CHINA'S ONE-CHILD POLICY: REGIONAL REGULATION VARIATION & THE SEX-RATIO AT BIRTH

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ABSTRACT

Since the enactment of the one-child policy, the sex ratio at birth has risen above normal values throughout China. To combat this problem, regional governments have derived their own one-child regulations to suit local needs. This study uses a two-stage least squares model and a sample of the thirty-one provinces, municipalities, and autonomous regions to examine relationship among regional one-child regulations, the sex ratio at birth, and regional characteristics. The results show that socioeconomic development is not a main factor in determining the strength of regional policies or the sex ratio at birth. Rather, political and cultural autonomy seem to be significant factors for both the sex ratio at birth and regulation strength. Furthermore, after controlling for socioeconomic, political, and cultural traits, policy strength explains little about a region's sex ratio at birth.

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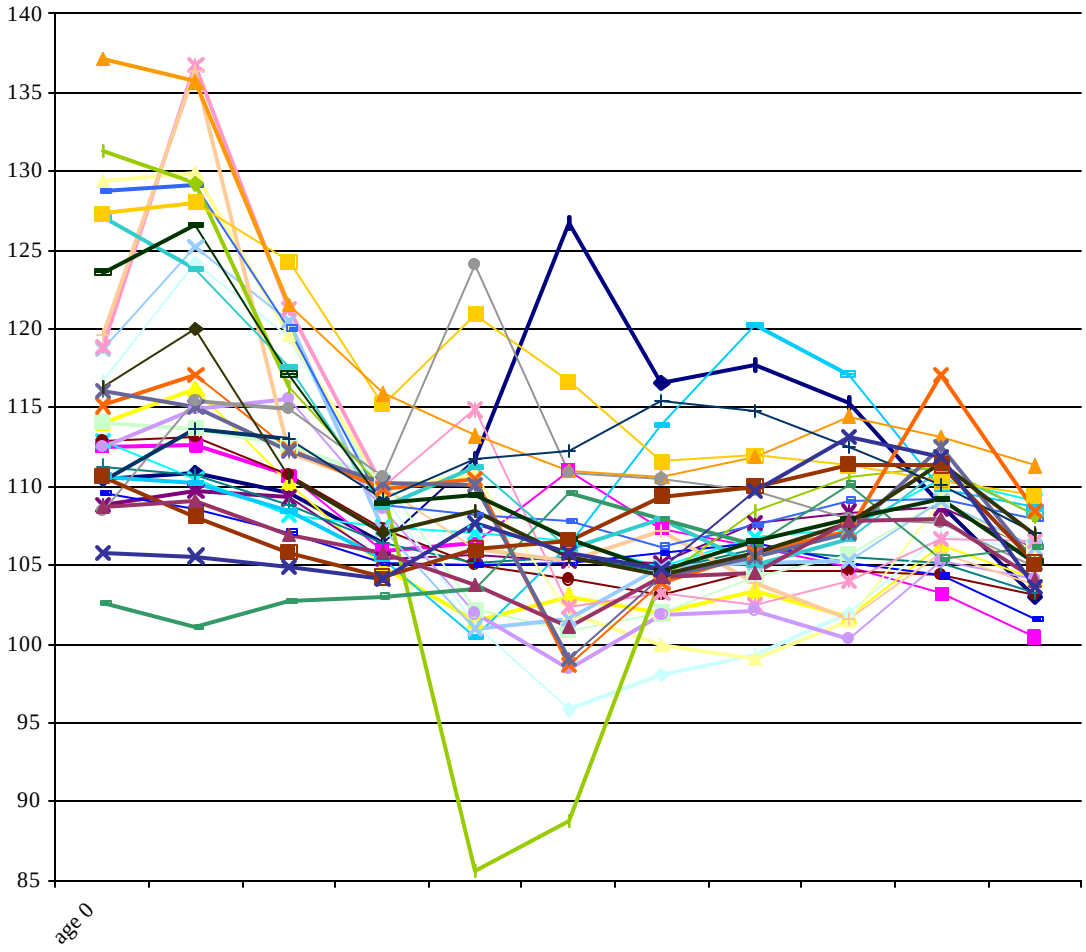
1. INTRODUCTION

Son preferences are deeply rooted in Confucian Chinese culture. Despite China's rapid economic development, such sexism has persevered and perhaps even escalated, as evident in the high sex ratio at birth since the onset of the one-child policy in 1979. Although originally implemented to target only fertility and population rates—which China has been successful to date—population control is hardly a one-dimensional problem, but involves and impacts other factors. Since its enactment, the one-child policy has also affected population composition, economic growth, resource consumption, and migration flow throughout China. Coupled with urbanization and an increasingly open market economy, population control has instigated social changes as well—family size has decreased, male-to-female ratio has increased, marriage and child-bearing ages have risen, and urban residence has escalated. Evidently, the multifaceted effects of the one-child policy cannot be reflected merely in population numbers or birth rates, but also in the quality of life, including living standards, education, and health. This paper examines one such qualitative factor—the sex-imbalance in an already sexist Confucian society. Moreover, the sex-imbalance can be represented by the rising sex ratio at birth (SRB). Defined as the number of registered male births per 100 registered female births in a given calendar year, the SRB has increased dramatically since the mid 1980's, and still remains above the accepted normal ratio of 107 today.

Chart 1 illustrates the rise of SRB over time through different age cohorts, especially after the 20 year olds who are the first only children after the one-child policy was enacted.

