The Impact of Ultrasound Technology on the Status of Women in China

Avraham Ebenstein, Hongbin Li, and Lingsheng Meng*

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Abstract

This paper examines the impact of the adoption of ultrasound technology in rural China during the 1980s on the status of women. While previous work has focused on ultrasound's role in raising the sex ratio at birth, we focus on the impact on adult women. By exploiting variation in the timing of ultrasound diffusion across China's counties, we find that in areas with earlier access, the technology lowered completed fertility rates and led to improvements in female welfare. We present evidence that ultrasound led to higher labor supply outside of agriculture, more bargaining power within families, and lower suicide rates.

Keywords: sex-selective abortion, ultrasound, China, female status

*Corresponding author is Ebenstein: Department of Economics, Hebrew University of Jerusalem, Mount Scopus, Israel (email: ebenstein@mscc.huji.ac.il); Telephone:+972-2-588-3254; Li and Meng: Department of Economics, School of Economics and Management, Tsinghua University, Beijing 10084, China (e-mail: lihongbin@sem.tsinghua.edu.cn, menglsh@sem.tsinghua.edu.cn). We thank Joan Fang, Alison Flamm, Eyal Frank, Michael Freedman, and Nir Regev for providing outstanding research assistance.

1 Introduction

For centuries, traditional patriarchal societies in both Western and Eastern cultures have placed pressure on women to bear a son. The root of the pressure lies in a desire for an heir to a political position, such as a crown prince, and has influenced the fertility and status of women. In China, Confucian tradition required a son to take over the family “throne", making the production of an heir particularly important. The eldest son was also expected to inherit the family property and care for his parents in their old age, whereas a daughter was expected to leave and join her husband’s family. Consequently, the desire for a son was manifest in intense pressure on Chinese women, resulting in lower status for women who failed to bear a son. As a result of their desire to bear a son and not a daughter, women in China have historically resorted to abandonment of daughters, adoption-out to kin, and in some cases, female infanticide. In the mid 1980s, a new technology became available in China that changed this dynamic entirely: ultrasound (Zeng et al. 1993).[1]

Ultrasound allows for nearly-perfect gender identification once a fetus reaches 20 weeks gestation. While Chinese midwives historically engaged in pulse-checking and other dubious forms of gender identification (Lavely 2005), ultrasound provided a scientific method to determine gender. This allowed women to reach a dual objective that had once been accomplished only by random chance: having a son, and having a small number of children. Following the Communist revolution, which provided women more equal opportunities in the labor market, there was increased benefit for women with fewer children. The One Child Policy added further incentive for women to limit fertility, as women would face fines and other punishments for having a large family (Scharping 2003). For women who wanted a small family and also wanted a son, ultrasound was a game-changing innovation.

In this paper, we examine the adoption of ultrasound sex-identification technology in rural China and the impact of the technology on the treatment and status of women. While it is well known that the fertility decline associated with ultrasound came at the expense of unborn female

[1] Zeng et al. (1993) report data from the Customs Administration indicating that over 2,000 high-quality color ultrasound machines were imported in 1989. By the early 1990s, China was already able to domestically produce 10,000 per year.

fetuses (Chu 2001), the impact on living women has been vastly understudied.[2] This paper attempts to fill this void. Similar to the introduction of the birth-control pill to the American public (Goldin and Katz 2002, Bailey 2006), the introduction of ultrasound represented a technology that allowed women to avoid unwanted fertility. While the impact may have been catastrophic for the survival rate of female fetuses, this paper will demonstrate that ultrasound had a positive impact on women of childbearing age by enhancing female status both in the labor market and in the household.

Using unique data on the timing of ultrasound's introduction by county (Chen et al. 2013), we exploit intra-province variation in the availability of the technology to identify the impact of ultrasound on the welfare and status of women. Using natality survey data, we demonstrate that women who had earlier access to ultrasound were more likely to have a male birth at the second parity, and were less likely to choose to have a third child. These women were also more likely to engage in non-agricultural occupations, where opportunities for higher wages exist (Zhao 1999). We also present evidence from a survey of Chinese household spending patterns in this period (China Health and Nutrition Survey 1993) that indicates that women who had access to ultrasound had fewer children and more leverage in household decisions. This further supports the claim that ultrasound had positive consequences for female welfare within the household.

In addition to these findings, we present an analysis of ultrasound's impact on female suicide rates. In China, suicide accounts for nearly a fifth of deaths among young women, and China is the only country where suicide rates are higher for women than men. We find that female suicide rates have declined in areas that adopted ultrasound earlier, possibly owing to the improvement in female welfare. Ultrasound adoption is associated with a decline in the share of female deaths by suicide by 3-4 percentage points, but is associated with almost no effect on male suicide rates. Our empirical results point to ultrasound availability leading to large welfare gains for young women: better employment outcomes, higher status within the household, and lower suicide rates. The results provide insight into why women rapidly adopted ultrasound technology, and point to the challenges associated with policies that prohibit its use without dealing with the underlying incen-

[2] A notable exception is Lin et al. (2009), who document a decline in mortality among young girls and an increase in fertility among older women following the legalization of abortion in Taiwan.

tives to engage in sex-selective abortion.

The paper is organized as follows. In the next section, we present background information on the historical context of the spread of ultrasound technology in rural China and our conceptual framework to predict its impact. In Section III, we present our data on ultrasound availability, demographic data, and measures of female status within the household. In Section IV, we present our empirical results for the impact of ultrasound's impact on fertility, occupational choice, bargaining power, and suicide. We conclude in Section V.

2 Background

2.1 Historical Context

The role of a woman in China has traditionally been to bear children and take care of domestic tasks within the household. A married woman's responsibility was to serve her husband and to care for her husband's parents, who commonly co-resided with the eldest married son. She was also expected to bear at least one son, and failure to do so was traditionally grounds for taking up another wife. In Confucian thought, only a son can grieve for his father, only a son can carry on the family name, and most importantly, only a son can be expected to care for his elderly parents. In light of the cultural and practical benefits to having at least one son, it is perhaps no surprise that women in China historically have exhibited much higher fertility rates when they have only daughters (Zeng et al. 1993).

China's Communist Revolution and subsequent Marriage Law (1950) formally outlawed discrimination against women in the context of marriage (Daimant 2000). However, high fertility rates in the 1950s and the 1960s prevented women from fully integrating into the labor market (Andors 1976). The resulting rapid population growth alarmed Chinese officials, and the Communist Party subsequently enacted a series of fertility control policies, culminating in the One Child Policy of 1979.[3] These policies were astoundingly effective at lowering both urban and rural fer-

[3]The One Child Policy actually refers to a system of regulations governing fertility that varies by region. Though

tility, with the total fertility rate falling from 5.6 in 1970 to 2.34 in 1990, a stunning decline in 20 years (World Bank Development Indicators). In 1979, China was also able to manufacture its first ultrasound machine and during the subsequent decade, the technology diffused rapidly. By the mid-1990s, all county hospitals and clinics, as well as most township clinics and family planning service stations, were equipped with ultrasound devices that could be used for prenatal sex identification (Chen et al. 2010).

Although women drastically reduced their fertility in the wake of the One Child Policy, the male fraction of births after daughters rose sharply and remained high among women without a son (Zeng et al. 1993). Today, there are roughly 25 million more men than women under the age of 20 in China (China 2005 .1% Census). In spite of bans on prenatal sex determination, it is widely recognized that the explosion in the male fraction of births was driven by ultrasound identification and sex-selective abortion (Chu 2001, Chen et al. 2010). The rapid spread of ultrasound allowed mothers to essentially choose the sex of their next live birth, and for many women this allowed them to both comply with the One Child Policy and have a son. For women who would have engaged in infanticide or out-adoption, the introduction of ultrasound halved the amount of time spent pregnant. Women could also avoid the psychological pain and social stigma associated with either adoption or infanticide. For women who would have kept and raised an unwanted daughter, ultrasound meant a woman could avoid the full time cost of raising a daughter.

The impact of ultrasound, and fertility decline more generally, has been profound and has been associated with the evolution of the social status of women. Today, women represent 45.4% of the Chinese labor force, occupy important roles in the government ministries, and represent a quarter of Chinese entrepreneurs (Sun 2010). According to the China Population and Information Research Center, which reported the results of a survey of 2,000 Chinese women, many older women reported wishing family planning had been available when they were younger. They characterized their lives as spent bearing too many children and trying to raise them in poverty. 'If family planning had been available earlier, my future would have been different,' said one woman

urban residents were limited to a single child, mothers of a daughter in several rural provinces were allowed to have a single additional birth (a "1.5-child" policy) and families in remote areas a second or third child (Gu et al. 2007).

from South Jiangsu. 'That is my life-long regret. Because I had too many children, I had to quit [teaching].' Another woman from North Anhui said, 'Young women are in heaven, and we are on the ground.'

