiences unlike any other in the world. The impact of external influences on the rates of spontaneous miscarriages and stillbirths has been well documented, but the magnitude of the effect of the stress imposed during pregnancy on the rates of spontaneous abortions is unclear. Because the stress would have a disproportionate effect on the male fetuses, the number of girls aborted by sex-selective abortion is to some degree underestimated.

Thirdly, as general health improves, the proportion of males born increases. How this affects the male infant mortality rate is ambiguous. The marginal increase in health may cause male fetuses who otherwise would have died in the womb, to postpone their life just long enough to die *outside* the womb, thereby increasing the male infant mortality rate. The marginal increase in general health, however, which led to the decrease in male mortality outside the womb, would likely decrease the male infant mortality rate.

However imperfect, life expectancy is highly correlated with changes in the natural sex ratio at birth. The correlation between life expectancy and natural sex ratio at birth is higher than between maternal mortality and the sex ratio.

With the natural sex ratio for each year's life expectancy, I solved for the corresponding female fraction at birth (equation 3). Inserting this value (f_{fab}) back into equation 1 provides the natural GRR for each TFR over the period.

The difference between the expected natural GRR and the actual GRR shows the extent of prenatal sex selection. In a country without sex selection, the difference between the expected natural and the actual GRR would be 0.00. When comparing the difference to the TFR, we can observe the relationship between fertility rates and sex-selective abortions.

Findings and Discussion

The data show that as total fertility decreases in China, sex selection increases at a higher rate.

Isolating the differences between the actual and natural GRR accomplishes several things. First, it avoids the common mistake of attributing all male births in excess of female births to be the result of sex-selective abortion. Even if there were a perfectly natural sex ratio at birth, there would still have been 11,430,000 more male births than female births during the 23-year period examined (see Appendix A). By using the GRR, we avoid counting those males as "excess." Second, the data only reflect abortions prompted by the sex of the fetus. This sequesters abortions prompted

by poverty, conformity to the one-child policy, the health of the mother, or any reason besides sex of the fetus. The Chinese government claims to have "prevented over 400 million births" since the implementation of their policy.[11] If every female birth prevented were attributed to sex-selective abortion, it would result in a gravely inaccurate picture of sex selection.

Lastly, by focusing only on discrimination before birth, we are bypassing the effects of male preference after birth, which are more difficult to quantify. Estimates of natural mortality rates are enormously less precise after birth, for as Klasen (1994) wrote, "it is difficult to imagine any society that does not influence sex-specific mortality rates in one way or another."

Finally, if we look at the data before 2010, that is, from 1990-2009, the R^2 between the TFR and the rates of sex-selective abortion is 0.8234. The data between 2010 and 2013, however, shows a pronounced divergence from the previous trend; the R^2 accordingly declines over the whole period to 0.5095. The trend after 2009 is significant. It indicates that forces other than fertility affect China's rates of sex selection. This is intuitive: sex selection is influenced by, for example, the cultural value of females.

This high correlation and the divergence in correlations demonstrate two important facts. The first is that the1990-2009 data show that fertility does matter. Decreasing fertility has huge effects on sex-selective abortions. As Tucker (2013) notes, "When a woman has six children, the probability that at least one of them will be male is greater than 98 percent." Similarly, even with three children, the probability of having at least one boy is 87 percent. As fertility falls, the chance of having a boy decreases along with it. Already stressed social systems come under increasing pressure as fertility falls. For this reason, sex ratios are consistently more skewed at higher parities; as couples near their desired family size, they become more desperate to have a male.[12] In rural Chinese areas, couples are allowed to have two children if the first is female. For first births, the sex ratios are natural at 105 males for every 100 females born. In contrast, urban Chinese who are very rarely allowed more than one child have skewed sex ratios even at first births.[13] Even when a system is pressured toward the ill of sex-selective abortion, demography can release some of that pressure. With all other variables being equal, decreasing fertility rates increase rates of sex-selective abortion.

