Has the One-Child Policy Generated Excessive Boys in China?

A Community-Level Analysis

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Abstract

High sex ratio at birth in China has been observed since the mid-1980s, and the one-child policy has been suggested as a cause. Using CHNS data (1989-2000) and highlighting local variations in policy rules and enforcement I find that (1) a strict policy (both policy rule and enforcement) reduces sex ratio of children, while a girl-exception policy contributes to excessive boys, and (2) shifting from a strict policy into a girl-exception policy exacerbates, while shifting into a stronger enforcement alleviates, sex ratio. Thus, more balanced sex ratio of children is achieved in places where and at times when the policy is enforced more strictly. However, policy effect is contingent on parity, and it is the gendered nature of the policy that generates excessive boys. Findings suggest that in settings where couple's ability to control the sex composition of offspring is greater than their ability to control the ideal number of children, external pressures should be adopted to reduce son proclivity and sex ratio of children.

Key words: Local variations of the one-child policy; Sex ratio of children; China

Studies have found that in places where fertility decline is faster than the decline of son preference, female discrimination might be reinforced (Das Gupta and Bhat 1997). With demographic transition from high fertility to low fertility, couple's ideal number of children drops dramatically, but son proclivity does not change accordingly. With the available technologies of sex selective abortion (Park and Cho 1995; Zeng et al. 1993), couples are, to some extent, able to control the sex of offspring while maintaining a desired family size. Consequently, a high sex ratio at birth has been observed in several countries or regions in Asia with or without restrictive birth planning policies, including Korea, Taiwan (Park and Cho 1995), India (Clark 2000; Das Gupta and Bhat 1997) and China (Greenhalgh et al. 1994; Li et al. 2006). In India and China alone, 30-70 million women are estimated "missing" by the early 1990s (Sen 1990, 1992).

The sex ratio at birth is particularly abnormal in China. Since the mid-1980s, it has been rising steadily, from 108.5 in 1982 to 113.8 in 1989 (Gu and Roy 1995), 116.9 in 2000 (PCO 2002) and 121.18 in 2004 (SSBC 2005). Because this phenomenon occurs after the onset of the one-child policy, the policy has been suggested as an underlying cause (Assche 2004; Banister 2004; Coale and Banister 1994; Greenhalgh et al. 1994; Wen 1993). However, some argues that there is no causal relation between the one-child policy and the abnormal sex ratio at birth (Yuan and Shi 2005). This is because that the sex ratio at birth varies substantially across regions. According to the 1990 census, it tends to be normal in large cities with a strong policy yet weak son preference (Chu 2000; Gu and Roy 1995; Liu 2002; Yuan and Shi 2005). Comparative studies also show that in settings with son preference, precipitous fertility decline generally results in a high sex ratio at birth, while in other settings, the sex ratio at birth tends to be normal (Goodkind 1999), despite different socioeconomic and politic contexts and population regulations (Coale and Banister 1994).

Thus, it is debatable whether the rising sex ratio at birth can be attributable, at least partially, to the one-child policy.

This paper examines the relationship between the one-child policy and community-level sex ratio of children (measured as the percent of boys) in China, a context where drops in fertility is much faster than the erosion of son proclivity. Unlike past studies that tend to compare the aggregate sex ratio at birth in pre- and post- policy period, this study focuses on local and temporal variations in policy rules and enforcement methods in post-policy period and their potential effects on the sex ratio of children at community level. China presents a unique setting: its rapid fertility decline and demographic transition are largely conditional on the one-child policy, which has yet no effective means to restrict or prevent sex selective abortion (Jie 2002). In such context, couples' ability to control the sex composition of offspring exceeds their ability to control the ideal number of children. Thus, how do couples respond to this policy and balance their desired sex of children in family building process? What is the independent role of the one-child policy in, and how much does the enforcement of the policy matter for, the rising sex ratio of children in an environment of socioeconomic and demographic transition with strong son preference? Particularly, are the local variations of the one-child policy associated with different sex ratios of children in China?

By doing so, this work complements past studies in several ways. First, it focuses on the local variations of the one-child policy by drawing on direct policy measures. Due to lack of data, very fewer relevant studies (Qian 2005; Zhang 2005) include direct policy measures. However, it is necessary and important to highlight local policy variations in exploring the relationship between the one-child policy and the sex ratio of children, given that the policy rules and enforcement strategies vary substantially across regions (Guo et al.

2003; Zhang and Chen 1999). Varying policy might have diverse implications for the sex ratio of children.

Second, it adopts a longitudinal research design. Although child sex ratio has been a focus of research, most studies have been cross-sectional, providing snapshots of sex ratio at single points in time. Such approach is, however, inadequate to understand changing relations between the policy and the sex ratio of children over time. By contrast, this paper draws on panel data from the China Health and Nutrition Survey (CHNS). CHNS has collected information during the 12 years between 1989 and 2000. This provides opportunities to assess changing dynamics over time in the relationship between the one-child policy and child sex ratio in a more satisfactory way, and helps avoid some potential problems in measurements of key concepts.

Finally, it examines the sex ratio of children at community level, and pays attentions to the interplay of socioeconomic, sociodemographic and policy factors. Past studies tend to describe macro-level (national, regional or provincial) sex ratio at birth, which provides no information on the independent role of the policy on the sex ratio of children (for exception, see Qian 2005). Our approaches would help understand whether, how and to what extent the one-child policy may matter for children's sex ratio, net of socioeconomic and other factors.

This paper is organized as follows. After a brief description of the one-child policy, it presents provincial-level sex ratio of children in relation to provincial-level policy rules. This is followed by a discussion of the sources of abnormal sex ratio of children. Then it describes data, specifies variables, and presents multilevel and multivariate, and fixed effect model results. Finally, it summarizes and discusses major findings.

The Local Variations of the One-Child Policy

The one-child policy was first initiated in some areas in China in 1979, and implemented throughout the entire country in 1980 except for some minority regions. While it is a national policy headed by the State Family Planning Committee,[1] the policy has varied locally and over time (Guo et al. 2003; Peng and Li 2002). It was strictly and centrally enforced in the late 1970s and early 1980s. Since 1982, particularly after 1984, however, it has been relaxed (Greenhalgh 1986; Yang 1994). About 5 percent of rural households were allowed a second birth in 1982; 10 percent in 1984 and 50 percent in 1986 (White 1992). Since 1988, except for those in six provinces and municipalities, farmers in rest provinces have been allowed to have two or more children provided a four-or-five year interval between births (Peng 1997).