Chart 1: Sex Ratios of Different Age Cohort



Over the years, the government has become aware of the expansive reach of the one-child policy, and has continuously performed research, altered regulations, and redirected goals to target all aspects of the policy, including the sex-imbalance problem. Although the one-child policy is a national policy headed by the State Family Planning Commission, it is administered through provincial and local governments who have better knowledge of regional needs and can better monitor its progress. Local governments have aimed to reduce the SRB by promoting sex equality, socioeconomic development, education, contraception awareness, and moral use of technology through regulations, services, and media. This paper aims to determine the relationship among the population control regulations and programs; regional cultural, political, and economic characteristics; and the provincial sex ratio at birth. While previous papers have addressed and identified the correlation between regional characteristics and the SRB, the affiliation between sex ratio and regulations, and the rapport between regulations and regional characteristics are more obscure. How do a province's regulations affect the SRB? How do regulations cater the characteristics and needs of a province? More specifically, this paper will investigate the relationship between total the fertility rate and the SRB; the effect of incentives, fines, and exceptions on the SRB; and the correlation between family planning programs and the SRB.

At first glance, it is tempting to assume that the one-child policy is the sole cause of the rising SRB in China, since the phenomenon did occur after its implementation. However, the one-child policy is not the only cause of the rise in SRB. Findings from researchers[1] propose that the one-child policy is not the only reason for the rise in the SRB To determine any relationship between provincial one-child regulations and sex

[1] See literature review.

ratios at birth, this paper will also need to consider the preference for sons, socioeconomic development, and rate of fertility decline, and family planning programs.

This paper uses a two-stage least squares model to examine the relationship among regional characteristics, one-child regulations, and sex ratios at birth. Section 2 reveals previous findings regarding the causes of China's imbalanced SRB and the variations and transformations of the one-child policy. Section 3 will describe the sources and statistical methods used in this study. Section 4 will explain the empirical results of the two-stage least squares model, followed by the discussion of regional one-child regulations, causes and results of rising sex ratios, and the design and implementation of regional one-child regulations in Section 5.

2. LITERATURE REVIEW

Each region designs and implements its own set of one-child policies according to its cultural, socioeconomic, and political characteristics to most effectively reduce fertility. Although there has been much research on the causes and trends in policies, and fertility declines, and sex ratio at birth, few have addressed the effectiveness of the regional population control campaign on controlling the SRB and addressing local needs. The following literature review focuses on the causes of the rise in the sex ratio at birth since the mid 1980's, China's fertility transition, and regional variation of the one-child policy campaigns.

2.1 The Rise of the Sex Ratio at Birth

The sex ratio at birth has surged throughout China since the mid 1980's, and has been an increasingly important issue for Family Panning Commissions. The natural SRB generally ranges from 103 to 107 (Duan et al, 2003), but the over all sex ratio at birth in

China was 119.9 in 2000, with 26 out of 31 provinces and municipalities exceeding the upper limit of 107 (Chu, 2000), the highest being 138.0 in Jiangxi province and 137.8 in Guangdong province (see Table 1). Moreover, many studies have shown that the sex ratio at birth is not significant for the first birth in a family, but escalates as the number of existing children increases, especially if there are already girls in the family (Wen, 1992; Gu and Roy 1995; Zeng et al, 1993; Liu, 2002; Duan et al, 2000; and Chu, 2000). This contradicts the natural genetic pattern in which the sex ratio at birth declines, or at least remains constant, as a woman's parity increases. The reason for this deviation can be attributed to couples with high son preferences who find it worthwhile to incur penalties or forgo benefits of compliance in order to increase the probability of having a son, including prenatal sex-determined abortions. With son preferences as the instigating factor, SRB is higher for rural inhabitants than urban inhabitants, for more educated women than uneducated women, and for wealthier couples than poorer couples.

Many have speculated the causes for the rise in the sex ratio at birth in China. Although it is easy to blame the one-child policy as the culprit—since the phenomenon did occur after its implementation—Liu (2002) explains the rise in SRB in a larger sense, as the link between the causes and effects of social, cultural, economic, demographic, and legal forces that are constantly and rapidly changing. Two facts reveal that the one-child policy is not the only cause of the rise in SRB: first, rising sex ratios at birth appeared simultaneously in Taiwan and the Republic of Korea around 1985, both of which have undergone voluntary fertility decline without population control regulations (Gu & Roy, 1995). Despite their different social, economic, and political contexts, these countries share two characteristics: precipitous drops in fertility rates to below replacement levels, and strong son preferences. Second, the overall sex ratio at birth in China did not become

abnormal until the mid 1980's (Gu & Roy, 1995), rather than immediately after the onset of the policy in 1979. These two findings propose that the one-child policy is not the only reason for the rise in the SRB, but that four factors are involved: 1) the cultural preference for sons, 2) the level of socio-economic development, 3) the rapidity of fertility decline, and 4) the focus of population programs (Gu & Roy, 1995). Jie (2002) discussed three weaknesses in the one-child regulations that have cultivated and permitted the escalation of the SRB: 1) delayed and inadequate focus on the quality of fertility decline, 2) ineffective regulations prohibiting and monitoring the use of fetal sex-determination technology, and 3) low quality of employees and administrators.

The underlying cause of the rise in sex ratio at birth can be attributed to son preferences that are deeply rooted in traditional Confucian Chinese culture. Ideally, Chinese families would prefer to have both sons and daughters (Liu, 2002; Chu, 2000). In the past, this led to large families that composed of both sons and daughters. However, in a new market economy that underscores education, raises the costs of raising children, and reduces job security, the demand for children drops, reducing the family size and exacerbating son preferences (Jie, 2002). In a situation where couples demand fewer children but cannot satisfy the demand for both a son and daughter, they would rather have a son, who traditionally carries the family name and is responsible for the old-age care. However, son preferences exist today beyond old age care issues. Even though women are increasing integrated into the workforce and are a qualified source of old age care for their family, sons are still preferred because Chinese culture only allows sons to carry the family name. Also, as economic development allows more individuals to fund their own old age care through insurance, savings, and state pensions, son preferences increase in wealthy areas because people want their sons to inherit their wealth and to