2.2 Conceptual Framework

Our conceptual framework is straightforward. For women who will have children until they bear a son, ultrasound allows them to have fewer children. In the context of fertility constraints (either legal or financial or otherwise) ultrasound access allows more women to have at least one son, an important value among many Chinese families. While some women would engage in sex selection through infanticide or female abandonment regardless, ultrasound is a technology that, when available, will generally lead to reduced fertility and a higher male fraction of births.

We posit two primary mechanisms for ultrasound to potentially improve female welfare. First, reduced fertility may result in greater access to market work and an accelerated entry into the workforce (Fang et al. 2010, Angrist and Evans 1998, Ebenstein 2009). Second, because women are more likely to have a son, they are likely to enjoy higher status within the family, in light of the pressure placed on women in Chinese culture to bear a son (Wu and Li 2011). This may result in greater bargaining power in the household, and potentially a more active role in family decisionmaking (Thomas 1990, Lundberg and Pollack 1993).[4] Inasmuch as unwanted fertility was reduced by ultrasound, and women enjoyed the aforementioned benefits of higher status and economic standing, female happiness may be improved, or conversely, rates of despair and depression could be reduced. This could affect suicide rates, which are extremely high among women in rural China and correlated with symptoms of depression (Phillips et al. 2002a). This, and data availability, dictates our empirical strategy. We examine first the relationship between female labor force participation, household bargaining, and ultrasound in Tables 2-5. Our final analysis, Table 6, examines whether these potential consequences of ultrasound have led to a welfare improvement

[4]Note that these mechanisms may operate in conjunction. An increase in female labor supply may also lead to greater bargaining power within the family and changes in family resource allocation (Schultz 1990).

among women, resulting in a decline in female suicide rates.

3 Data and Descriptive Statistics

Our empirical analysis draws on several data sets containing information on ultrasound timing, and a broad set of responses we wish to investigate, such as subsequent fertility, employment status, and welfare among the affected women. Our data on ultrasound timing is taken from a collection of publications issued in China known as the Local Chronicle. Each local government has a Local Chronicle Compilation Committee and performs a systematic review of its jurisdiction in a host of areas. The publication is an authoritative compilation of trends at the county level in China, and in most cases contains a chapter on public health issues. The time of the introduction of ultrasound machines was generally recorded in these chapters, as it represented a remarkable advancement in public health technology. The compilation of the Local Chronicles provides a near-universal record of ultrasound availability by year across China's more than 2,000 counties. As shown in Figure 1, ultrasound adoption in China occurred very rapidly during the 1980s. Although less than a fifth of counties had ultrasound technology in 1984, this fraction had increased to 80% by 1988.

Our data on ultrasound timing is matched to a large-scale fertility survey conducted in China shortly after ultrasound's diffusion, presented in Table 1, Panel A. We analyze the Chinese Children Survey (1992), a nationally representative survey sponsored by the State Statistical Bureau of China and UNICEF. The sample was selected using a stratified two-stage, probability-proportionate-to-size approach, with systematic sampling at each stage (State Statistical Bureau 1992). The survey sampled a total of over 500,000 children aged 0–14 years, with data available on ultrasound access for roughly 282,000 of the children.[5] The sample is nationally representative for both rural and urban women. Rural and urban women were given slightly different questionnaires, but both versions instructed women to include detailed information on all conceptions

[5]While we cannot directly assess whether bias is introduced by our inability to obtain ultrasound information for all births, the fraction of males is almost identical in the sample of births where information is available (53.1%) versus the births where it is unavailable (52.9%).

since 1976. The survey is ideal for our purposes, since it contains detailed information on several relevant responses to ultrasound's innovation. For each conception, we know whether it was terminated, whether the birth was male, length of gestation and whether the mother received prenatal care. For each mother, we know her complete fertility history at the time of the survey, including both aborted conceptions and live births.[6] This enables a careful analysis of the trends in Figure 2, which document that the rising abortion rates in China correspond to the period of ultrasound adoption, declining fertility, and the rising sex ratio at birth. The survey also collected detailed information on the household, including the mother's employment status and whether she worked in a non-agricultural occupation. We are also able to assign to each mother the fine associated with births in violation of the One Child Policy.[7]

A second survey used in our analysis is a matched sample of mothers and their children taken from the China Health and Nutrition Survey (CHNS) of 1993 (Table 1, Panel B).[8] In addition to fertility information, we also observe who in the household has the final say regarding whether to purchase typical durable household goods (e.g. washing machines). These questions in the CHNS have been used by other scholars to measure female status within the household **(**see Wu and Li 2011**)**.[9] We use averages of this measure over 15 household good types to capture a women's relative bargaining power in the family. Using these data, we examine the relationship between a woman's access to ultrasound, her fertility outcomes and her bargaining power. This measure is not ideal, but superior alternatives are not available in our data.[10] We also have data on whether

[6]While we cannot verify the accuracy of the data directly, Chinese policy explicitly encouraged abortions to prevent excess fertility suggesting that women would answer these questions in a more forthcoming manner than in social contexts where abortion was taboo (Scharping 2003). The Chinese Children Survey was also conducted by UNICEF and China's SSB with attention paid to assuring the respondents of the confidentiality of their information.

[7]Ebenstein (2010) catalogues the punishments for births in violation of the One Child Policy, with all fines reported in terms of years of income. Several other factors are considered in fine assignment to mothers, including the mother's province of residence, ethnicity, whether she has urban registration, and the gender of her first child. These are described in detail in his technical appendix.

[8]Although the CHNS contains information from the years 1989 to 2006, the CHNS 1993 is the only year which contains both information on relative bargaining power and fertility information.

[9]Based on answers to the survey question "who in your household decided to buy XXX (one of the fifteen durable goods)," we construct a variable to measure a woman's role in the purchase of durable goods, with a value of "0" if the husband makes the decision alone, "0.5" if both the husband and the wife decide, and "1" if the wife decides alone. We then take an average of these scores to get a measure for women's role in all decisions. This mean score, in the range between 0 and 1, is used as a proxy for women's status in the family.

[10]For example, consumption towards "children's goods" is often used as a measure of a woman's bargaining power

the community currently has ultrasound, and the number of years that the community has offered abortion to its residents. We define a mother as having access to ultrasound if her village currently offers ultrasound abortion and offered at the time of her second child's birth.[11] We also include the fine level for out of quota births in the mother's community, measured in yuan. We present the summary statistics for the full sample of 2,338 women in the CHNS from which we select our sample for analysis.

Finally, a third survey we exploit is the analysis of mortality patterns in China which is based on China's Disease Surveillance Point (DSP) system (Table 1, Panel C). The DSP is a set of 145 sites chosen to form a nationally representative sample of China's population, and selects sites across different levels of wealth and urbanization. The coverage population was also chosen to reproduce geographic dispersion in China's population, relative to patterns in China's 1990 census. The DSP records all deaths among the coverage population of 10 million residents at the sites and, due to careful sample selection of the DSP sites, yields an annual sample of deaths that mirrors patterns in the country nationwide (Yang et al. 2005). Our sample is restricted to roughly 40,000 deaths between 1991 and 2000, among young persons between the ages 20-40 for whom ultrasound data are available.[12]

(Thomas 1990, Gitter and Barham 2008). For our study, however, since our independent variable is fertility, this measure is problematic since a decrease in fertility will most likely be accociated with a mechanical decrease in spending on children's goods. Our measure is also potentially problematic. It may be that women who are responsible for the household chores are also responsible for purchases related to the household. However, we note that in our data, a woman's share of the decisionmaking for these household goods is *negatively* correlated with a woman's share of domestic tasks, suggesting our measure is not merely picking up whether the woman is responsible for homemaking duties.

[11] This is imputed from a categorical variable on the number of years since abortion became available [Q34_6]. We assume it became available in 1992 if it was available for less than a year, in 1991 if available for a year, in 1989 if available for 3-6 years, in 1985 if available for 6-10 years, and 1983 if available for 10 or more years.

[12] The DSP mortality collection is based on the location of the decedent. Migration is a potential problem if migrants are recorded where they die rather than where they spent most of their lives, since their assigned ultrasound measures will be incorrect. It is worth noting that most migration is from rural areas to urban areas, and most suicide is in rural areas. As such, it is unlikely that the results are affected greatly by migration.