On the spectrum of local variations, since the early 1980s, the state government has stressed the importance for the policy to suit unique regional demands (Peng 1997), leaving provincial governments to stipulate, administer and monitor policy regulations and implementations. Thus, each province designs its own set of policy, depending largely on local economic structure (Merli and Smith, 2002) and population size, leading to substantial local policy variations.

Among numerous exceptions under which couples are allowed to have more than one child under normal circumstances,[2] a girl-exception and two-or-more child exception are the most common. The first allows couples whose first child is a daughter to have a second birth; the latter allows couples to have two or more children, irrespective of the sex of the first child. Since 1988, six provinces and municipalities implement a strict one-child policy; six provinces and autonomous regions implement a two-or-more-child policy, and the rest provinces have a girl-exception policy in the countryside (Peng 1997).[3] They are

implemented in approximately 35, 11 and 54 percent of areas in China, respectively (Guo et al. 2003). Girl-exception is a common rule across provinces, and has the potential to affect the reproductive behavior of more than half of all couples in China.[4]

The core of the one-child policy is a set of systematically designed implementation strategies, including incentives (e.g., healthcare subsidy to the only children), disincentives (e.g., out-of-plan birth fine), and family planning responsibility system. Policy incentives target couples who sign the one-child certificate, a pledge agreeing to have only one child in return for benefits. On the contrary, disincentives exist as sanctions for couples that have "out of plan births," including fines. Under the family planning responsibility system, the local chief cadre is responsible for implementing the policy and keep the number of births under his/her jurisdiction under the officially assigned birth quota, and the evaluations on his/her job performance partly depends upon how well he/she implements the policy.

These implementation methods, as economic, institutional and administrative constraints to couples' reproduction, aim to encourage couples to conform to the policy. Together with policy rules, they would have greatly shaped couples' reproductive behavior. It is important to note that, however, policy rules and strategies only aim to reduce births, and there are so far no effective ways for the policy to prevent sex selective abortion practice. Thus, couples' ability to have an ideal sex composition of offspring exceeds their ability to have an ideal number of children, which would have implications for the sex ratio of children.

The One-Child Policy and Provincial-level Sex Ratio of Children

In the late 1970s when China replaced the "later marriage, longer spacing and fewer children" birth planning program with the stricter one-child policy, there was a debate

whether the new policy would result in a surfeit of boys. The government argued that it would not:

> Since the liberation in 1949, each population census has shown that the sex ratio at birth is overall balanced with boys slightly outnumbering girls. After the initiation of the one-child policy, several government agencies have investigated the sex ratio of the first birth in some areas, and found that boys are still only slightly more than girls (CCCPC 1980).

Whether or not coincident, however, the sex ratio at birth has risen after the onset of the one-child policy (Greenhalgh et al. 1994). In three villages in Shaanxi, Greenhalgh et al. (1994) find that it fluctuates from 114 boys to 100 girls in 1979-83, when the one-child policy is first promulgated, to 98 to 100 in the locally lenient period of 1984-87, and to 145 to 100 in the 1988-93 period when the policy is strictly enforced. However, others argue that high sex ratio at birth is not a consequence of the one-child policy, and contrary to what many believe, the policy has not worsened (Secondi 2002) or caused (Yuan and Shi 2005) the bias in the sex ratio at birth.

Table 1 presents provincial-level sex ratio by age cohort, parity and residence in the context of policy rules[5] based on the 2000 census. As it shows, sex ratio is extremely skewed in most provinces. Overall, central provinces have higher sex ratios of children than other provinces, irrespective of child age, parity, residence as well as policy.

By age cohort: In all provinces, except Xizang (Tibet) and Xinjiang, the sex ratio at birth (age 0) exceeds the normal upper limit: the highest is 138.0 in Jiangxi and 137.8 in Guangdong; it is also highly abnormal in Jiangsu, Anhui, and Hainan. This pattern holds for children age 1-4. Sex ratio decreases among children age 5-9 in almost all provinces, and reduces further after age 10 (not shown here). This pattern might relate to the differential mortality rates of boys and girls. It is also possible that girls previously not registered are

now registered for school or other purposes. Overall, provinces with a strong policy have on average a lower sex ratio than those with a girl-exception policy, but the sex ratio of children is the lowest in provinces with a two-child policy.

[Table 1 about here]

By parity: Many studies have shown that the sex ratio at birth is relatively normal for the first birth, but escalates as number of existing children increases, especially if there are already girls in the family (Chu 2000; Duan et al. 2003; Gu and Roy 1995; Liu 2002). However, the 2000 census shows that, regardless of policy rules, Guangdong, Jiangxi, Beijing, Jiangsu, Hainan, Shanghai, and Hubei all have a sex ratio of parity 1 over 110.

The sex ratio of parity 2 is particularly high across all policy regimes. Three provinces have a sex ratio of parity 2 over 200, ten over 150, and all except Ningxia and Xinjiang 117 or above. In Jiangsu, a province with a strong policy, for example, it is near 200; it is 205.5 in Anhui and 203.6 in Jiangxi, two provinces with a girl-exception policy; Hainan province with a weak policy has a sex ratio of 166. A similar pattern is observed for parity 3. On average, the sex ratio at birth is the highest in strict policy environment for parity 1, but the highest in girl-exception policy context for parities 2 and 3. A two-child policy is associated with the lowest sex ratio, though abnormal.

By urban residence: An abnormal sex ratio is observed across all residences and policy rules. In the 1990 census, although the sex ratio at birth in the countryside is imbalanced, it in urban settings remains relatively normal (Zhang 2003). In the 2000 census, however, the sex ratio at birth is 114.2, 119.9, and 121.7 for city, town, and village, respectively. Thus, by 2000, the sex ratio at birth becomes abnormal across the entire country. Regardless of residence, a girl-exception policy is averagely associated with the highest ratio, while a two-child policy the lowest sex ratio at birth.

Overall, the sex ratio of children reflected in the 2000 census is abnormal in most parts of China, and it is the highest in provinces with a girl-exception policy, but the lowest in provinces with a two-child policy, although variations exist within each policy rule. The relatively normal sex ratio of children in some two-child policy provinces might be relevant to their relatively loose policy rules and enforcement methods, as well as their large minority population, whose fertility desires and attitudes towards boys might differ from other places.