carry on the family name. In other words, the fundamental cause of the rise in the sex ratio at birth is the preference of sons over daughters[2]. In his model, Liu (2002) verified the importance of son preferences when he compared the SRB of a hypothetical society with strong son-preferences, with one that has no sex-preferences. He found that the society without son preferences, the sex ratio at birth remains constant at around 106.2 for all parities and age cohorts, at both high and low fertility rates. However, holding fertility levels constant, the impact of sex preferences becomes much more significant than the fertility levels, affecting the make up of families with various offspring sex compositions, the sex ratio of offspring, and the number of children borne. Liu then compares two countries that have finished population transitions without population control: Taiwan to represent the society with strong son preferences, and the United States, to represent the society with no son preferences. The sex ratios and sex composition of children in American families are extremely close to the Liu's predicted values of a society without sex-preferences. However, in Taiwan, the sex ratios of children for all age cohorts are much higher than the normal ratio. Cohorts from age 15 to 44 tend to have above normal sex ratios, with the highest value at the second cohort, until the fourth child, where the sex ratio drops to below normal values. Also, the percentage of families with mixed sex compositions exceeds that of single sex compositions, with mixed compositions tending to have more sons than daughters. Liu concludes that son preferences lead to two results: first, a rise in the sex ratio of children to above normal values, and second, a change in the make up of families with mixed-sex children compositions. His study not only demonstrates that son preferences will increase the sex ratio to above normal values, but that in general, families prefer to have

[2] Chu, 2000, quoting Family Planning Chief Commissioner Pang Peiyun in his speech

both sons and daughters, even if sons are worth more. In a country undergoing fertility transition such as China, the effects of son preferences become even more significant and hasten the rise of the sex ratio and changes in the composition of children. Jie (2002) found that son preferences in China are especially strong among the following: the elderly, the poorly educated, families with existing daughters, rural and farming communities, and the central and western regions.

The impact of son preferences can be revealed in Chu's case study of Yichang, Zhejiang province (2000). Zhejiang province has the highest sex ratio at birth in China among all thirty-one provinces, autonomous regions, and municipalities, valued at 131.6 in 1995. However, Yichang has always had a normal sex ratio at birth of approximately 105. Yichang is a moderately developed, but not flourishing city. One aspect distinguishes Yichang from the rest of Zhejiang and China—a lack of son preferences in their culture. Here, it is common and accepted for husbands to marry into the wife's family, and for couples to decide which surname their children will inherit, considering the welfare of the children. This mentality eliminates the difference between sons and daughters in the responsibility of taking care of their elders and upholding the family name. Also, Yichang people tend to be less superstitious and more pragmatic, and believe that education and individual effort, rather than blessings from ancestors, lead to success. Likewise, while most cultures in China prefer burials, cremation practices are common in Yichang, reducing the value of ancestor worship and superstitious beliefs that enhance the value of inheritance and preferences for sons. Chu's investigation supports Liu's findings that in the absence of son preferences, the sex ratio remains normal, even under population control.

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dated March 21, 1993.

As Jie described (2002), the deficiencies of the one-child policy permit people to satisfy their son preferences, resulting in the rise of the sex ratio at birth. The surge in SRB has been materialized through the following mechanisms: underreporting of female births sex-selective abortions after fetal sex identification, infanticide, abandonment, and migration (Zeng et al 1993, Duan et al 2003, Merli & Raftery 1992). As China's socioeconomic setting evolved, the modes of increasing SRB transformed as well. According to Zeng et al. (1993) and Duan et Al (2003), the underreporting of female births accounts for about 43% to 75% of the difference between the reported and normal value of SRB during the second half of the 1980's. Couples who underreport female births hide from authorities by 1) giving up the daughter for adoption to friends or relatives, 2) not reporting the girl at birth but later as an inmigrant, or 3) not reporting the girl at all and thereby classifying her as part of the "floating population" of unregistered persons. In an investigation of four rural counties in Northern China, Merli & Raftery (1992) found that in three of four counties, the interval between marriage and first birth is extended by not reporting the first birth and reporting the second birth as a first birth. This is made possible in a population control system of rewards and penalties aimed at both couples and cadres. In the 80's, births were underreported because couples feared punishment for exceeding birth quotas or because officials were eager to meet their target. However, in the early 1990's, the underreporting became more widespread because of the introduction of new economic mechanisms to improve local birth planning by making it a major criterion for evaluating cadre's performance at every level, especially those in charge of high fertility regions (Merli & Rafter, 1992).

Sex-selective abortions make up the majority of the difference between the reported and normal SRB, and eventually replaced underreporting as the main

mechanism of SRB increase in the 1990's (Duan et al 2003). Today, there are many methods of fetal sex determination that vary in safety, effectiveness, and cost. Sperm selection, external fertilization, and gene diagnosis are methods to increase chances of a male baby, or even to generate male embryos, with probabilities of success ranging from 70% to 100%. Due to their high costs, and therefore low popularity, the government deemed these methods legal. Other technology use fetal sex determination to selectively abort baby girls; these include the ultrasound B machine, chorionic villus sampling, amniocentesis, or vaginal cell analysis. (Zeng et al. 1993). Of all fetal sex determination techniques, the ultrasound B machine is the most widespread for three reasons: 1) the machine is a simple and accurate technology that even minimally trained workers can perform; 2) the machine is relatively inexpensive and readily available in even rural and private clinics, and their high demand deems them profitable; and 3) the fetal sex-determination service is inexpensive for consumers. In addition, the ultrasound B machine is a necessary device for hospitals and clinics to examine the health of fetuses. The spread of the machine from urban to rural, coastal to central and western areas has been facilitated by China's economic development. They are now available in every city, town, and village (Jie 2002). Although national law prohibits the use of the ultrasound B machine for prenatal sex determination, these laws have been ineffective, mostly due to son preferences and the inimitability of the machine for regular prenatal checkups. Furthermore, the national regulations do not have enough precision, both in describing who is allowed to perform fetal sex determination, and what are the consequences for violating the law. Currently, the law dictates that prenatal sex determination is legitimate only for medical reasons that may endanger the lives of the baby and/or the mother.

However, it lacks a precise definition of a "medical reason." As for violators, the laws are ambiguous in terms of punishers, violators, and punishments. (Zhao 2000).