3.1 Was ultrasound's adoption exogenous to fertility tastes or regulations?

A reasonable concern for our analysis is whether ultrasound's adoption can be thought of as exogenous to features of a county's residents, such as attitudes towards sons, fertility, and gender equity. It may be that early-adopting counties have populations which are more modern and willing to slow fertility even in the absence of ultrasound. Indeed, our data reflect that ultrasound was available in wealthier and more urban areas prior to its diffusion in remote rural areas. A valid concern is that areas with more intense son preference would adopt the technology earlier.[13] A second problem that we face is that the timing of the diffusion of ultrasound was partly driven by the need to enforce the One Child Policy (Ertfelt 2006). If local variations in the enforcement of the policy are correlated with ultrasound access, the direct effect of ultrasound will be confounded with the effect of the fertility control programme. For example, if ultrasound machines were distributed within a county to enforce the policy, and so fertility decline was correlated with ultrasound's adoption due to its correlation with stricter enforcement of the fertility regulations, our strategy would erroneously attribute the fertility decline to ultrasound.

We bring the following evidence from our data to address these concerns. First, as shown in Figure 3, the technology expansion did not follow any clear geographic pattern (for example, from the coast to the interior) and diffused quite rapidly throughout the country. Yet it is worth examining the relationship between ultrasound availability and features of the mother, both as it relates to the exogeneity of ultrasound and as a historical question interesting in its own right. We focus on the sample of births taken in the 1992 survey, since this is the richest data set available to us. Our results in Table 2 indicate that ultrasound availability is in fact positively correlated with measures of affluence such as average income and education, indicating that regions that received the technology early may have been more likely to have "modern" views on the role of women. However, when we add controls for the severity of the punishment for the One Child Policy and

[13] In order to examine this possibility empirically, we stratified the sample by counties that adopted ultrasound early (prior to 1985) versus those that adopted later (after 1985). The sex ratio of children born between 1976 and 1980, prior to the diffusion of ultrasound, are roughly similar in the two sets of counties. The results are available upon request.

fixed effects for birth year, ultrasound availability is more weakly correlated with measures of wealth and modernity. This suggests that women who had children prior to ultrasound's availability were broadly similar to women who had children after it became available. When we add fixed effects for county and county-specific time trends, we further reduce the residual correlation between ultrasound availability and features of the mother. The results in columns 3-5 indicate that the correlation between observables and ultrasound diffusion is absorbed by the included controls.

As such, in our paper's main results, we include county or province fixed effects and rich sets of covariates of the mother to account for a correlation between ultrasound availability and other factors that will affect our outcome variables. However, if unobserved variation in preferences or enforcement of the One Child Policy is correlated with ultrasound timing, including these covariates will not solve this problem. Since we do not have a valid instrument for ultrasound availability, the results should be interpreted with some caution.[14]

4 Empirical Results

4.1 Ultrasound, Fertility, and Occupational Choice

We begin our analysis of ultrasound's impact on fertility patterns in China using a sample of over 86,000 births among women having their second child. The sex ratio of first births is essentially normal in China but second births account for nearly 90% of the "missing girls" in the 2000 census (Ebenstein 2010), suggesting that at this parity some fraction of mothers are engaging in sex-selective abortion.[15] We then examine the relationship between ultrasound availability and whether a woman has a third child. A third child has been demonstrated to have a large causal impact on a woman's labor supply, and so ultrasound's benefit to women may be mediated through a reduced

[14]Measurement error in our covariates may also lead to biased coefficients, if we fail to properly account for a female's actual income or education and this is correlated with ultrasound availability. Conversely, measurement error in ultrasound availability that is classical could lead to attenuated estimates of its actual impact.

[15]This is confirmed in the Chinese Children Survey data as well, where 51.9% of first births in our sample are male, approximately the natural rate. The rate rises steeply among women with sons, with the patterns mirroring the fertility patterns observed in Chinese census data.

chance of a third birth (Angrist and Evans 1998, Ebenstein 2009). If ultrasound increases the fraction of women who complete their fertility with two children, it may have a large impact on female career prospects.

Our empirical strategy is to estimate the reduced form relationship between outcomes related to female welfare and the availability of ultrasound during her fertility window. In our basic specification, we estimate regressions of the following form:

$$Boy_{i,j,t} = \beta_0 + \beta_1 U_{j,t} + \beta_2 G_i + \beta_3 U_{j,t} G_i + Controls_{i,j,t} + \mu_j + \gamma_t + \epsilon_{i,j,t} \quad (1)$$

where we predict fertility outcomes related to the availability of ultrasound, such as the chance woman i in county j has a boy in year t, Boy_{ijt}. U_{jt} refers to the availability of ultrasound in county j in year t. We include controls for U_{jt}, having a first-born daughter G_{ijt}, and demographic features of the mother X_{ij}. The models include fixed effects of county μ_j and year γ_t to absorb variation that is occuring across counties and over time in fertility, and controls that vary by individual i or across counties and year. In this set-up, we predict the chance of having a boy at the second parity, but we also estimate models where the dependent variable is having a third child, and working outside of agriculture.

Our interest is in the interaction between having a first-born daughter and having ultrasound access during her second pregnancy (β_3), as this will reflect the impact of ultrasound on the group most likely to be affected - those with a first-born daughter who are still seeking a son. We find that this interaction is associated with both an increased chance of having a son at the second parity *and* not having a third child. In Panel A, we confirm the first hypothesis and in Panel B, we confirm the second hypothesis. In column 1, we report the results of models without any controls, and the results indicate that having both ultrasound and a first-born daughter is associated with a 4.7 percentage point increase in the chance of a son and a 1.5 percentage point decrease in the probability of a third child, with both results statistically significant at the 5% level. The results are modified only slightly by including rich set of controls such as direct measures of the severity of

the punishment for the One Child Policy, assorted demographic covariates, fixed effects for county and birth year, and county-specific time trends. The results indicate that ultrasound increased the sex ratio of second births and decreased the likelihood of a woman having a third child.

The improving status of women in China's labor market can be traced to two related trends: declining fertility and increasing labor supply outside of agriculture. In Table 4, we examine the impact of ultrasound on a mother's probability of finding employment outside of agriculture using the same sample shown in Table 3. Our fertility survey contains detailed information on a woman's occupation, and we are particularly interested in whether ultrasound availability during her second pregnancy affects the chance that a woman is able to find employment outside the home, and outside agriculture. Our left-hand side variable is a dummy equal to one for women who report an occupation other than agriculture or "staying at home for housework". In column 1, we find that the availability of ultrasound among women with a first-born daughter is associated with a 1.1 percentage point increase in the probability of working outside agriculture and the home. Using the same set-up as in Table 3, where we add increasingly rich sets of control variables, we find the results are highly robust to the inclusion of demographic covariates, birth year fixed effects, county fixed effects, and county-specific trends. Our richest specification indicates that the presence of ultrasound increases employment outside of agriculture by 0.74 percentage points, a 5% increase relative to a base rate of 13.4 percent, and this estimate is statistically significant at the 5% level. In combination with our previous results, the data indicate that ultrasound led to an increase in the share of women who were able to have smaller families and find better employment opportunities.[16]

While to some extent fertility decisions and finding employment outside agriculture are decisions that are jointly determined, the robust correlation between ultrasound availability and

[16]In Appendix Table 1, we perform a similiar analysis to Table 4 by comparing the effect of ultrasound on fertility outcomes and occupational choice of women. Panel A reports the results of the 1992 survey while Panel B reports the results of the China 2000 census. As opposed to Table 4, in this table we examine how the overall impact of ultrasound may differ by whether one had a first-born son or a first-born daughter. The specification is slightly different, where ultrasound availability is determined by whether a mother had access at age 20. The results are consistent with those shown in Table 4, where we find ultrasound availability lowers fertility and increases the chance of employment outside agriculture in both the fertility survey and the census sample.

fertility outcomes is suggestive of a causal link between access to sex-selective abortion, reduced fertility, and increased labor force participation. However, it is worth noting that this result is reduced form in nature, and one cannot rule out reverse causality, in which women who want to work outside of agriculture have fewer children (Fang et al. 2010).