The 2010-2013 data show that, while demography is important, it is not the final word. We see the effects of another variables, such as gender values or access to sex selection. Despite continued low fertility rates, there are some decreases in the rates of sex selection.

The causes and effects of sex selection have important implications for national and international policymaking. While the UN continues to prescribe lowering fertility to "facilitate the achievement of development goals," lowering fertility is not a one-size-fits-all solution to policy problems.[14] On the contrary, the Chinese sex-ratio debacle was partially caused and exacerbated by falling fertility. Furthermore, after decades of draconian measures to decrease family size, it is un-

11 Stated by Zhang Wuiqinq, family planning commissioner of China from 1988 to 2008. For reference of statistic, see BBC "Has China's One-child Policy Worked?"

12 See Guilmoto (2009).

13 Hesketh, Therese, Li Lu, and Zhu Wei Xing. (2005). See also Li, Shuzhuo (2007).

14 United Nations Population Facts No. 2010/5, August 2010

clear that a relaxation of Chinese policies would result in a voluntary resurgence in childbearing.[15]

Conclusion

The Chinese government announced in November 2013 its plans to revise its one child per-family policy to allow more couples to apply for permission to have a second child. The revision will not solve the problem of the country's skewed sex ratio, however, because it perpetuates the suppression of fertility rates. Low fertility is among the necessary conditions that must be met for sex-selective abortion and unnatural sex ratios to blight a country. As fertility rates decrease, all else being equal, rates of sex-selective abortion increase. Modern China is changing quickly; access to prenatal sex determination and the status of women are changing. In the midst of this change, fertility in China is often given a perfunctory nod as a causal factor, but receives little attention.

The data shown here reveal that demographic changes alone cannot solve the problem of sex-selective abortions, but nor can it be ignored. Demography must be considered, because as China's total fertility declines, sex selection increases. By looking at the Gross Reproduction Rate, we can isolate the effects of total fertility on China's rates of sex-selective abortion, independent of other causes. As China and other countries look to moderate their skewed sex ratios, we find that—despite increases in the status of women—the "fertility squeeze" in China remains a force to be reckoned with.