If fetal sex determined abortions and underreporting of female births are the main mechanisms used in the rise of the SRB (Zeng et al 1993, Duan et al 2003), the small remainder can be attributed to infant abandonment and rural-rural migration. Infanticide and rural-urban migration are inconsequential factors. Infanticide, though a plausible factor in the high sex ratios of the 1930's to 40's, is not applicable to contemporary China for the following reasons: 1) the social and legal systems as well as the close bond between neighbors and relatives make it difficult to conceal a crime such as infanticide; 2) infanticide is not cost effective due to the high moral and psychological costs and financial penalty; 3) sex determination technology has become much more inexpensive; 4) abandonment is more convenient and moral than infanticide, 5) infanticide cannot explain why the reported SRB is higher for educated mothers than for poorly educated mothers, for urban areas than rural areas for parities 2 and 3; and 6) Infanticide does not explain the low SRB for those with existing sons but no daughters (Zeng et al. 1993).

The floating population of unregistered migrants has also been blamed for the rise in the SRB, who have been assumed to eschew the one-child policy by not staying in their registered location. On the contrary, Yang (2000) found this assumption to be partially true, and Zeng et al (1993) and Duan et al (2003) have eliminated it as a major cause in the rise of China's SRB. In his study, Yang found that rural-urban migrants comprise a majority of the migrants in search for jobs in large cities, are not the ones to blame for increases in out-of-panning births. If any blame is to be placed for the rise in SRB since the mid 80's, it should be on the rural-rural temporary migrants. But, as, Zeng

et al. and Duan et al. concluded, there is little room to attribute the rise in sex ratio at birth to factors besides underreporting or sex-selective abortions.

2.2 Fertility Decline

The sex ratio at birth began to rise during the mid 1980's, at a time when fertility rates fell below replacement levels. Both Duan et al and Gu & Roy discovered that the plunge in fertility rates reduced the demand for children and raised the value of sons compared to daughters. Furthermore, Gu and Roy (1995) found that sex ratios at birth in Chinese regions display an inverted U-shape relationship with both fertility level and socio-economic development. On one hand, the more developed an area, the lower the degree of son preferences, but at the same time the more accessible the sex determination techniques. On the other hand, the less developed an area, the higher the preferences for sons, but lower the availability of those techniques. The highest sex ratios at birth are found in small cities that are in midst of socioeconomic development and accelerated fertility transition.

Hence, variables that affect fertility rates can also be correlated with the sex ratio at birth, and factors that aid the fertility decline may be factors in the rise of the SRB. China's fertility decline can be classified as the third stage of population transition, where historically high fertility rates fall drastically and are not expected to rise again on a sustained basis, birth control technologies are widely available, and infant mortality rates are low (Schultz 2001). Societies at this stage of population transition reduce fertility due to economic pressures: rising cost of rearing children and the demand for quality children. Not only has the cost of education, health services, and medical services associated in rearing children increased, but also the opportunity cost of rearing children

has risen, since children are "time-intensive commodities" and wage rates have increased relative to per capital income. In this setting, a woman's education becomes the most important variable in affecting fertility. Women who have higher education levels have social and intellectual advantage, and earn higher wages, which indicates higher opportunity costs of rearing children, and a natural decline in fertility rates. Lavely & Freedman (1990) found that the origins of Chinese fertility to be similar to nineteenth century Europe, where rising levels of health, education, and urbanization induced fertility decline even before the introduction of family planning programs.

Despite a natural fertility decline due to rising opportunity costs of raising children, China's one-child policy has an inarguable impact on the fertility rate. The family planning commission controls fertility rates by limiting each couple to one child after a certain legal age. To do so, the one-child certificate was introduced as part of an incentive-disincentive program to compel couples to have only one child. The benefits of signing the certificate and abiding by the laws may come in different forms and amounts, including cash grants, child health care assistance, extra food, and better housing. Other benefits, especially in urban areas, include preferential education, job placement, or priority in public child-care. On the contrary, policy disincentives exist as sanctions for couples who have "out of plan births," and include a range of fines, sterilizations, or abortions. Sanctions exist also for those who did not sign the one-child certificate, who may receive inferior assistance for health care or education, and may be prevented from getting extra food or land allocations that might otherwise belong to them (Short & Zhai 1998). You's case study of Shaanxi province (1993) discovered a substantial association between the acceptance of the certificate, the type of residence, the age of the mother, the education level of the mother, and the flexibility of the policy. Urban residents are much

more likely than rural residents to accept the certificate. Women's age and education are both positively related to the acceptance of the certificate. Flexibility of the policy is also positively correlated with the acceptance of the certificate, so that acceptance was low prior to 1984 when the policy was strict, and higher when the policy was modified to be more flexible after 1984. However, You found only a weak association between the gender of the child and the acceptance of the certificate.

In addition to considering whether a couple signs the certificate and the effect on fertility, Zhang and Sturm (1994) studied the factors affecting the timing of signing the one-child certificate, which should in turn can impact fertility rates by increasing or reducing the time interval between marriage and first birth. Restricting their sample to urban residents who were Han Chinese and with one living child born after January 1980, they identified education, household income, possession of durables, woman's age at marriage, and living space as significant factors that affected the timing of signing the one-child certificate. Increases in all these variables, except for living space, hasten the signing of the certificate. More educated couples may be more knowledgeable about the policy, and may sign the certificate sooner. Wealthier couples may sign the certificate earlier because they face higher penalties if they do not accept it. However, couples with larger living spaces may sign the certificate later than couples with smaller living spaces because the latter finds a second child less appealing. Like You, Zhang & Sturm discovered little effect of gender on the timing of accepting the certificate. Age cohorts and living with extended family also did not have a large effect on the timing of signing the certificate.