4.2 Ultrasound and Bargaining Power

In this section, we examine the impact of ultrasound on lifetime fertility and female bargaining power. We posit that ultrasound will depresss fertility by allowing women to have sons at an earlier parity, and improve female status as a by-product of fertility decline. We examine female bargaining power and fertility outcomes in Figure 4, where we compare the bargaining power of women (using our measure) among those with daughters versus those with sons. The figure indicates that women with a daughter have less bargaining power than those with a son, and those with two daughters have less power than parents with a daughter and a son. This is logical, as sons confer status upon the mother and increase her standing in the family. This also provides suggestive evidence that ultrasound could improve female welfare by enabling more women to have a son with lower lifetime fertility.[17]

We examine the impact of ultrasound more rigorously in Table 5, where we examine the relationship between access to ultrasound, fertility outcomes and female bargaining power. We estimate regressions of the following form:

$$Bargain_{i,j} = \beta_0 + \beta_1 U_{i,j} + Controls_{i,j} + \mu_j + \epsilon_{i,j} \tag{2}$$

While we only have a cross-section of mothers in the 1993 CHNS, since they had children at different points in time and communities offered prenatal health services at different points in time, we can examine the impact an individual woman i living in community j having access to ultra-

[17] In Appendix Table 2, we present results that corroborate these findings. The China Female Status Survey (1990) contains detailed information of fertility and financial independence in household decisionmaking. In this survey, we document that controling for the number of children and a rich set of covariates, female financial independence is higher among women with more sons.

sound U_{ij}, and our outcome variables, controlling for time-invariant features of each community μ_j. In the empirical estimation, we are also able to include factors that vary at the individual or community level, such as fixed effects for the mother's occupation, her ethnicity, the community fine in place for births in violation of the One Child Policy, and a dummy for whether she is over 40 at the time of the survey. While we would ideally have a full set of dummies for the year of the mother's second birth, our sample size is limited. We instead include a dummy for whether the mother was over age 40 in 1993, which serves as a "pre" dummy in our analysis.

The results of these models are presented in Table 5. In column 1, we first examine the correlation between the availability of ultrasound, and her lifetime fertility. The coefficient indicates that women with access to ultrasound have on average .55 fewer children. When controls are added to absorb variation associated with the demographic features of the mother, time-invariant features of the community, and the stringency of the One Child Policy, the results indicate that ultrasound depressed fertility by .31 children, statistically significant at the 1% level. We perform a similar exercise to assess the impact ultrasound on female bargaining power. In column 3, we report that ultrasound availability increases female bargaining power by .075 units, nearly a third of the average value of female bargaining power (.42). After adding our controls, the coefficient increases to .145, indicating that women with ultrasound are a third more empowered than women without access to ultrasound, and this result is statistically significant at the 5% level. While the sample size is limited in the CHNS, and we are not able to fully examine mechanisms for the correlation between bargaining power and the availability of ultrasound, the result corroborate our claim that ultrasound is associated with declining fertility, and improved female status and welfare.

4.3 Ultrasound and Suicide

The aforementioned benefits to women may have improved status and welfare, and this could potentially affect female happiness and as a result, female suicide rates.[18] China has the highest

[18]Special thanks to Justin Wolfers, who provided code on his website that is used in Table 6 and Figure 5. The code is taken from Stevenson and Wolfers (2006), who examine the impact of unilateral divorce laws on domestic violence.

female suicide rate in the world, and suicide accounts for about a fifth of deaths of young women. In recent years female suicide rates have begun to decline, possibly owing to women enjoying higher status in China. As shown in Figure 4, our data reflect a marked declined in the fraction of deaths to young women in rural China attributed to suicide during the 1990s. Interestingly, no similar decline is observed among men during this period. However, whether the changes in suicide patterns are (partly) related to ultrasound is difficult to assess. First, verifying the accurate classification of deaths as suicides can be extremely challenging (Phillips 2002b). Suicide rates could be changing due to the taboo nature of reporting a death as a suicide, and evolving attitudes towards suicide. While we cannot directly evaluate this possibility, the DSP carefully records and verifies the cause of death in all cases, suggesting the data are reliable (Yang 2005). Second, we do not have comprehensive time series data on suicide for the period before and after ultrasound's introduction. Instead, we use the DSP to examine the connection between suicide and ultrasound availability using microdata for a sample of young adult deaths during the 1990s.

We estimate the relationship between ultrasound's availability and the probability that a given death was attributed to suicide. We employ OLS to estimate

$$Suicide_{i,c,t} = \sum_k \beta_k Ultrasound^k_{c,t} + Controls_{i,c} + \mu_p + \gamma_t + \epsilon_{i,c,t} \tag{3}$$

where $Ultrasound^k$ refers to a series of dummy variables set equal to one if a county had access to ultrasound k years ago and $Suicide_{ict}$ is a dichomotous variable set equal to one if individual i's death was attributed to suicide in county c in year t. The coefficients in the series are therefore interpreted as the percentage point increase or decrease in the probability that a given death was due to suicide as a result of the availability of ultrasound in the county k years ago. As such, they map out the full dynamic response of the suicide probability due to the availability of ultrasound. We also include demographic controls at the individual level for years of education, age and urban status, controls at the county level for average income, and province (μ_p) and year (γ_t) fixed effects.

Our sample used for our analysis in Table 6 is deaths among men and women age 20-

40, and our outcome of interest is the proportion for which suicide is attributed as the cause. As reflected in the sample means, 21.1% of deaths among women in this age group are from suicide, which is remarkably high and more than double the 9.2% for men. Our right-hand side variable of interest is whether ultrasound was available in the year the decedent turned 20. The regressions also include a rich set of controls, including year of death, fixed effects for province, controls for county income, and demographic covariates: years of education, age, and urban status. Note that our data are not sufficiently rich to control for county level fixed effects or county time trends since ultrasound information is only available for 138 (of 145) DSP sites. The results, therefore, may be more suggestive in nature. As shown in the table, having ultrasound available reduces the probability of a female death being attributed to suicide by 3.4 percentage points. The availability has almost no impact on male suicide rates, suggesting they benefited less from the technology. Interestingly, the results also show that when we restrict to only rural deaths, the estimated effect for women increases to 4.0 percentage points. This is sensible since rural women are more likely to benefit from a technology that allows for gender identification, since they experience greater pressure to bear a son than their urban counterparts.

We examine the timing of ultrasound's impact on suicide rates in greater detail in Figure 5. In the figure, we plot the regression coefficients from Table 6. The figure indicates that ultrasound's relationship with suicide rates is negligible prior to its introduction. However, after ultrasound becomes available, the figure reflects marked declines in suicide rates for women and no change for men. The figure also indicates a significant drop in suicide rates about 8 years after ultrasound's introduction, suggesting that ultrasound mainly affected suicide through a lagged effect. One explanation for this delay in the registered impact is that access to ultrasound was limited after the machine's were first recorded by the county as available, and it took several years for them to become widely used. Another possibility is that after ultrasound became available, the benefits to women became stronger over time. For example, insofar as ultrasound allows women to pursue employment outside the home because of lower fertility, this will become more important only after the youngest child begins grade school. While we do not have sufficient data to fully

investigate why female suicide rates decline in areas with ultrasound, the results are suggestive that women are benefiting greatly from ultrasound's adoption. In combination with our other findings, we propose that this indicates a real and marked shift in quality of life for women as a result of ultrasound's diffusion throughout China.

5 Conclusion

This paper has presented evidence that ultrasound technology had massive implications for the cohorts of women who adopted the technology. Although Chinese parents have for centuries manipulated the sex mix of their children through adoption and differential resource provision, ultrasound made this process cheaper, safer, less emotional, and more efficient. While the country will soon have to deal with the implications of 23 million men failing to marry (Poston and Glover 2005), the benefit to the women who engaged in this technology is already apparent. The women who adopted ultrasound were able to have a son, have a smaller family, and take on a more important role in the Chinese economy. While ultrasound is only partly responsible for the changes in China's fertility patterns and the related increase in female labor supply, this paper identifies a key role for the technology in China's demographic and economic change during the last several decades.

While it is beyond the scope of this paper to discuss a welfare analysis comparing the utility of living women to unborn women, it is worth taking note of the windfall the living women received and how they continue to benefit, at least in the short run, from access to ultrasound technology. In recent years, Chinese policy has made attempts to ratchet up enforcement on legal bans of ultrasound for gender identification, including harsher penalties for doctors who enable this practice (Li 2007). In spite of these efforts, China's sex ratio has continued to rise, reaching 118 in 2005.[19] This study has pointed to some of the benefits that woman who engage in this practice enjoy, and economic realities in rural communities will continue to ensure that the high

[19]Report issued by Chinese State Council and Central Committee (January 2007).

value of sons remains constant. For example, China's limited and locally-funded social insurance programs in rural China imply that sons still represent the surest way of guaranteeing support in old age. Without a relaxation of the One Child Policy, which has been proposed by some but rejected by the government (Zeng 2007), future policy will need to address the concerns facing parents in rural China today. Expansions of existing rural social insurance and old age programs (Ebenstein and Leung 2010) should be considered instead of draconian measures against abortion, which only deal with the symptom rather than the underlying cause. Policies that make having a son less critical would allow women to maintain low fertility rates – and the related professional advantage of doing so – without engaging in sex-selective abortion with the help of ultrasound.