15 See Guilmoto (2012)

Appendix A: Sex-selective abortions in China

Year	TFR (Total Fertility Rate per woman)	Life expectancy at birth	Sex Ratio at Birth (Males per Female)	Total births	Number of males born	Number of females born	Expected number of females = number of males actually born * the expected number of females born per male	Expected number of males in excess of females at birth	Actual number of excess males at birth	Females missing from SSA = expected females born- actual number of females born
1990	2.21	68	1.09	24,219,007	12,602,651	11,616,356	12,000,696	601,955	986,294	384,340
1991	2.02	69	1.1	22,911,489	12,022,861	10,888,628	11,439,122	583,738	1,134,232	550,494
1992	1.84	69	1.11	21,490,025	11,328,981	10,161,044	10,778,932	550,049	1,167,936	617,887
1993	1.83	69	1.11	21,589,512	11,325,646	10,263,866	10,775,759	549,887	1,061,779	511,892
1994	1.8	69	1.12	21,271,177	11,226,455	10,044,722	10,681,384	545,071	1,181,732	636,661
1995	1.78	69	1.13	20,849,727	11,010,530	9,839,197	10,475,943	534,587	1,171,333	636,746
1996	1.68	70	1.14	19,290,029	10,219,123	9,070,906	9,714,918	504,204	1,148,216	644,012
1997	1.65	70	1.15	18,473,835	9,852,712	8,621,123	9,366,586	486,126	1,231,589	745,463
1998	1.63	70	1.15	17,739,482	9,468,312	8,271,170	9,001,153	467,160	1,197,143	729,983
1999	1.6	70	1.16	16,931,779	9,100,831	7,830,948	8,651,803	449,029	1,269,883	820,855
2000	1.56	71	1.17	16,300,924	8,777,421	7,523,503	8,337,453	439,967	1,253,917	813,950
2001	1.53	71	1.17	15,808,058	8,472,293	7,335,765	8,047,620	424,673	1,136,527	711,854
2002	1.51	72	1.17	15,472,672	8,299,910	7,172,762	7,877,368	422,542	1,127,148	704,606
2003	1.5	72	1.17	15,270,366	8,245,998	7,024,368	7,826,200	419,797	1,221,629	801,832
2004	1.52	73	1.17	15,260,641	8,232,714	7,027,927	7,807,147	425,568	1,204,787	779,220
2005	1.52	74	1.18	15,248,742	8,226,295	7,022,447	7,794,628	431,667	1,203,848	772,182
2006	1.48	74	1.17	14,868,585	8,037,073	6,831,512	7,615,336	421,737	1,205,561	783,824
2007	1.52	74	1.16	15,346,933	8,279,266	7,067,667	7,844,820	434,446	1,211,600	777,154
2008	1.53	74	1.15	15,659,911	8,392,893	7,267,018	7,952,485	440,409	1,125,876	685,467
2009	1.53	74	1.15	15,909,571	8,526,698	7,382,873	8,079,268	447,430	1,143,825	696,395
2010	1.54	75	1.14	16,187,820	8,619,489	7,568,331	8,160,463	459,026	1,051,157	592,131
2011	1.54	75	1.13	16,428,264	8,747,517	7,680,747	8,281,673	465,844	1,066,770	600,926
2012	1.55	75	1.13	16,535,283	8,747,698	7,787,585	8,281,844	465,854	960,113	494,259
2013	1.55	75	1.12	16,532,427	8,746,187	7,786,240	8,280,414	465,773	959,947	494,174
Summation				**409,063,832**	**226,509,553**	**199,086,706**	**215,073,014**	**11,436,539**	**27,422,846**	**15,986,307**

References

Cai, Yong. 2010. "China's Below-Replacement Fertility: Government Policy or Socioeconomic Development?." *Population and Development Review* 36(3): 419-440.

Central Intelligence Agency (CIA) (2013) Total Fertility Rate. *The World Factbook.* Retrieved from https://www.cia.gov/library/publications/the-world-factbook/fields/2127.html#af

Chi, Zhou, et al. 2013. "Changing Gender Preference in China Today: Implications for the Sex Ratio." *Indian Journal of Gender Studies* 20(1): 51-68.

Coale, Ansley. "The Demographic Transition Reconsidered." *Congres de l'IUSSP*. 1.

Greenhalgh, Susan. 2013. "Patriarchal Demographics? China's Sex Ratio Reconsidered." *Population and Development Review* 38(1): 130-149.

Guilmoto, Christophe Z. 2009. "The sex ratio transition in Asia." *Population and Development Review* 35(3):519-549.

Guilmoto, Christophe. "Sex Imbalances at Birth: Trends, Consequences, and Policy Implications," UNFPA Asia and the Pacific Regional Office, August 2012.

Guilmoto, Christophe, and Isabelle Attané. 2007."The geography of deteriorating child sex ratio in China and India." 109-129.

"Has China's One-child Policy Worked?" *BBC News*. BBC, 20 Sept. 2007. Web. 03 Oct. 2013.

Hesketh, T. and Wei Xing Zhu. 2006. Abnormal sex ratios in human populations: Causes and consequences. *Proceedings of the National Academy of Sciences,* 103 (36): 13271-13275.

Hesketh, Therese, Li Lu, and Zhu Wei Xing. 2005. "The effect of China's one-child family policy after 25 years." *New England Journal of Medicine* 353(11): 1171-1176.

"Indicators: GII: Gender Inequality Index, Value." *International Human Development Indicators*. United Nations Development Program, n.d. Web. 03 Oct. 2013.< http://hdrstats.undp.org/en/indicators/68606.html>

Klasen, Stephan, and Claudia Wink. 2003. "'Missing women': Revisiting the debate." *Feminist Economics* 9(2-3): 263-299.