While socioeconomic factors are important causes in the fertility decline, China's One-Child Policy has unarguably played a large role. Schultz & Zeng (1995) attempted

to determine how much of the rural fertility decline can be attributed to China's economic development and how much can be credited to family planning programs. They found that the family planning programs play an authoritative role rather than a facilitative role, helping less educated women prevent unwanted births. Although the one-child policy has imposed many limits on couples of child-bearing age, fertility variation associated with socioeconomic characteristics indicate that individual choices are still being made in response to costs and benefits. Like Zhang & Sturm (1994) and You (1993), Schultz and Zeng found the following socioeconomic variables to influenced the rural fertility rate: women's education and the type of industry activities in the region, where the more years of education results in lower fertility and a shift from agriculture to industrial employment decreases fertility rates. Interestingly, the effect of income on fertility is ambiguous in their study—higher income facilitates earlier childbearing for younger women, and earlier termination of childbearing for older women. They used four variables to indicate the various forms of family planning and health programs: family planning service, family planning worker, doctor, and clinic. They concluded that younger women living in areas with such facilities and personnel have noticeably lower fertility, and not simply due to the delay of marriage. Furthermore, these facilities have a larger impact on less educated women than educated women.

2.3 One-Child Policy Variations

Although the one-child policy is a national policy, it has varied only over time and across regions. On the time spectrum, the one-child policy has changed from strict, centrally enforced policy implementation in the late 1970's and early 80's, to more decentralized policy implementation and local family planning regulations since 1984

(Yang 1994). In fact, the government stresses the importance and effectiveness of regulation adjustments at local levels to suit regional socioeconomic and cultural conditions.

Policy variation is extremely important due to the rapid changes in China's socioeconomic and political environment. Chinese society, which was formally closed and homogeneous, has opened to a more heterogeneous society (Peng & Li, 2002). However, under this progressive environment, the design, implementation, and results of the family planning regulations will vary tremendously (Peng & Li 2002, Zhai et al. 2002).

Family planning varies in two ways: regulations and services. Local family planning regulations work mainly to limit the number of children each couple may have, and to facilitate the implementation of the one-child policy, including population planning, contraceptive use, rewards and punishments, and floating population related issues.(Yang 1994).

Although the strength of the one-child policy can be measured in multiple ways, Short and Zhai (1998) chose the exception allowing couples whose first child is a girl to have a second child as a benchmark. The reason is that this exception is not infrequent in many provinces, and has the potential to affect approximately half of all couples where it is implemented. (Exceptions are sometimes different for rural and urban inhabitants. Other exceptions may include: first child is a girl, first child is disabled, parents are only children, and parents have special occupations. Furthermore, over time, the exception for parents who are only children changes the most, especially in rural areas.) Strong policy are ones that restrict at least some couples from having two children and prohibit couples whose first child is a girl to have a second child. Weak policy either allows all

couples two children or couples whose first child is a girl to have a second. Short and Zhai found that incentives and disincentives play a role in the strength of the policy. 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, policy disincentives exist as sanctions for couples that have "out of plan births," and include a range of fines, or may require sterilizations or abortions. Disincentives seem to be more correlated with the policy strength than incentives are, partly because incentives are small relative to household income. In addition, regulations in urban areas tend to be more stable than in rural areas, and therefore more developed provinces tend to have stronger policies.

In a study of the provincial patterns of contraceptive use, Yang (1994) measured the strength of family planning regulations based on the contraception requirements. He found that the regulations of Liaoning, Henan, Hunan, Shanxi, Gansu, Ningxia, Yunnan, and Guizhou provinces to clearly state that all pregnant women with out-of-planned pregnancies *must* end them by abortions, while fourteen other provinces stated that the couple *should* stop their unplanned pregnancies by abortions, and one province required the couple to pay a certain fine. Also, about fourteen of the provincial family planning regulations denote specific methods of contraception by birth order according to the national guideline of first child: IUD, second child: sterilization. Like Gu and Roy (1995), Yang found that the most developed and undeveloped regions shared similar contraceptive patterns while the moderately developed regions had a distinct pattern. The more and less developed provinces had higher percentages of IUD and other user-controlled methods and low percentage of sterilization, while mid-level provinces had high levels of sterilization and low usage of IUD and user-controlled methods. This

suggests that the influence of the national guidelines of contraceptive use by birth order was most effective among these provinces.

Besides regulation variation, family planning also differs in the history, quantity, and quality of services. Family planning programs have existed in some provinces as early as the 1950s, while other provinces developed programs only recently. The age of family planning programs may explain the success of family planning services today (Kaufman et al. 1992).

Provincial family planning programs offer services and supplies through five channels: 1) hospitals where babies are delivered and other surgical operations are performed, 2) family planning stations that give general counseling and services for couples, 3) family planning workers who are responsible for outreach and monitoring activities, 4) local health clinics that are typical sources of birth control, including condoms, IUD insertions, sterilizations, or abortions, and 5) doctors and nurses who collaborate with the above family planning services (Schultz & Zeng, 1995). Peng & Li (2002) found that since the 1970's, the amount of investment in family planning services has been negatively correlated with the fertility rate, although the social marginal rates of return on investment in family planning must have diminished markedly, because the rate of decline in fertility is slowing in spite of the steady increase in expenditures for such programs. On a more optimistic note, these investments have increased the availability of services and supplies to the rural population, provided an alternative to overcrowded township hospitals, and replaced relatives and friends as the traditional source of information about contraception. (Kaufman et al. 1992).

The overall results of previous literature explain the background of the rise in the SRB, the decline in fertility rates, and measures of one-child policy variations. However,

none directly addresses how policy strength affects the sex ratio at birth. The primary aim of this paper is to delve in to the legal as well as socioeconomic causes of the rise in the sex ratio at birth on the provincial level.

3. DATA & METHODS

3.1 Statistical Sources

The statistical data used in this study come from three sources: Tabulation on the 2000 Population Census of the People's Republic of China, China Population Statistics Yearbook 2002, and China Statistical Yearbook 2002. Since the enactment of the One-Child Policy, the national government in China has been stressing the need for quality in research, statistic, and data gathering methods for the betterment of implementing and analyzing the policy. The sources that I used are all published by agencies affiliated with the national government, and are assumed to be reliable sources information. However, there are some discrepancies between the data, which can be attributed to different surveys, sampling, and timing. For my study, I used a single data set for each variable, so that even if different data sets have different values for the same variable, the relative variation between provinces would be consistent. Furthermore, the study, sources, and family planning regulations only pertain to Mainland China, and exclude the Hong Kong, Macau, and Taiwan special administrative areas.