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Table 1

Summary Statistics

Variable	Mean	Standard Deviation	Min	Max	Obs-ervations
	(1)	(2)	(3)	(4)	(5)
Panel A: Chinese Children Survey - Maternal Sample					
Number of Children	2.12	1.33	1.00	15.00	282,345
Number of Sons	1.11	0.92	0.00	9.00	282,345
Number of Daughters	1.02	1.01	0.00	10.00	282,345
Pregnancies	2.44	1.41	1.00	20.00	282,345
Abortions	1.02	1.01	0.00	11.00	282,345
Miscarriages	1.11	0.92	0.00	12.00	282,345
Years of Education	6.56	4.17	0.00	16.00	282,345
Age	33.11	6.83	20.00	50.00	282,345
Han (1=yes)	0.88	0.32	0.00	1.00	282,345
Urban (1=yes)	0.29	0.46	0.00	1.00	282,345
Log of Household Income (yuan)	8.01	0.73	0.00	11.70	275,151
Employed (non-farming)	0.30	0.46	0.00	1.00	282,345
One Child Policy Fine Rate (years income)	0.80	0.59	0.02	7.50	198,088
Year of Ultrasound Access	1984.65	2.09	1977	1990	282,345
Panel B: China Health and Nutrition Survey (1993), Matched Sample of Mothers and Children					
Number of Children	2.07	1.04	1.00	8.00	2,338
Number of Sons	1.08	0.79	0.00	6.00	2,338
Number of Daughters	0.99	0.90	0.00	5.00	2,338
Han (1=yes)	0.84	0.37	0.00	1.00	2,338
Age	37.53	7.63	18.00	88.00	2,239
Years of Education	6.27	4.11	0.00	19.00	2,328
Access to Ultrasound (1=yes)	0.24	0.43	0.00	1.00	2,338
Average Bargaining Power	0.43	0.26	0.00	1.00	1,434
One Child Policy Fine Rate (yuan)	3176.23	2842.06	0.00	9999	2,228
Panel C: China Disease Surveillance Points Mortality Sample, Young Adult Sample Age 20-40					
Male	0.62	0.49	0.00	1.00	40,594
Suicide (1=yes)	0.14	0.34	0.00	1.00	40,594
Years of Education	7.73	3.55	0.00	16.00	40,594
Age	30.76	6.03	20.00	40.00	40,594
Han (1=yes)	0.89	0.32	0.00	1.00	40,594
Urban (1=yes)	0.17	0.38	0.00	1.00	40,594
Year of Ultrasound Access	1985.16	2.43	1965	1990	40,594

Source : Chinese Children Survey (1992), China Health and Nutrtion Survey (1993), China Disease Surveillance Points (1991-2000)

Table 2

Correlation between Covariates and Ultrasound Availability

	RHS: Was ultrasound available during the pregnancy? (1=yes)				
Dependent Variable	(1)	(2)	(3)	(4)	(5)
Years of Education	0.421***	0.359***	0.166	0.041	0.024
	(0.084)	(0.094)	(0.198)	(0.050)	(0.057)
Log of Household Income (yuan)	0.0860***	0.108***	0.248***	0.0157*	0.014
	(0.018)	(0.021)	(0.036)	(0.009)	(0.010)
Han (1=yes)	0.0251***	0.013	0.029	-0.002	-0.002
	(0.009)	(0.010)	(0.020)	(0.003)	(0.004)
Urban (1=yes)	0.0745***	0.0922***	0.232***	-0.002	-0.002
	(0.025)	(0.029)	(0.055)	(0.002)	(0.002)
Mother age	2.981***	2.409***	0.047	0.062	0.152
	(0.081)	(0.097)	(0.115)	(0.100)	(0.104)
Mother's age squared	172.6***	139.3***	1.256	2.342	6.467
	(4.744)	(5.675)	(6.763)	(5.786)	(6.079)
Gestation Length (in months)	-0.0264	-0.0349*	-0.0795*	0.00811	0.00574
	(0.018)	(0.020)	(0.041)	(0.006)	(0.006)
Prenatal Care in First Trimester (1=yes)	0.0321***	0.0303***	0.006	-0.001	-0.001
	(0.006)	(0.007)	(0.012)	(0.005)	(0.005)
Prenatal Care in Second Trimester (1=yes)	0.0453***	0.0417***	-0.003	-0.003	0.003
	(0.005)	(0.006)	(0.010)	(0.005)	(0.005)
Prenatal Care in Third Trimester (1=yes)	0.0552***	0.0443***	0.006	-0.005	-0.003
	(0.005)	(0.006)	(0.011)	(0.005)	(0.005)
One Child Policy Fine	No	Yes	Yes	Yes	Yes
Birth Year Fixed Effects	No	No	Yes	Yes	Yes
County Fixed Effects	No	No	No	Yes	Yes
County Time Trends	No	No	No	No	Yes

Source : Chinese Children Survey (1992)

Note : Robust standard errors are listed in parentheses under the coefficients. Each cell in the table represents a separate regression. These are the demographic covariates included in the regressions shown in Table 3. Regressions clustered at the county level.

Table 3

Effect of Ultrasound on Sex Ratio of Second Births and Chance of Third Birth

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Impact of Ultrasound on Chance of Having a Son at the Second Parity						
First-born Daughter	0.0354***	0.0434***	0.0429***	0.0430***	0.0432***	0.0444***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	-0.00628
Ultrasound Available	-0.00439	-0.0058	-0.00828	-0.0201***	-0.0105	-0.00694
	(0.005)	(0.005)	(0.006)	(0.007)	(0.008)	-0.00915
Ultrasound Available X First-born Daughter	0.0472***	0.0395***	0.0381***	0.0379***	0.0390***	0.0384***
	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	-0.00864
Mean of LHS Variable	0.540	0.540	0.540	0.540	0.540	0.540
Observations	86,357	78,227	76,563	76,563	76,563	76,563
R^2	0.004	0.005	0.005	0.006	0.012	0.019
Panel B: Impact of Ultrasound on Chance of Having a Third Child						
First-born Daughter	0.0863***	0.0923***	0.0960***	0.0958***	0.111***	0.115***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.006)	(0.006)
Ultrasound Available	-0.227***	-0.160***	-0.139***	-0.014	-0.00653	0.00381
	(0.012)	(0.012)	(0.011)	(0.016)	(0.010)	(0.010)
Ultrasound Available X First-born Daughter	-0.0155**	-0.0238***	-0.0214***	-0.0214***	-0.0227***	-0.0298***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)
Mean of LHS Variable	0.312	0.312	0.312	0.312	0.312	0.312
Observations	86,357	78,227	76,563	76,563	76,563	76,563
R^2	0.071	0.086	0.119	0.144	0.228	0.244
One Child Policy Fine	No	Yes	Yes	Yes	Yes	Yes
Demographic Controls	No	No	Yes	Yes	Yes	Yes
Birth Year Fixed Effects	No	No	No	Yes	Yes	Yes
County Fixed Effects	No	No	No	No	Yes	Yes
County Time Trends	No	No	No	No	No	Yes

* significant at 10% ** significant at 5%. *** significant at 1%.

Source : Chinese Children Survey (1992)

Notes : Robust standard errors are listed in parentheses under the coefficients. Standard errors are clustered at the county level. The suppressed demographic controls are years of education, age, age squared, household income, ethnic status, urban registration status, gestation length of the pregnancy, and prenatal care by trimester. Controls for year of birth in Panel B are based on the year of birth for the child at the second parity.

Table 4

Effect of Ultrasound on Occupational Choice of Women

	Dependent Variable: Did you work outside agriculture? (1=yes)					
	(1)	(2)	(3)	(4)	(5)	(6)
First-born Daughter	0.00886**	0.0121***	0.0122***	0.0005	0.0008	0.0002
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Ultrasound Available	-0.0233***	-0.0191**	-0.0130	-0.0039	-0.0052	-0.00805*
	(0.008)	(0.009)	(0.009)	(0.004)	(0.005)	(0.004)
Ultrasound Available X First-born Daughter	0.0110**	0.0132**	0.0141***	0.00693*	0.00735*	0.00743**
	(0.006)	(0.006)	(0.005)	(0.004)	(0.004)	(0.004)
Mean of LHS Variable	0.134	0.134	0.134	0.134	0.134	0.134
Observations	86,316	86,316	86,316	86,316	86,316	86,316
R^2	0.001	0.002	0.124	0.444	0.444	0.45
One Child Policy Fine	No	Yes	Yes	Yes	Yes	Yes
Demographic Controls	No	No	Yes	Yes	Yes	Yes
County Fixed Effects	No	No	No	Yes	Yes	Yes
Birth Year Fixed Effects	No	No	No	No	Yes	Yes
County Time Trends	No	No	No	No	No	Yes

* significant at 10% ** significant at 5%. *** significant at 1%.