Sources of the Abnormal Sex Ratio of Children

Studies have found that in demographic transition to low fertility in societies characterized by son preference, two countervailing factors are likely to affect the sex ratio at birth: a "parity effect" and an "intensification effect" (Das Gupta and Bhat 1997). A "parity effect" tends to reduce gender bias, because, as the proportion of higher-parity births declines with fertility reduction, all children are cherished, reducing gender bias. In contrast, an "intensification effect" is likely to intensify gender bias; that is, if the desire for children declines faster than the desire for sons, girls at lower parities are less welcome, reinforcing gender bias. Due to the lingering son preference and low fertility in China, parity effect and intensification effect might be "relevant to understanding the relationship between the one-child policy and the expression of gender bias" (Short et al. 2001:916). The latter is particularly relevant to the study of the sex ratio of children in China.

Three proximate causes have been proposed to explain the distorted sex ratio of children in China: female infanticide (Coale and Banester 1994; Banister 1994), underreporting of girls (Croll 2001; Li et al. 2006; Merli and Raftery 2000; Qiao 2004) and sex selective abortion practices (Assche 2004; Chu 2000; Li et al. 2006; Tu and Smith 1995;

Zeng et al. 1993). Recent studies reveal that the ways by which the sex ratio at birth increases change over time. In the 1980s, underreporting of female births accounts for about 43 to 75 percent of missing girls (Duan et al. 2003). By contrast, as ultra-sound machines become more available, sex-selective abortion makes up the majority of the difference between the reported and normal sex ratio at birth, and has replaced underreporting as the major mechanism of the high sex ratio at birth since the early 1990s (Duan et al. 2003).

These proximate causes do not work in vain. Studies suggest that the underlying forces behind these proximate causes are strong preference for sons over daughters (Liu 2005; Yuan and Shi 2005), the one-child policy targeting at fertility reduction (Assche 2004; Greenhalgh et al. 1994), and socioeconomic transition as well as the interplay of these factors.

Historical data in China and contemporary, cross-cultural studies all point to the decisive power of son preference in the rising sex ratio at birth. In settings where, and times when, son preference is less salient, gender bias manifested through the sex ratio at birth has been absent, irrespective of economic conditions (e.g., Goodkind 1999; Park and Cho 1995). For example, the sex ratio at birth in China was high in the 1930s and 1940s due to son preference (Coale and Banister 1994), but it fell to the normal range in the 1960s and 1970s (Banister 2004) due to strong government actions combating against gender bias and other traditional practices viewed as harmful (Coale and Banister 1994). The absence of manifest son preference in North Korea, Indonesia, Sri Lanka, and Thailand, all less developed, also leads to a balanced sex ratio at birth. By contrast, South Korea and Taiwan, both economically advanced yet with son proclivity, have a high sex ratio at birth.

The sex ratio at birth begins to rise at a time when China economy starts to develop,

while fertility starts to fall rapidly. Socioeconomic transformation raises the costs of childbearing and the demand for "high quality" – read "boys" in the context of offspring's sex – children. Meanwhile, the one-child policy facilitates fertility decline and transition. Nevertheless, both transitions do not erode son proclivity accordingly. The majority of Chinese, while desiring for fewer children, still prefer to have both at least a son and a daughter (Chu 2000). Before the one-child program, this desire led to large families with sons and daughters. Contemporarily, son preference is exacerbated because the demand for children drops faster than the demand for a son (and a daughter). Couples prefer to have a son for family line continuation, old age support, property inheritance (Jie 2002), and mother's status (Gu and Roy 1995). Hence, the occurrence of the high sex ratio at birth since the mid-1980s has been a consequence of the combination of the downward change in the desired (and actual) family size due to the one-child policy and socioeconomic transformation, and the persistence of son preference. It meets parental son preference, small family desire (Gu and Roy 1995; Park and Cho 1995) and policy regulations. In this sense, the one-child might be related to the high sex ratio of children. The issues are, net of socioeconomic factors: how are they related? What are the mechanisms by which the policy affects the sex ratio at birth? Are the local variations of the policy related to excessive boys?

Data and Methods

To answer these questions I draw on data from multiple waves of the Chinese Health and Nutrition Survey (CHNS). The CHNS is a collaborative project between the University of North Carolina and the Chinese Academy of Preventive Medicine, Beijing. It is designed to examine how social and economic transformation of Chinese society and

family planning programs affect the health and nutritional status of its population. As a panel survey, the CHNS draws a sample from nine provinces during the period of 1989-2000 (specifically, in 1989, 1991, 1993, 1997 and 2000): Heilongjiang Liaoning, Shangdong, Henan, Jiangsu, Hubei, Hunan, Guizhou, and Guangxi.[6] These provinces considerably differ in demography (PCO et al. 2002) and socioeconomic development (SSBC 2002). Other analyses of birth planning data indicate that policy varies across communities and over time (Short and Zhai 1998). The sex ratio of children, as shown in Table 1, also varies substantially across survey provinces, and is comparable to the national average.

The sample selection process adopts a stratified, multistage, random cluster design. Counties in the nine provinces are stratified by income; four counties in each province are randomly selected using a weighted sampling scheme. In addition, the provincial capital and a lower income city are selected. Some 190 villages and townships within counties and urban and suburban neighborhoods within cities are selected randomly. The one-child policy questions are directed to the cadres responsible for family planning policy in communities. One advantage of this survey lies in its relatively comprehensive coverage of the measures of the one-child policy. Together with the usual array of social and economic variables, it allows an investigation of how the one-child policy affects sex ratio, net of socioeconomic and other characteristics.

Variables

Dependent variable: This analysis is a community-level analysis. The dependent variable is the community-level sex ratio of children born after 1986, gauged as the percent of boys. Percent of boys is used because of some all girls' or all boys' communities in the sample. A value of 100 indicates that all children in a community are boys, while a value of

0 indicates that all children in a community are girls. A sex ratio of 107 corresponds to 51.7 percent of boys.

This paper uses data from 1989, 1993, 1997 and 2000 CHNS. Only communities with at least 4 children born after 1986, when the girl-exception policy was commonly adopted across provinces, are included in the analysis. There are 175, 178, 187 and 214 communities in the sample in the four waves of survey, respectively. Children age 5 or above are included to avoid the possibility of underreporting of girls at earlier ages; the total sample size is 754. Among these, 746 communities have parity 1; 631 communities have parity 2, and 285 communities have parity 3+. The small sample size of parity 3 makes it meaningless to do analysis and therefore, there is no further discussion on parity 3.