The Population Census Office under the State Council and the Department of Population Social, Science, and Technology Statistics under the National Bureau of Statistics of China compiled the Tabulation on the 2000 Population Census of the People's Republic of China. This is the fifth national population census, but the first since China adopted the socialist market economy system. The reference time for the

census is at the zero hour of November 1, 2000. It covered all persons who hold the nationality, and have a permanent residing place in the People's Republic of China. During the census, each person was enumerated in his or her permanent residing place. Therefore, the population does not include data on the floating population, which comprises of people who have are not registered in any province. Although Yang (2000) found that rural-rural temporary migrants might have an effect on the fertility and SRB, I did not include this variable in my models or tests. However, the proportion of non-registered persons compared with registered persons is small, so that the data in this census should be adequate in describing general trends of each region. Two types of questionnaires were used in the census: the short form contains items regarding the basic situation of the population, and the long form include all short form items and others such as migration, education, economic activities, marriage and family, fertility, housing, etc. According to the Statute for the Fifth National Population Census and the Procedures, households were selected by a random sampling program to complete the long forms, and the remainder of households completed short forms. According to the preface written by the editor, the results of the tabulation are based on the processing of data directly from enumeration without any adjustments. However, the 2.5 million servicemen of the People's Liberation Army are not included in the census. Compared to studies by the National Bureau of Statistics; there is a 23.22 million discrepancy for the total population number; and a post-enumeration sample survey indicates an undercount of 1.81%.

The China Population Statistics Yearbook 2002 was compiled by the Department of Population, Social Science, and Technology Statistics in collaboration with the National Bureau of Statistics. This annual statistical publication covers data on the population at the national and local levels of province, autonomous region, and

municipalities directly under the central government. It used a stratified, multi-stage and clustering sample technique with probability proportionate to size. The sample comprises 0.963% of the whole country, with 1.22 million people, 896 counties, 3398 townships, 5049 village groups, and 31 provinces, autonomous regions, and municipalities. In order to meet the needs of different departments and institutions, this yearbook contains data from various sources, including figures of the national population change survey in 2001, figure of the population census in 2000, and figures of family planning statistics in 2001[3]. A drawback is the variations in definitions and data collection methods under the same headings or topics. To minimize such variations, I used the same source for each category of variables.

The China Statistical Yearbook 2002 is one in a series of annual publications by the National Bureau of Statistics of China. It includes data from the year 2001. While the population chapters are mostly identical to the data from the China Population Statistics Yearbook, this publication was a valuable source for the economic indicators of China. The major data sources were obtained from annual statistical reports and some from sampling surveys. Statistical discrepancies due to rounding are not adjusted.

3.2 Rating the Strength of One-Child Regulations

Each province, municipality, and autonomous region has a set of Population and Family Planning Regulations based on the goal of fertility reduction. Many have been revised since 1979. Since the data and statistics for the study dates from 2000 to 2001, I investigated the regional regulations in use during those years, despite the fact that some

[3] The 2000 population census is the same as the source mentioned above.

regions have revised their regulations since. The only exception is Xinjiang Uygur Autonomous Region, which had its first regulations enacted in 2003.[4]

There is no official standard to rate a region's one-child policy. When measuring the strength of the regulation, one must distinguish the different goals: the primary one of fertility decline and the secondary one of SRB reduction. Although these two goals are simultaneously addressed in the regulations, they can sometimes work in opposition to each other, especially when son preferences are strong. In places with high son preferences, limiting the number of children may force couples to perform illegal measures such as prenatal sex-determined abortions to reach their desired outcome. On the other hand, striving for a lower SRB in a high son-preference culture would require allowing couples to have as many tries as needed to have a son. Strong enforcement of restraints on illegal sex-selection procedures and strong enforcement of the one-child norm may reduce both fertility and SRB, but couples with son preferences would be dissatisfied. Weak enforcement of the one-child rule would also result in a lower SRB, even if son preferences were strong and there were restraints on sex-selective procedures. Consequently, both restraints on sex-selection and enforcement of the one-child rule effect the SRB. Therefore, two measures are needed to rate the strength of a region's regulations: one for fertility reduction, and one for SRB reduction. A *strong* regulation can be one that forcefully enforces one-child per couple, one that strictly prohibits sex-selective procedures, and a *very strong* policy would be one that does both.

[4] I still used Xinjiang as part of my sample because there has not been many changes in the socioeconomic or cultural characteristics between 2000 and 2003, especially since Xinjiang is on the far Northwestern region of China where there is little economic investment. I hypothesize the regulations to still reflect the regional characteristics.

I derived a scoring system based on three criteria found in all family planning regulations: exemptions, rewards, and punishments. I further broke these down into nine classifications. Table 1 summarizes the nine classifications under the three criteria.

Exceptions. Exceptions to the one-child rule allow various couples to have more than one child. Among the most common are: both parents are single children, the only child is mentally or physically disabled, the couple is diagnosed to be infertile but become pregnant after a certain number of years, and ex-military officers who are paralyzed in battle. However, many regions have their own exceptions that address the needs of their population, including ones for farming, fishing, or mining couples, ethnic minority groups, couples where the husband marries into the wife's family, if the couple lives in certain mountains areas, and if the husband has one or more infertile brothers. *E1* refers to the former type of exceptions for personal reasons, and *E2* refers to the latter type for socioeconomic and cultural reasons. Both kinds of exceptions work against the goal of fertility reduction by increasing the number of people who may have more children. But, exceptions work in favor of SRB reduction by preventing the people most likely to have high son preferences from resorting to sex-selection methods such as prenatal sex-determination abortions, infanticide, or abandonment. A strong set of exceptions for controlling the fertility rate would have few exceptions. Conversely, strong exceptions for controlling the SRB would require more exceptions. In this study, E1 and E2 are used as measures to control the SRB, not the fertility rate. Therefore, regulations with more exceptions for both types would have a sub-score of 1 for E1 and/or E2, and regulations with fewer exceptions would have a sub-score of 0.