Source : Chinese Children Survey (1992)

Notes : Robust standard errors are listed in parentheses under the coefficients. Standard errors are clustered at the county level. The suppressed demographic controls are years of education, age, age squared, ethnic status, and urban registration. The left-hand side variable is a dummy which is equal to one for all women who report an occupation other than caring for children at home or agricultural work.

Table 5

Effect of Ultrasound on Fertility and Female Bargaining Power, CHNS (1993)

	Dependent Variable: Woman's Total Fertility		Dependent Variable: Woman's Bargaining Power on Household Purchases (0-1)	
	(1)	(2)	(3)	(4)
Was ultrasound available in your health clinic when your 2nd child was born?	-0.551***	-0.309***	0.0751*	0.145**
	(0.067)	(0.113)	(0.039)	(0.064)
Mean of LHS Variable	2.680	2.706	0.416	0.412
Observations	776	734	465	436
R-squared	0.035	0.478	0.007	0.465
One Child Policy Control	No	Yes	No	Yes
Demographic Controls	No	Yes	No	Yes
Community Fixed Effects	No	Yes	No	Yes

* significant at 10% ** significant at 5%. *** significant at 1%.

Source: Chinese Health and Nutrition Survey (1993)

Note: Robust standard errors are listed in parentheses under the coefficients. Standard errors are clustered at the community level. Each cell represents a different regression. The variable bargaining power is calculated using information on who makes household purchase decisions with respect to 15 different appliances (e.g. television). If the wife is the decision maker for this appliance the value is 1, if both decide the value is 0.5, and if the husband decides the value is zero. Bargaining power is the average across a total of 15 household appliances for which this question was asked. Ultrasound availability is determined by how many years prior the clinic had access to abortion, and current access to ultrasound. The One Child Policy control is the village's fine rate for out of plan births in 1993. The demographic controls are years of education, occupation fixed effects, ethnicity, and whether the mother is 40 or older in the year of the survey.

Table 6

Effects of Ultrasound on Fraction of Deaths Due to Suicide

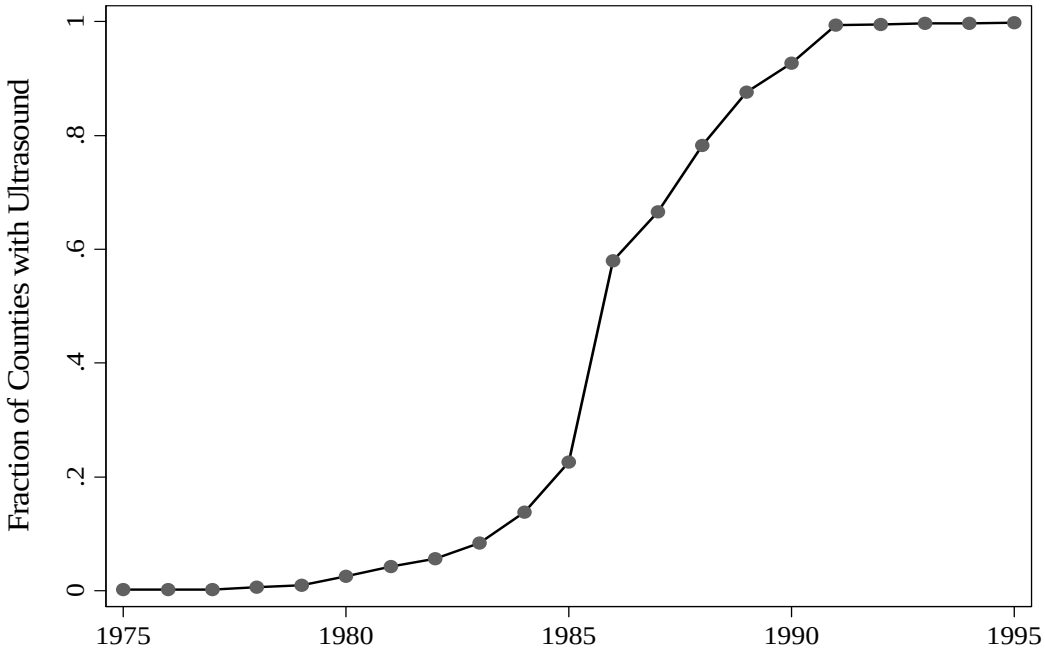
	Females (Age 20-40)		Males (Age 20-40)	
	(1)	(2)	(3)	(4)
Year of Introduction	-0.5%	-0.8%	-0.2%	-0.4%
	(1.6)	(1.7)	(1.0)	(1.2)
1-2 Years Later	-2.1%	-2.4%	0.4%	0.2%
	(1.4)	(1.5)	(1.0)	(1.2)
3-4 Years Later	-1.6%	-1.8%	1.3%	0.6%
	(2.0)	(2.2)	(1.0)	(1.3)
5-6 Years Later	-0.6%	-1.4%	-0.2%	-0.4%
	(2.3)	(2.4)	(1.2)	(1.5)
7-8 Years Later	-7.4%	-8.6%	0.3%	-0.7%
	(2.6)	(2.9)	(1.5)	(1.8)
9-10 Years Later	-8.3%	-9.8%	-0.4%	-1.4%
	(3.2)	(3.7)	(1.6)	(1.9)
11-12 Years Later	-10.9%	-11.7%	-2.0%	-3.2%
	(4.2)	(5.1)	(1.9)	(2.5)
13-14 Years Later	-11.8%	-13.3%	-0.9%	-2.5%
	(4.9)	(6.4)	(2.6)	(3.3)
Percent of Deaths by Suicide	21.1%	23.5%	9.2%	10.1%
Average Effect over 14 years following Ultrasound	-3.4%	-4.0%	-0.7%	-0.1%
	(1.76)	(2.00)	(1.17)	(0.92)
F-Test of joint significance	p=0.0006	p=0.0018	p= 0.2461	p=0.5936
Demographic Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes
Sample	Full	Rural Only	Full	Rural Only
Observations	14,037	11,933	22,808	18,493
R^2	0.098	0.092	0.031	0.035

Source : China Disease Surveillance Points (1991-2000)

Notes : The dependent variable in the regressions is a dummy for whether the cause of death was by suicide (1=yes). Ultrasound availability timing is determined by whether ultrasound was available in the decedent's county when she/he turned 20. The coefficients are reported as the percentage point change in the death being attributed to suicide due to the availability of ultrasound the stated number of years ago. Robust standard errors are in parentheses, and they are clustered at the county level. All regressions include province and year fixed effects, dummies for county income category, and controls for the years of education, age, and urban status of the decedent.

Figure 1

Timing of Ultrasound Introduction Across China's Counties

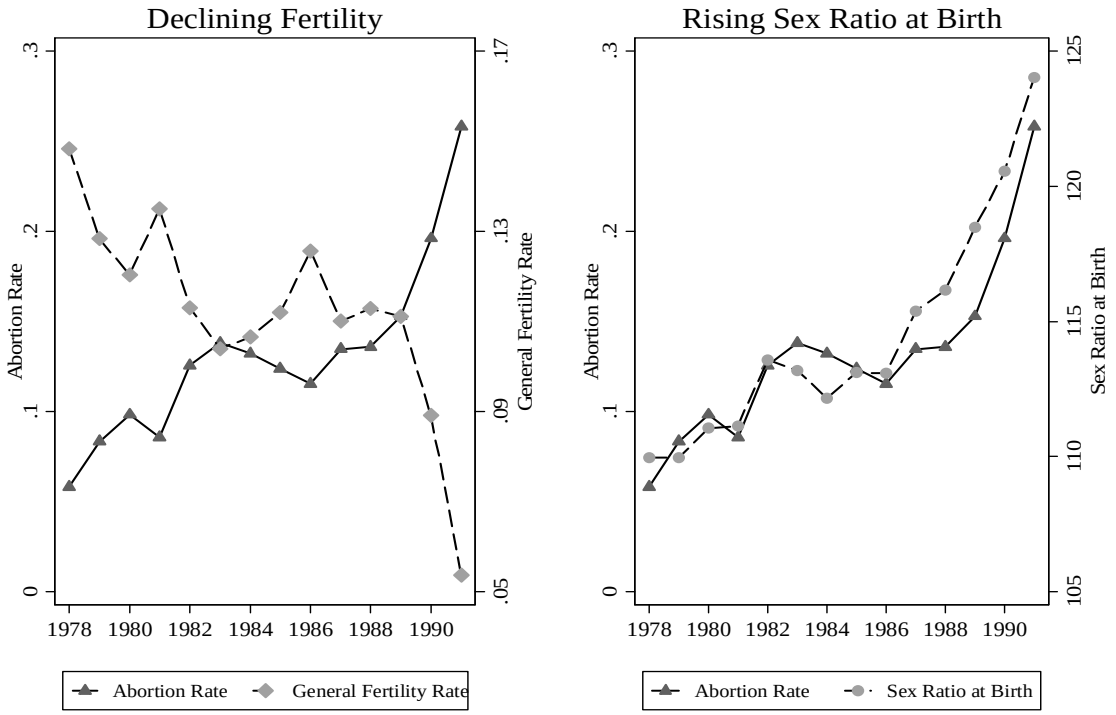


Source : Authors' calculations from official Chinese publications.