Because the CHNS only provides policy information since 1989, including children born between 1986 and 1989 makes an assumption that the policy (both rules and implementation strategies) across the survey areas stays similar over the years. One caveat is that the policy might be modified, generating causal problem. Alternatively, I attempt to adopt a lagged research design, using community information in earlier waves to predict the sex ratio of children born between two adjacent surveys. However, this design is compromised by the small sample size of community.

Key predictors: To evaluate the effect of the one-child policy on the sex ratio of children, my focus is on local policy variations across villages and neighborhoods. The community survey asks local cadres if couples in their communities are allowed to have one child, two or more children, or a second birth if the first child is a daughter, among other exceptions. Correspondingly, I highlight the two exceptions that allow couples a second birth if the first child is a daughter, and two or more children under normal circumstances. The two exceptions are particularly relevant to this study and likely a

reasonable indicator of local policy climate (Short et al. 2001). Using these exceptions, I distinguish between three kinds of policy rules: *one-child policy, girl-exception policy,* and *two-child policy*, and refer them as strong, moderate and weak for the ease of discussion (Short et al. 2001).

Family planning responsibility system and one-child subsidy are also included in this analysis.[7] While family planning responsibility system has been adopted throughout China, some places may not impose penalties or awards on local cadres based on his/her performance in implementing the policy. In such communities, the effect of this method on fertility control will be limited. Thus, I collapse them with those without this system and assign these communities a value of 0, while assigning communities that implement this system with incentives and disincentives a value of 1. Additionally, the survey asks local family planning cadres if their communities provide couples who have only one child with one-child subsidy and/or child healthcare subsidy. Communities providing one-child couples with either of these two types of subsidy or both are assigned a value of 1.

Control variable: To model the relationship between the one-child policy and the sex ratio of children, I control the following variables, all measured at community level, either integral to and only measurable at that level, or derived from individual or household characteristics.

Percent of girls of parity 1: This variable is aggregated from the sex of the first children in community, and used to predict the percent of boys of parity 2. Studies have found that the sex of existing children is an important predictor of the sex of later children (Gu and Roy 1995; Liu 2005). At the community level, percent of girls of parity 1 may reflect local environment of gender preference.

Mother's education: Aggregated from individual mothers' year of schooling in a

community, mother's education, coded continuously, reflects local human capital. However, it may have mixed effects on the sex ratio of children. On the one hand, education increases job options and earnings for women, raises opportunity costs of childrearing, and challenges traditional notions of male supremacy and son preferences (Clark 2000). Thus, education is found to be inversely related to the sex ratio at birth (Lavely and Freeman 1990). On the other hand, however, better-educated mothers might be more informed on, and have easier access to, sex-selective abortion practice, resulting in more boys than girls.

Household wealth. Due to the difficulty and complexity to measure income in China, this paper uses the possession of household consumer durable goods to proximate community-level average household wealth, which is the unweighted sum of 12 items, including television, telephone, refrigerator, microwave, washing machine. Studies on India and Vietnam find no effect of household wealth on childhood sex ratio (Das Gupta 1987; Haughton and Haughton 1998). Nevertheless, it can be linked to a higher sex ratio of children for a number of reasons. For example, wealthier households might be able to afford fines for extra children, particularly for a son, and have more incentives to have a son for property inheritance.

Percent of labor force in agriculture. Percent of labor force in agriculture in communities is used as a proxy of local development. The degree of agriculture has a significant effect on the sex ratio at birth (Lavely and Freedman 1990; Schultz and Zeng 1995). Agriculturally intensive communities tend to be less developed, associated with lower opportunity costs of childbearing and childrearing, and adhere to stronger son preference (Jie 2002; Yang 1994). However, the relationship between development and sex ratio might be non-linear, and development does not necessarily guarantee a balanced sex ratio at birth (Gu and Roy 1995; Yuan and Shi 2005).

Urban residence.[8] China is highly stratified between urban and rural areas. Urban residence is used to measure the extent of urbanization on the sex ratio of children. If the community is located in a city or town, it is defined as urban residence; if the community is located in a village or suburb, it is coded as rural residence.

Region. The survey provinces substantially differ from each other. Ideally, provincial dummies will better capture the heterogeneity across provinces, but due to small sample size, this analysis collapses them as North (Heilongjiang, Liaoning, Henan and Shandong), Center (Jiangsu, Hubei and Hunan), and South (Guangxi and Guizhou). In addition to capturing the effects on the sex ratio of children of geographical regions, they may also reflect divergent fertility desire, intensity of gender preference and cultural differences beyond the political boundaries of provinces.

Table 2 presents means (or proportion) and standard deviations, as appropriate, for all children and by parity. Percent of boys increases with parity, from 51.47 percent for parity 1 to 53.84 percent for parity 2, respectively.

[Table 2 about here]

Figure 1 depicts the sex ratio of children by policy rules and family planning responsibility system, means of implementation. Both are evidently related to community sex ratio of children. Particularly, the combination of a girl-exception policy and weak enforcement is associated with the highest sex ratio of children, while the combination of a strong policy and strong enforcement, as well as a weak policy yet a strong enforcement are both associated with the lowest sex ratio of children.

[Figure 1 about here]

Methods

The analysis adopts a two-step strategy. First, it investigates the time trend of the

percent of boys in 1989, 1993, 1997 and 2000 in the context of the one-child policy.9 Since about two-thirds (141) of communities have participated in all of the four surveys, and over 90 percent of community has participated in the survey at least twice, it creates a two-level data structure: communities and observations. Controlling for region and local development in models may not fully capture all differences across communities that affect the sex ratio of children. Some differences are difficult to quantify. Consequently, two-level, random-intercept linear models are applied, treating communities as level 2 and observations as level 1. This approach takes into account unobserved or unobservable heterogeneity *between* communities, and generates unbiased parameter estimates (Singer 1998). Diagnostic model (unconditional means model) results (not shown here) also suggest the necessity to employ multilevel modeling technique.

Fixed effect models are then fitted. One advantage of fixed effect models is that it addresses the possibility that substantively important omitted variables are creating bias for our analysis. The most plausible omitted variables include son preference, fertility desire and behavior (including abortion), all of which are known to affect child sex ratio. Thus, it is possible that a lower fertility desire but a stronger gender proclivity would lead to more boys than girls. Since son proclivity and fertility norms remain relatively stable over the time period I examine, with the fixed effect method, the unobserved heterogeneity *within* communities will effectively drop out, and parameter estimates reflect pure influence from variables of interest.