Rewards. Rewards act as incentives for couples to adhere to the one-child policy, and are given under two circumstances: late marriage and late birth (R2)[5], and signing the one-child certificate (R1). Extra rewards are awarded to those who qualify to have additional children, but volunteer to have only one child (R3). Rewards for late marriage and birth usually entail additional days of paid wedding and maternity leave. Rewards for the one-child certificate include benefits such as monthly stipend until the child reaches a certain age, subsidies for child care, medical care, maternal care, and operation expenses, additional days of paid maternity and wedding leave, job search priority, housing priority, loans, exemptions in mandatory community service days, and increases in old age and retirement benefits. There is a wide range of rewards; for example, some provinces had thirty days paid maternity leave while others had six months; some had higher monthly monetary stipend than other; some rewarded the parents in their retirement and old age while others did not. Furthermore, there is a large variation in the specificity the regulations. Some regulations had quantified rewards while others were vaguely defined as encouragement from the local government. Stronger policies in the rewards criterion are those with more specific rewards and higher quantities of benefits. A stronger incentive system induces couples to have one child, but does not necessarily work to prevent sex selective procedures. Therefore R1, R2, and R3 are incorporated in the score for the strength of fertility control. Nevertheless, the rewards are also incorporated into the score for strength of SRB reduction as interaction variables (see Section 3.3 below)

Punishments. Penalties work as disincentives to prevent deviations from the one-child rule and the use of sex selective procedures. Penalties apply to couples who have

[5] For most regions, age 23 for women and 25 for men are considered a late marriage.

unapproved children, couples who approval to have two children but who fail to fulfill a certain time gap between births, couples who use any form of prenatal sex-determination such as the Ultrasound B machine, and family planning affiliates who abuse their power and participate in any illegal procedures. In general, I discovered that penalties outweigh

Table 1

Code	Description	Definition of Strong	Regulation measure for fertility or SRB
Exceptions			
E1	Exceptions for personal reasons (e.g. husband has infertile brothers, first child is disabled, spouse is disabled, etc)	Fewer exceptions	SRB
E2	Exceptions for socioeconomic reasons (geographical location, employment, ethnic minority, etc)	Fewer exceptions	SRB
Rewards			
R1	Rewards for signing the one-child certificate	more rewards, more specific	Fertility
R2	Rewards for delayed marriage and childbirth	more rewards, more specific	Fertility
R3	Rewards for having only one child although qualified for exemption	more rewards, more specific	Fertility
Punishments			
P1	Punishments for exceeding the one-child rule without approval	More punishments, higher monetary fines, more specificity	Fertility
P2	Punishments for qualified but unapproved/early births	More punishments, higher monetary fines, more specificity	Fertility
P3	Punishments for couples who use prenatal sex determination	More punishments, higher monetary fines, more specificity	SRB
P4	Punishments for family planning agents, doctors, and officials for misconduct, mis-reporting, or illegal procedures	More punishments, higher monetary fines, more specificity	SRB

rewards, so that violating the one-child certificate is much more severe than the benefits

Age 24 for women is considered a late birth.

of adhering to it. Punishments include monetary fines, confiscation of one-child certificate and rewards, repayment for all rewards received, interest payments all outstanding balance, no allocation of land or housing, suspension or demotion at work, no benefits or promotions, and additional punishments at the discretion of the regional government. Like the incentive system, the punishments ranged from region to region in both quantity and specificity. For example, some regions used absolute amounts for fines for each additional child while others used a amounts relative to the couple's annual income (ranging from 30% to 600%). Other variations include the duration of fine payment, the severity of punishment from the work place, and the involvement of the local court. As mentioned earlier, penalties reduce both fertility rates and SRB's. There are four types of penalties: P1 for couples who exceed the number of approved births, P2 for couples who have the wrong timing for their births, P3 for couples who partake in illegal prenatal sex-selection, and P4 for family planning affiliates who partake in illegal prenatal sex-selection or misreporting of numbers. P1 and P2 are measures of policy strength in terms of reducing fertility rates; P3 and P4 are measures of policy strength in terms of controlling the SRB. A strong penalty for both goals is one with and more severe and specific penalties.

Appendix A summarizes, scores, and translates to English each region's family planning regulations according to these nine classifications. Each province is also given a 0 or 1 for each of the nine categories, with 0 as weak and as strong.

Since family planning regulations have two goals—to reduce fertility and to reduce SRB—I calculated two scores of policy strength with respect to each goal:

*Fertreg = R1+R2+R3+P1+P2+P1*R1+P1*R2+P1*R3+P1*R1+P1*R2+P1*R3*

*SRBreg = E1+E2+P3+P4+P3+E1*P3+E2*P3+E1*P4+E2*P4+E1*R3+E2*R3+P1*P4*

Fertreg refers to regulation strength with respect to fertility reduction, and SRBreg refers to regulation strength with respect to SRB reduction. The equation for Fertreg is a summation of all pertinent sub-scores and the interactions between these sub-scores. Likewise, the equation for SRBreg was a summation of all pertinent sub-scores, interactions between these SRB sub-scores, and the interactions with fertility sub scores (E1*R3, E2*R3, R1*P1). Since fertility reduction is the primary goal of China's family planning campaign, regulations aimed at reducing SRB necessarily deal with regulations focused on reducing fertility rates. Therefore, I interacted the E1 and E2 with R3 to incorporate how policies deal with people who tend to have higher son preferences. I also interacted P1 and P4 to examine the interaction between individual responsibility of fertility control and government liability for SRB reduction. Table 2 reveals the sub-scores and policy strength with respect to fertility and SRB control for each province, municipality, and autonomous region.