Notes : The sample is composed of 1,253 counties for which we have data on when ultrasound became available.

Figure 2

Abortion, Declining Fertility and the Rising Sex Ratio at Birth

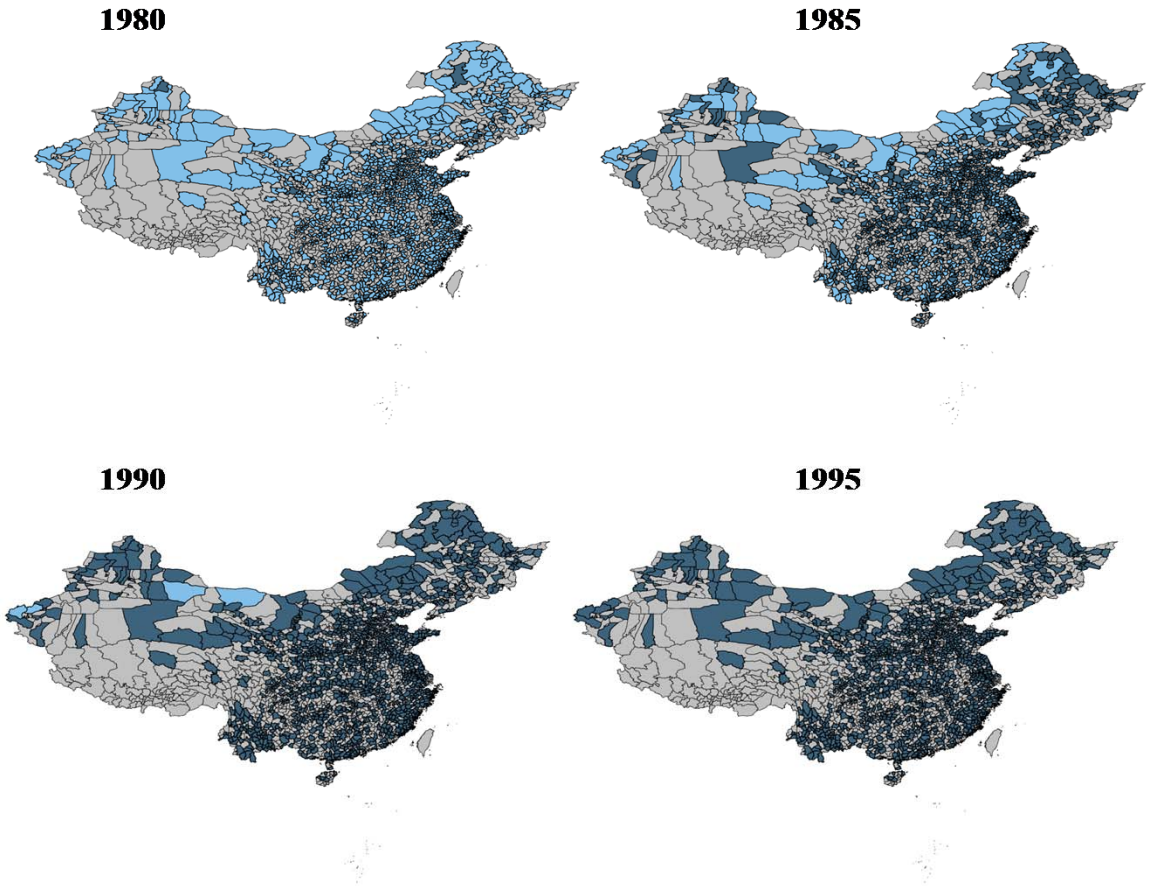


Source : Chinese Children Survey (1992)

Notes : The abortion rate is defined as the share of pregnancies which are terminated by abortion. The general fertility rate is the number of live births per year among women age 15-44. The sex ratio at birth is the ratio of male to female live births (times 100).

Figure 3

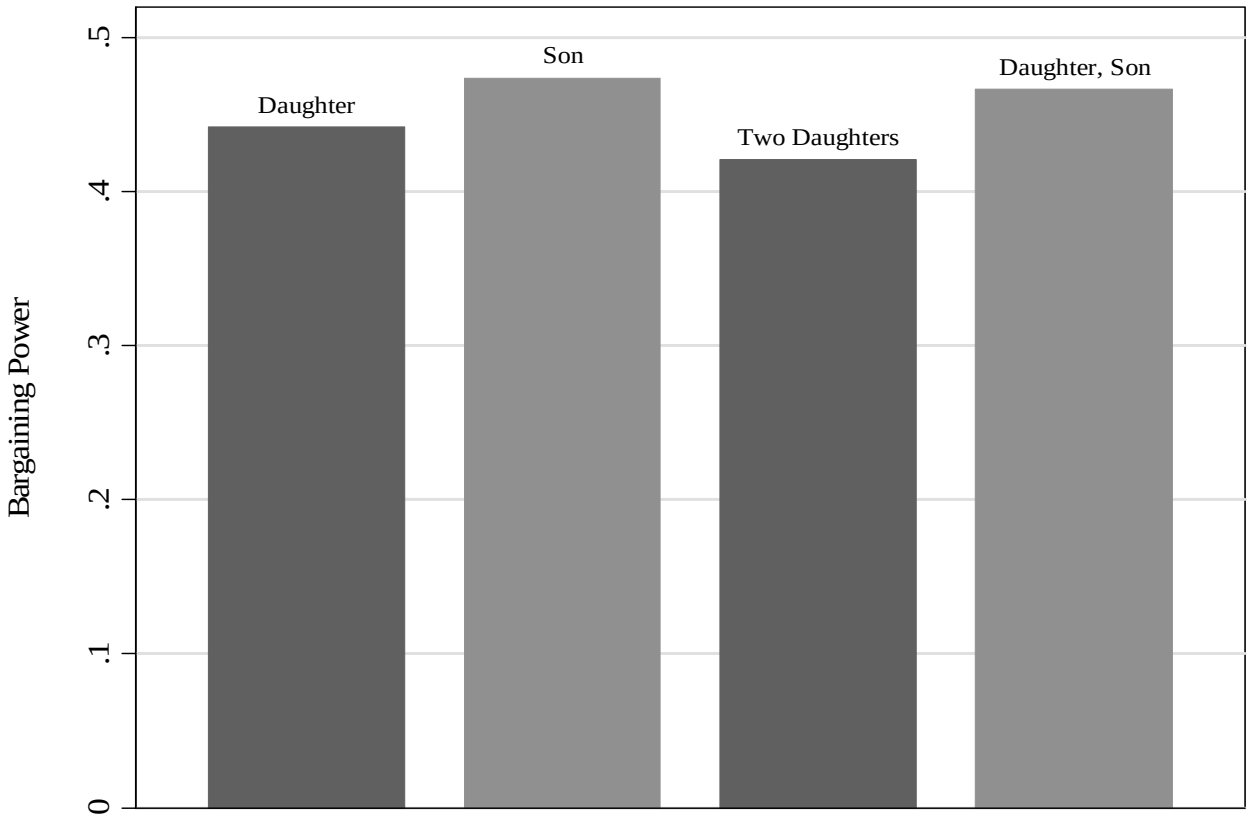
Ultrasound's Diffusion Across China's Counties



Notes : Tabulations of the author's dataset on ultrasound introduction at the county level. The shading corresponds to the availability of ultrasound where dark blue areas represent counties that had ultrasound; light blue areas denote counties without ultrasound, and grey areas are counties for which the information on ultrasound adoption is not available.