Analytical results

Multivariate and multilevel analysis

Table 3 presents findings of the percent of boys at community in the late 1980s and

1990s for all children and for parities 1 and 2, respectively. As it shows, for the full sample, policy rules and strategies are not significantly related to the outcome variable. Although communities with a girl-exception policy have a higher, while communities with a two-child policy have a lower, percent of boys than communities with a strict one-child policy, and while communities with family planning responsibility system have a lower percent of boys than other communities, the difference is statistically non-significant.

[Table 3 about here]

Among control variables, mother's education is significantly yet inversely related to sex ratio. Education potentially conveys two kinds of information, ideal number of children and ideal sex composition of offspring. A higher education elevates the value of women in the workforce, increases opportunity costs of childrearing, and thereby motivates mothers to adjust down their family size. Also, women of higher education have more autonomy, better negotiation power within households and can better withstand the pressure from others to have a son (Clark 2000). Additionally, those women are likely susceptible to stronger policy pressure (stricter regulations and higher penalties for violation), generating more balanced sex ratio of children.

Patterns observed for the full sample largely hold for parity 1 with regard to policy. Again, policy is not significantly associated with the outcome variable. Communities with strong, moderate or weak policy, as well as communities with or without implementation methods do not differ statistically from each other in the percent of boys.

However, among control variables, in addition to mother's education, several other factors also bear an effect on the outcome variable. Percent of labor force in agriculture and household wealth are consequential determinants of child sex ratio: a higher percent in agriculture and better household wealth both contribute to more boys. The similar effect on

the dependent variable of these two factors seems intriguing: both measure development, but more developed communities have fewer boys, while more wealthy households have more boys. The seemingly conflicting results may confirm that, while development is generally associated with a more balanced sex ratio of children, it does not necessarily guarantee it (Das Gupta 1987): individual choices are still being made in response to one's own fertility desire and family norm. South Korea and Taiwan are developed in Asia, yet their sex ratio at birth is distorted. Community provides a setting disseminating family planning- and policy- related information and promoting new norms and ideologies of family and children, and a setting where couples communicate with each other, and act on information received. Nevertheless, individual behavior, while conditioned on local settings, also responds to household context. Better household economy raises couples' ability to have more children and the risks they are willing to take in order to have a son. Wealthier households, because of property inheritance, might particularly desired a son.

Also, there is a clear time trend in the sex ratio of parity 1, other things being equal: the percent of boys increases over time. Compared with 1989, 1993, 1997 and 2000 all have more boys in the surveyed communities, particularly in 1997.

As would be expected, findings for parity 2 are very different: policy rules and enforcement strategies do relate to the outcome variable. Percent of boys in communities with a girl-exception policy or a two-child policy is about 5 and 2 percent higher, respectively, than that in communities with a strict one-child policy, although the difference between two-child policy and one-child policy is non-significant. By contrast, family planning responsibility system reduces the community percent of boys by over 4 percent. This suggests that a more balanced sex ratio of parity 2 might be achieved in communities with a strong policy rule and implementation method, and that when policy does raises the

sex ratio of children, it is the gendered nature of the policy (Murphy 2003) that does so.

Not surprisingly, the percent of girls of parity 1 is positively associated with the percent of boys of parity 2: more girls among parity 1 leads to more boys of parity 2. But mother's education, household wealth and percent of labor force in agriculture bear no significant effect on parity 2.

Region/province is a strong determinant of the sex ratio of parity 2. Communities in northern provinces have a more balanced sex ratio than those in central and southern provinces. This confirms to past studies (Jie 2002) and is consistent with the patterns described in Table 1, the descriptive report of the 2000 census. Northern provinces generally have more rigorous policy rule and implementation strategies. Closer to Beijing, the political center of China, they are subject to greater pressure to adhere to a strict policy rule. Meanwhile, residents in northern provinces (except Henan) tend to hold a more equal gender ideology. All these may contribute to a relatively more balanced sex ratio of children (but again, lumping the four provinces together may conceal the substantial differences between them. Henan province, for example, has a rather high sex ratio).

Fixed effect analysis

Although the above analysis has found that the one-child policy relates to the sex ratio of children and its effect varies across parities, the validity of these results could be questioned due to substantially important missing variables (such as son preference) and heterogeneity *within* communities during the period of 1986-2000. To address the missing variable and heterogeneity problems and to take advantage of the panel nature of the sample further, I estimate within-community fixed effect models. A strength of this paper is the ability to follow communities over this recent 12-year period. Since fixed effect models

assess whether a change in the primary covariates of interest is associated with a change in the outcome variable, only variables that change over time are necessarily included in models.

Table 4 presents fixed effect model results for all parities and by parity. The specifications presented in this table confirm to the importance of changing policy characteristics over time for the sex ratio of parity 2. Shifting from a strong policy into a girl-exception policy increases the percent of boys by 5 percent, and shifting into a weak policy raises the percent of boys by 3 percent (but not significant). By contrast, shifting into family planning responsibility system from without decreases the percent of boys of parity 2 by over 4 percent. This confirms to Secondi's (2002) finding. By comparing birth cohorts before and after, and policy changes after, the implementation of the one-child policy, Secondi finds that a more balanced childhood sex ratio is achieved at the time when the policy is enforced more strictly. Policy bears no significant effects on the outcome variable for other parities.

[Table 4 about here]

Interestingly, none of the predictors is found to be related to the outcome variable when all parities are taken into account. For parity 1, there is an indication that changes in the percent of labor force in agriculture and average household wealth tend to exacerbate child sex ratio. For parity 2, increase in the percent of girls of parity 1 or average mother's education relates to more boys.

The positive effect of mother's education on the percent of boys of parity 2 may suggest that for women who are determined to have a second birth, education may convey a different meaning. While a higher education may be associated with a lower fertility desire, it is more or less ineffective in reducing traditional patriarchal and gender ideology. On the

contrary, a higher education increases women's ability to satisfy their son preference by providing knowledge and network to circumvent the policy and means to pay for illegal practices. Thus, although better-educated mothers are likely to be under stronger administrative and normative pressure and influence, and are forced to have fewer children, their desire for sons as a second child produces more boys.