Klasen, Stephan, and Claudia Wink. 2002. "A turning point in gender bias in mortality? An update on the number of missing women." *Population and Development Review* 28(2): 285-312.

Klasen, Stephan. 1994. "'Missing women' reconsidered." *World Development* 22(7): 1061-1071.

Li, Shuzhuo. 2007. "Imbalanced sex ratio at birth and comprehensive intervention in China," paper prepared for the 4th Asia Pacific Conference on Reproductive and Sexual Health and Rights, 29–31 October, Hyderabad, India <http://www.unfpa.org/gender/docs/studies/china.pdf>.

Nakamura, Katrina, Sam Sheps, and Petra Clara Arck. 2008. "Stress and reproductive failure: past notions, present insights and future directions." *Journal of Assisted Reproduction and Genetics* 25(2-3): 47-62.

Neugebauer, Richard, et al. 1996. "Association of stressful life events with chromosomally normal spontaneous abortion." *American Journal of Epidemiology* 143(6): 588-596.

Nigel, Barber. 2004. “Sex ratio at birth, polygyny, and fertility: A cross-national study.” *Biodemography and Social Biology* 51(1-2): 71-77.

Parazzini, Fabio, et al. 1998. “Trends in male: female ratio among newborn infants in 29 countries from five continents.” *Human Reproduction* 13(5): 1394-1396.

Park, Sunjoo, William M. Bowen, and Roberta Steinbacher. 2012. “Social and Demographic Dimensions of Sex Selection Technologies: Review and Analysis of the Research Literature.” *Biodemography and Social Biology* 58(1): 62-74.

Sen, Amartya. 1990. “More than 100 million women are missing.” *The New York Review of Books* 37.

Steinmann, Peter, Sabine Kiefer, Parviz Kamoliddinov, Barbara Matthys, Patrick Hanlon, and Kaspar Wyss. “Demand and Supply-side Incentives to Increase Utilization of Primary Health Care Services in Tajikistan.” *Swiss Centre for International Health*. Swiss TPH, n.d. Web.

Stinson, Sara. 1985. “Sex differences in environmental sensitivity during growth and development.” *American Journal of Physical Anthropology* 28(6): 123-147.

“Tajikistan.” 2013. *Social Institutions and Gender Index*. OECD Development Centre, Web. 03 Oct. 2013. <http://genderindex.org/country/tajikistan>.

“The Rise of the South: Human Progress in a Diverse World.” 2013. *Human Development Report 2013*. United Nations Development Program, Web. <http://hdrstats.undp.org/images/explanations/TJK.pdf>.

Tucker, Catherine, and Jennifer Van Hook. 2013. “Surplus Chinese Men: Demographic Determinants of the Sex Ratio at Marriageable Ages in China.” *Population and Development Review* 39(2): 209-229.

United Nations Population Facts No. 2010/5, August 2010 – Accelerating achievement of the MDGs by lowering fertility: Overcoming the challenges of high population growth in the least developed countries.

Xiaolei, Wang, et al. “Rising Women’s Status, Modernisation and Persisting Son Preference in China.” *Indian Journal of Gender Studies* 20.1 (2013): 85-109.

Zeng, Junxia, et al. 2013. “Gender Inequality In Education In China: A Meta-Regression Analysis.” *Contemporary Economic Policy* .

Zhou, Chi, et al. “Son preference and sex-selective abortion in China: informing policy options.” *International journal of public health* 57.3 (2012): 459-465.

Zhou Chi, et al. 2013. Changing Gender Preference in China Today: Implications for the Sex Ratio. *Indian Journal of Gender Studies,* 20 (1): 51-68.

Zhu, Wei Xing, Li Lu, and Therese Hesketh. 2009. “China’s excess males, sex selective abortion, and one child policy: analysis of data from 2005 national intercensus survey.” *BMJ: British Medical Journal* 338.