Figure 4

Female Bargaining Power and the Sex of Her Children

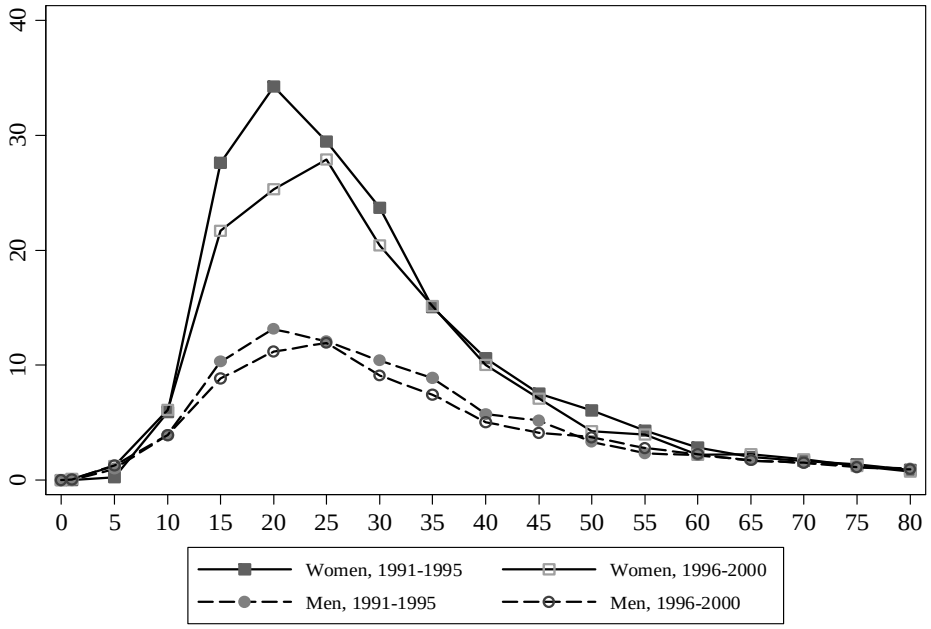


Source : China Health and Nutrition Survey (1993)

Notes: Bargaining power is defined in terms of a woman's authority over household purchase decisions of durable goods.

Figure 5

Percentage of Deaths Due to Suicide by Age, Rural China 1991-2000

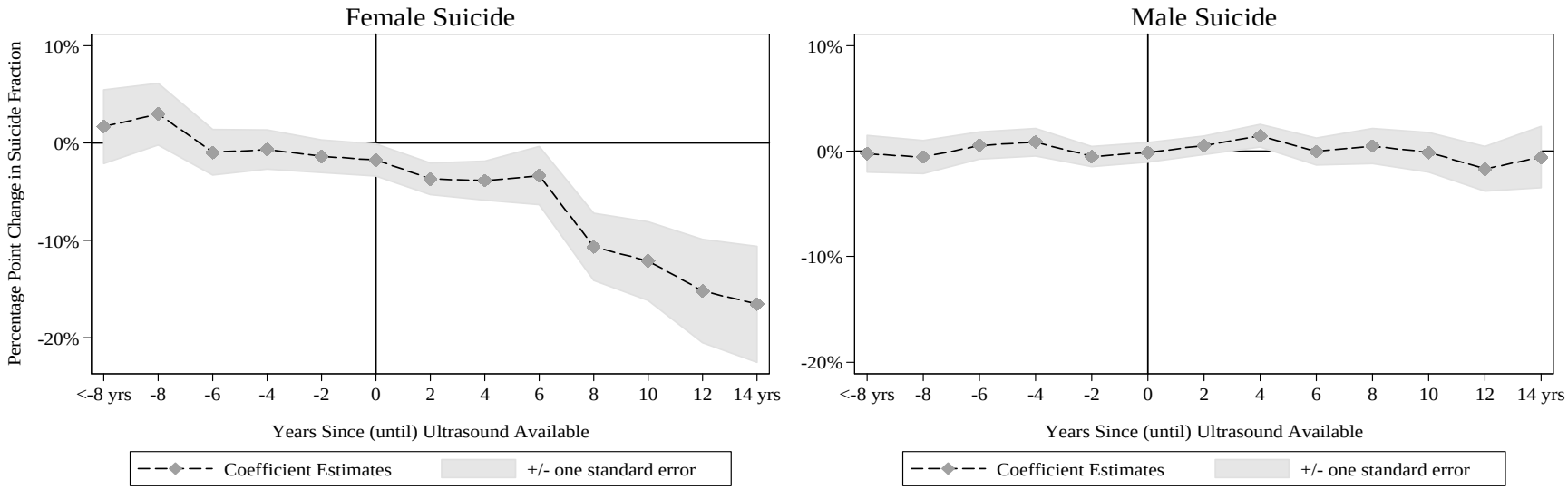


Source : China Disease Surveillance Points (1991-2000)

Notes: Sample is restricted to deaths occurring at rural DSP sites.

Figure 6

Effect of Ultrasound Availability on Fraction of Deaths by Suicide



Source : China Disease Surveillance Points (1991-2000)

Note : The sample is composed of all decedents age 20 to 40. The regression is as estimated by OLS with death by suicide (1=yes) as the dependent variable. The models include province and year fixed effects, dummies for county income category, and controls for the years of education, age, and urban status of the decedent. Ultrasound availability timing is determined by whether ultrasound was available in the decedent's county when she/he turned 20, and the plot represents the coefficients of dummies for the number of years before/after age 20 that it became available in the county. Standard errors are clustered at the county level.

Appendix Table 1

Effect of Ultrasound on Having a Third Child and Occupational Choice of Women

	LHS: Did you have a Third Child?			LHS: Work in other than agriculture?		
	All	First-born Daughter	First-born Son	All	First-born Daughter	First-born Son
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Results using the 1992 Fertility Survey						
Ultrasound Available (1=yes)	-0.0047*	-0.0100**	0.0001	0.0071**	0.0118***	0.0026
	(0.003)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)
Observations	216,612	103,779	112,833	216,612	103,779	112,833
R^2	0.17	0.18	0.17	0.63	0.63	0.62
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
One Child Policy Fine	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: Results using the 2000 Census Sample						
	LHS: Number of Children			LHS: Work in other than agriculture?		
Ultrasound Available (1=yes)	-0.048***	-0.045**	-0.052**	0.024**	0.025**	0.0186***
	(0.017)	(0.019)	(0.019)	(0.010)	(0.011)	(0.007)
Observations	126,186	61,145	65,041	126,186	61,145	65,041
R^2	0.36	0.35	0.35	0.420	0.420	0.421
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
One Child Policy Fine	Yes	Yes	Yes	Yes	Yes	Yes

* significant at 10% ** significant at 5%. *** significant at 1%.

Source : Chinese Children Survey (1992), China 2000 Census (.1%)

Notes : Robust standard errors are listed in parentheses under the coefficients. Each cell in the table represents a different regression. Ultrasound availability is determined by whether ultrasound was available in the respondent's county when she was 20 years old. For counties where ultrasound timing is unavailable, we use the average year of introduction among all counties in the prefecture. Data on ultrasound for the census sample is based on the prefecture. The fertility survey includes all women age 20-50, and the census sample includes women 30-45. The fertility outcome for the fertility survey is whether the mother had a third child. The fertility outcome for the census sample is total number of matched children. The suppressed demographic controls are years of education, age, age squared, urban registration status, ethnic status, and the fine rate for births in violation of the One Child Policy. The fixed effects are at the county level in the fertilty survey and at the province level in the census sample. The standard errors are clustered at the province and county level in the fertility and census samples respectively.

Appendix Table 2

Female Status in the Household and the Sex of her Children

	Dependent variable: What is the minimum amount of money do you (the mother) need to discuss with the other family members before expenditure?				
	(1)	(2)	(3)	(4)	(5)
Number of sons	2.713* (1.28)	3.407*** (0.76)	4.020*** (0.53)	8.361** (2.46)	8.113** (3.09)
Province fixed effects	No	Yes	Yes	Yes	Yes
Sample	All	All	Han Only	Less than 4 chlidren	Han with less than 4 children
Observations	4084	4084	3557	2208	2113
R-squared	0.0595	0.1221	0.1194	0.1088	0.1136

*significant at the 10% level, ** at the 5% level, *** at the 1% level.

Source : 1990 Woman's Status Survey

Notes : Robust standard errors are listed in parentheses under the coefficients. The listed covariates are for the wife, and the age difference refers to the difference between the husand and wife's age. The results in column 3 exclude non-Han mothers. The results in column 4 exclude families with 4 or more children, and in column 5 families with non-Han mothers or 4 or more children are excluded. Supressed controls include the total number of children, age, labor income, and years of education. The standard errors are clustered by province.