The above findings suggest that variations in policy rules and implementation strategies play a role in the sex ratio of parity 2, while local and household human and economic capital (mother's education, household wealth and percent in agriculture) are important for the sex ratio of parity 1. Since the community specific fixed effect models condition on a community total number of boys during the period examined, the community heterogeneity is controlled for. Results from both random-intercept models and fixed effect models are similar, although the random-intercept models might be over controlled by controlling for both locations and policy rules. The consistency points to the validity of model results.

Discussion and Conclusion

Since the onset of the one-child policy, the sex ratio at birth in China has escalated substantially, and the one-child policy has been suggested as an underlying driving force. Drawing on data from multiple waves of the China Health and Nutrition Survey, and highlighting local variations and temporal changes of the policy, this study evaluates the potential effect of the one-child policy on the sex ratio of children in the late 1980s and 1990s. Findings suggest that policy variations are relevant to the sex ratio of children. Overall, a more balanced sex ratio of children is achieved in places where and at the times when the policy is enforced more strictly, and that policy effects are conditional on parity,

and it only affects parity 2. Evidently, it is the gendered nature of the policy, rather than its strictness, that raises sex ratio and generates excessive boys.

Specifically, first, a strict policy rule and strong implementation strategy reduce the sex ratio of children, while a girl-exception (moderation) policy contributes to more boys; second, shifting from a strong policy into a moderate policy exacerbates, while shifting into a stronger implementation ameliorates, the sex ratio of children, confirming to what Secondi (2002) has found. It might be that communities with a rigid policy rule and family planning responsibility system impose stronger and more effective institutional, administrative and organizational limits to couples' reproduction, making it more difficult to conceal pregnancies or abort unwanted fetuses, compelling them to adhere to the policy and deterring those who insist on having a son or another child. Such communities are also subject to intensive policy campaigns, which create normative pressure of gender equality, fighting against traditional inclination for sons, reducing the sex ratio of children.

By contrast, the girl-exception policy per se is gendered (Greenhalgh 1986; Murphy 2003). Couples with a daughter as the first child are allowed to have a second birth by official family planning policy. Thus, the sex of the first child is less important for many Chinese. In fact, in girl-exception policy communities, couples might be willing to have a daughter as the first child in order to have both a son and a daughter, the ideal sex composition of offspring. It is a different scenario for parity 2. Regardless of the sex of the second child, couples are required to stop reproduction. Thus, for those who are determined to have a son, they would try all means to reach this goal, generating excessive boys among parity 2 in such communities. Therefore, the policy effect on sex ratio of children is contingent on parity, and it only bears an effect on parity 2. Given this, the mechanism by which the one-child policy affects child sex ratio is through the gendered nature of the

policy (i.e., the girl-exception policy rule).

These findings of the relationship between the one-child policy and child sex ratio, however, might not be final and decisive due to limitations of this study resulting from lack of data. For example, the sample size is small; some important factors (such as son preference and community abortion rates) which are related to the sex ratio of children are missing from the models. Thus, more studies on nationally representative data with more relevant information, and on both quantitative and qualitative data are necessary for a better understanding of the association between the one-child policy in general, and girl-exception policy in particular, and the high sex ratio of children.

Nevertheless, based on the findings of this analysis, we know that, by allowing couples whose first child is a daughter to have a second birth, the one-child policy is related to the rising sex ratio of children. Thus, one strategy to reduce child sex ratio might be to modify policy rules. The issue is how to modify it in order to accommodate the desire of both a balanced sex ratio at birth and a low fertility. Findings of this analysis suggest that a girl-exception policy and a weak enforcement are both associated with a higher sex ratio, and when both are combined, the sex ratio of children is the highest. By contrast, a strong policy and strong enforcement relate to a lower sex ratio of children, and when both are combined, it is the lowest. There seems no difference between the combination of a weak policy yet strong enforcement and the combination of a strong policy and strong enforcement. Hence, two opposite options to reduce the sex ratio of children in relation to the one-child policy emerge from this analysis.

First, expand the strong policy rule and strong enforcement to the entire nation. Nevertheless, readopting a strong policy in the countryside requires correspondingly forceful and sometimes inhumane methods of enforcement, and it conflicts with the new

focus and direction of current family planning policy in China, which emphasizes human-centered services. In fact, given the inadequate social welfare and social security in the vast rural areas, it is unrealistic to readopt a strong policy throughout China.

Alternatively, abolish the girl-exception policy, and relax policy rule but strengthen policy enforcement. Without the latter, striving for lowering the sex ratio at birth in a strong son-preference culture would require allowing couples to have as many tries as needed to have a son. Thus, if a two-child policy will be adopted across the nation, it has to be implemented with strong methods in order to meet both a low fertility rate and a balanced sex ratio of children at the national level. The sex ratio of children in two-child policy context is still abnormal, though lower than that in girl-exception communities. Thus, currently, a two-child policy per se is not sufficient to achieve a balanced sex ratio at birth; efforts to promote gender equality and prohibit sex-selective abortions have to be strengthened.

Both are only temporary solutions. The ultimate solution to reach a normal sex ratio at birth is to reduce, if not eliminate, son preference, which is deeply rooted in the social and cultural organizations of patriarchic, patrilineal, and patrilocal system, and maintained by lack of or inadequate social welfare and security, particularly in the countryside. Studies have invariably indicated that patriarchal ideology is slow to change. However, lessons from China's past and North Korea (Goodkind 1999) suggest a success of government intervention in reducing gender disparity. The particular vigor with which the socialist political agenda has been implemented in North Korea evidently overcomes an enormous cultural preference for sons. Similarly, Mao's strong political agenda of gender equality grants Chinese women similar opportunities as men in many aspects. However, sex discrimination resurges or is reinforced in China in the era of market economy, which

presents challenges for the government to reduce the sex ratio at birth.

Thus, at this stage of socioeconomic development, when people prefer fewer children than before but do not treat male fetuses/infants and female fetuses/infants similarly voluntarily, and when couple's ability to control the sex composition of offspring is greater than their ability to control the ideal number of children, external pressures should be adopted to lower the sex ratio of children.

Notes:

1. The name of this institute changes over time. Currently, it is named National Population and Family Planning Committee of China.
2. Normal circumstance is defined broadly. For example, children do not have health problems; couples are of Han ethnicity (the majority), have no sibling, are not from overseas, and do not work on special occupations. Exceptions sometimes differ for rural and urban inhabitants, and are broadened over time, especially in the countryside. Currently, couples are allowed to have a second birth under 31 conditions.
3. Strict one-child policy provinces and municipalities include Beijing, Tianjin, Shanghai, Chongqing, Jiangsu and Sichuan; two-child policy provinces include Qianhai, Hainan, Yunan, Tibet, Ningxia and Xinjiang; the rest provinces implement a girl-exception policy in the countryside. Nevertheless, variations always exist within each policy rule. Sichuan and Jiangsu, for example, still allow some couples to have a second birth (White 1992; Zeng 1989).
4. These two exceptions mostly apply to rural residents. Urban residents are under stricter policy control and required to have only one child (Ahn 1994). Also, regulations in urban areas tend to be more stable than in the countryside. Nevertheless, there are still

urban families, which are allowed to have more than one child.

5. The classification of provinces by policy rules, based on Peng (1997), is rough because exceptions always exist within province. Studies have found that even within close proximity in the same geographic areas, practice of the one-child policy varies widely (Kaufman et al. 1989).
6. In the first three waves of CHNS, Heilongjiang is not included; Liaoning is substituted by Heilongjiang in 1997 survey, while the 2000 survey includes both, as well as the other seven provinces.
7. Out-of-plan-birth fine might be relevant to sex ratio: couples with high son preferences find it worthwhile to incur penalties or forgo benefits of compliance to have a son. Since the 1997 and 2000 CHNS do not contain this information, for compatibility, it is not included in this analysis.
8. Percent of labor force in agriculture, household wealth, and urban residence are closely related. More advanced communities typically have a better household wealth. However, agriculture also suggests reproductive norms and gender role ideology.
9. As is common with panel data, attrition is substantial. For example, communities which dropped out tend to locate in urban areas. Thus, we must be cautious in interpreting the results.

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Table 1. Sex Ratio of Children by One-Child Policy Rules,[1] Age Cohorts, Parity and Residence

	By age[2]				By parity[3]			By residence[4]		
	0	1-4	5-9	All	1	2	3	City	Town	Village
National level	117.8	120.8	115.4	119.9	107.1	151.9	160.3	114.2	119.9	121.7
One-child policy										
Beijing	110.5	110.9	109.6	114.6	112.5	130.3	122.7	116.8	109.1	110.9
Tianjin	112.5	112.6	110.7	113.0	106.3	137.7	134.5	108.7	104.9	123.8
Shanghai	110.6	110.2	108.5	115.5	111.4	152.8	206.7	112.7	124.5	123.5
Chongqing	115.1	117.0	112.3	115.8	107.6	134.5	198.0	103.9	111.0	120.6
Jiangsu	116.7	124.2	119.5	120.2	112.2	196.9	268.2	113.0	121.7	123.2
Sichuan	116.1	115.1	112.2	116.4	109.5	133.7	141.9	111.2	108.6	118.8
Average	***113.6***	***115.0***	***112.1***	***115.9***	***109.9***	***147.6***	***178.7***	***111.0***	***113.3***	***120.1***
Girl-exception policy										
Hebei	114.1	116.2	110.2	118.5	104.4	147.3	186.8	113.3	116.5	119.8
Shanxi	112.8	110.4	108.2	112.8	104.7	121.1	146.3	109.6	114.6	113.3
Neimeng	108.8	109.7	109.3	108.5	104.1	128.0	118.7	105.0	103.1	111.8
Heilongjiang	109.6	108.6	107.1	107.5	106.0	115.2	157.8	108.7	110.0	106.0
Liaoning	112.9	113.1	110.7	112.2	106.4	136.3	170.6	107.7	112.2	115.3
Jilin	111.3	110.7	108.8	109.9	107.1	122.5	153.7	110.7	112.7	108.6
Zhejiang	114.1	113.7	112.6	113.1	107.3	132.4	176.6	112.7	112.9	113.4
Anhui	129.4	129.9	119.7	130.8	109.9	205.5	257.6	112.9	125.9	134.8
Fujian	118.7	125.2	120.5	120.3	108.9	157.7	222.2	113.5	116.9	123.7
Jiangxi	118.9	136.8	121.3	138.0	115.5	203.6	204.3	126.4	133.7	140.8
Shandong	112.5	114.9	115.6	113.5	106.3	132.8	159.5	110.8	116.1	114.0
Henan	119.6	136.4	122.1	130.3	104.4	194.0	214.6	116.7	133.7	132.3
Hubei	128.7	129.1	120.0	128.0	110.5	206.0	199.0	122.3	124.5	131.8
Hunan	127.1	123.8	117.5	126.9	108.7	173.8	167.8	113.0	119.6	131.3
Guangdong	131.3	129.2	116.3	137.8	117.3	179.7	183.9	128.1	144.0	143.7
Guangxi	127.3	128.0	124.3	128.8	109.8	160.6	184.1	122.7	137.0	128.3
Guizhou	108.5	115.4	114.9	105.4	88.2	122.5	138.2	106.7	114.6	104.1
Gansu	116.3	120.0	110.6	119.4	101.1	157.7	165.3	111.3	116.6	121.9
Shanxxi	123.6	126.6	117.1	125.2	105.9	184.8	234.5	114.9	118.4	129.3
Average	***118.2***	***120.9***	***115.1***	***120.3***	***106.7***	***156.9***	***181.1***	***114.1***	***120.2***	***122.3***
Two-child policy										
Qinghai	110.6	108.1	105.8	103.5	95.8	118.3	100.7	98.1	108.8	103.9
Hainan	137.1	135.7	121.5	135.0	111.6	166.9	186.1	138.6	144.5	131.5
Yunnan	110.4	113.6	113.0	110.6	102.9	117.6	128.9	104.8	107.5	111.6
Xizang	102.6	101.1	102.8	97.4	93.4	100.4	102.1	89.1	84.4	99.4
Ningxia	108.7	109.0	106.9	108.0	103.2	119.4	103.7	102.9	98.4	110.4
Xinjiang	105.8	105.6	104.9	106.7	105.4	104.5	109.9	105.9	108.0	106.7
Average	***112.5***	***112.2***	***109.2***	***110.2***	***102.1***	***121.2***	***121.9***	***106.5***	***108.6***	***110.6***

Note: 1. The classification of policy is based on Peng (1997).

2. Calculated from Table 1-7 (PCO 2002).

3 and 4. Sex ratio of children born between November 1, 1999 and October 31, 2000. The source of 3 is Table 6.1, and the source of 4 is Tables 6.1a, 1b and 1c (PCO 2002).

Table 2. Means/proportion and Standard Deviations for the Sample of Percent of Boys at Community, CHNS 1989-2000

	All parities	Parity 1	Parity2
Percent of boys	52.80	51.47	53.84
One-child policy			
Policy rules			
One-child policy	0.53	0.53	0.48
Girl-exception policy	0.28	0.28	0.32
Two-child policy	0.19	0.19	0.21
Policy strategies			
Family planning responsibility system	0.81	0.81	0.81
One-child subsidy	0.64	0.63	0.61
Other variables			
Percent of girls of parity 1	-	-	0.52
			(0.31)
Mother's education	5.48	5.48	5.17
	(2.32)	(2.32)	(2.10)
Household wealth (durable goods)	4.77	4.77	4.42
	(2.07)	(2.07)	(1.87)
Percent of labor force in agriculture	0.42	0.42	0.47
	(0.35)	(0.35)	(0.34)
Urban residence	0.33	0.33	0.26
Region			
North	0.39	0.39	0.37
Center	0.36	0.36	0.35
South	0.25	0.25	0.27
Survey year			
1989	0.23	0.23	0.23
1993	0.24	0.24	0.24
1997	0.25	0.25	0.25
2000	0.28	0.28	0.28
N	754	746	631

Source: 1989, 1993, 1997 and 2000 CHNS.
Values in parentheses are standard deviations.

Table 3. Multilevel Estimates of Percent of Boys at Community by Parity, CHNS 1989 - 2000

	All children		Parity 1		Parity 2	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
One-child policy						
Policy rules						
One-child policy(=ref)						
Girl-exception policy	0.42	1.06	-0.13	1.45	5.03 *	2.09
Two-child policy	-0.57	1.18	-0.70	1.61	2.24	2.33
Policy strategies						
Family planning responsibility system	-1.30	0.93	0.49	1.28	-4.09 *	1.88
One-child subsidy	0.82	0.79	1.39	1.09	0.06	1.58
Other variables						
Percent of girls of parity 1					15.97 ***	3.42
Mother's education	-0.74 *	0.34	-0.76 ^	0.44	0.22	0.72
Household wealth	0.53	0.38	0.86 ^	0.51	-0.61	0.81
Percent in agriculture	2.03	1.82	5.18 *	2.43	0.52	3.56
Urban residence	-1.12	1.09	0.48	1.48	-2.61	2.25
Region (North =ref)						
Center	2.38	1.98	0.69	2.36	7.53 **	2.47
South	2.75	2.22	1.02	2.64	9.54 ***	2.80
Survey year (1989 =ref)						
1993	0.60	1.04	1.34	1.43	2.24	2.13
1997	1.15	1.15	2.71 ^	1.56	3.26	2.38
2000	0.41	1.32	2.65	1.77	2.92	2.74
Intercept	52.85 ***	2.78	46.14 ***	3.58	40.54 ***	6.03
Number of communities	754		746		631	

Source: 1989, 1993, 1997 and 2000 CHNS.

Note: The sample includes children born after 1986.

^ p<0.10; * p<0.05; ** p<0.01; *** p<0.001.

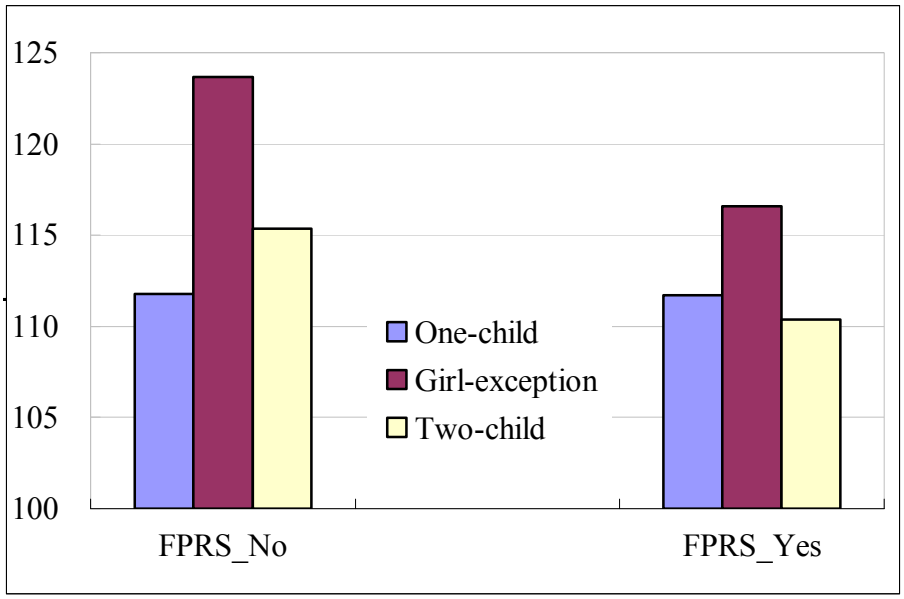
Table 4. Fixed Effect Model Estimates of Percent of Boys at Community by Parity, CHNS 1989 - 2

	All parities			Parity 1			Parity 2		
	Coeff.		S.E.	Coeff.		S.E.	Coeff.		S.E.
One-child policy									
Policy rules									
One-child policy(=ref)									
Girl-exception policy	0.45		1.11	0.26		1.55	4.97	*	2.28
Two-child policy	0.18		1.22	0.59		1.69	3.26		2.49
Policy strategies									
Family planning responsibility system	-1.25		0.93	0.97		1.29	-4.13	*	1.98
One-child subsidy	1.76		3.18	0.97		3.18	-1.14		1.70
Other variables									
Percent of girls of parity 1	-			-			11.86	*	4.91
Mother's education	-0.61		0.45	0.22		0.49	1.47	**	0.55
Household wealth	0.53		0.33	1.17	**	0.37	-0.58		0.50
Percent of labor force in agriculture	1.19		2.09	7.43	**	2.89	0.57		4.19
Intercept	53.48	***	1.31	40.14	***	3.86	41.31	***	5.25

Source: 1989, 1993, 1997 and 2000 CHNS.

Note: The sample includes children born after 1986.

^ $p<0.10$; * $p<0.05$; ** $p<0.01$; *** $p<0.001$.



Source: 1989, 1993, 1997 and 2000 CHNS.

Figure 1. Sex Ratio of Children by Policy Rules and Family Planning Responsibility System (FPRS): CHNS 1989-2000