3.3 Statistical Methods

The goal of this paper is to find the relationship between the sex ratio at birth and the strength of the one-child regulations. First, I will use a t-test to determine whether the SRB of the thirty-one provinces, municipalities, and autonomous regions deviates from

TABLE 2

Province	E1	E2	R1	R2	R3	P1	P2	P3	P4	Fertreg	SRBreg
Beijing	1	1	1	1	0	1	0	0	1	5	6
Tianjin	1	1	0	1	0	0	0	0	0	1	2
Hebei	1	1	0	1	0	1	1	0	1	5	6
Shanxi	1	1	1	1	1	0	1	0	1	7	7
Inner Mongolia Autonomous Region	0	1	0	0	0	1	0	0	0	1	1
Liaoning	0	1	0	1	0	1	1	0	1	5	4
Jilin	1	1	0	0	0	1	1	0	1	2	6
Heilongjiang	0	1	1	1	0	0	0	1	1	2	5
shanghai	1	0	1	0	0	1	0	0	0	3	1
Jiangsu	1	0	0	0	0	1	1	0	1	2	4
Zhejiang	1	1	0	0	0	1	1	0	1	2	6
Anhui	1	1	1	1	0	0	0	0	1	2	5
Fujian	1	0	1	1	0	1	1	0	1	8	4
Jiangxi	1	1	0	0	0	1	0	0	0	1	2
Shandong	1	1	1	1	0	0	0	0	0	2	2
Henan	1	1	0	0	0	0	0	0	0	0	2
Hubei	0	1	0	0	0	1	0	0	0	1	1
Hunan	0	1	1	0	0	1	1	0	1	5	4
Guangdong	1	1	1	0	0	1	1	0	0	5	2
Guangxi Zhuang Autonomous region	0	1	1	0	1	1	1	0	0	8	2
Hainan	1	1	1	0	0	1	1	0	1	5	6
Chongqing	1	1	1	0	0	1	0	0	1	3	6
Sichuan	1	1	0	0	0	0	0	0	1	0	5
Guizhou	1	1	1	0	1	1	1	0	1	8	8
Yunnan	1	1	1	0	0	1	0	0	0	3	2
Xizang autonomous region	1	0	1	0	0	1	1	0	0	2	1
Shaanxi	1	1	1	0	1	1	1	0	1	8	8
Gansu	1	1	0	1	0	1	0	0	0	3	2
Qinghai	1	1	1	0	0	1	1	0	0	5	2
Ningxia Hui Autonomous Region	0	1	0	0	0	1	0	0	0	1	1
Xinjiang Uygur Autonomous region	1	0	1	0	0	1	1	0	1	5	4

107, the upper end of the accepted normal SRB value (Gu & Roy, 1995)[6]. The null and alternative hypotheses are as follows:

[6] The accepted normal value of the sex ratio at birth ranges from 104-107. Some studies in the literature review used 106 as the single normal value. However, this paper uses the upper end of 107.

$$H_o: m = 107$$

$$H_A: m > 107$$

After using the actual SRB and the normal SRB to calculate the number of missing girls, a second t-test will determine whether the number of missing girls differs significantly from 0. If the overall national SRB does vary significantly above 107, and the number of missing girls is significantly greater than 0, then two questions are at hand: 1) what is the effect of policy strength on the SRB, and 2) how do regulations reflect the needs and characteristics of the province. To achieve these two goals, I will use two methods: a t-test to test the SRB difference between strong SRB policy regions and weak SRB policy regions (based on a region's SRBreg score), and a two-stage least squares model to ultimately determine the effect of policy strength on SRB.

The first one-sided t-test will compare the means of SRB between regions with strong policy and weak policy. As mentioned above, the regulations of each province, municipality, and autonomous region was scored from 1 to 8, dividing the sample into two groups, a weak policy group with SRBreg 1 to 4, and a strong policy group with scores 5 to 8. The null hypothesis is that the mean SRB for the two groups are the same. The alternative hypothesis is the mean SRB for the strong policy group would be lower than the weak policy group:

$$H_o: m_{0,1} = m_{2,3}$$

$$H_A: m_{0,1} < m_{2,3}$$

The second part will use the two-stage least squares (2SLS) approach to test the relationship between the SRB and regulation strength. The first model utilizes a linear regression to explain provincial SRB via its economic, political, and social characteristics. The second stage uses the same variables to explain policy strength for fertility reduction, i.e. regressing Fertreg on the regional characteristics and SRB. A third regression explains policy strength for SRB reduction (SRBreg) using the same independent variables and SRB. Finally, the complete model inserts the residuals from the second and third regression (policy strength equations) into the first regression (SRB equation).

Equation 1) $SRB = \beta_1(\text{provincial characteristics}) + k_1$

Equation 2) $Fertreg = \beta_2(\text{provincial characteristics}) + \alpha_1 SRB + k_2$

Equation 3) $SRBreg = \beta_3(\text{provincial characteristics}) + \alpha_2 SRB + k_3$

$Residuals_i = (\text{actual policy strength}_i - \text{predicted policy strength}_i)$

Equation 4) $SRB = \beta_1(\text{provincial characteristics}) + \beta_4(residual_{fertreg}) + \beta_5(residual_{SRBreg}) + k_4$

I used the 2SLS approach for three reasons. First, it allows me to see how one-child regulations relate to regional characteristics. Second, given that a provincial governments design regulations to fit a province's economic, political, and cultural characteristics, high correlations exists between variables that influence the SRB and variables that influence policy strength. Third, and most importantly, policy strengths may be affected by expected SRB levels themselves. Strong regulations to control the SRB may not be needed if sex-selection procedures were not so readily available, such as

in low-income, rural, and low-density areas. Yet, family planning authorities may design stronger policies to control the SRB in response to indications that it may rise when the one-child rule is enforced. Hence, SRB is used as a proxy in the policy strength equations as a proxy for the expected tendency of people to apply sex-selection under the one-child rule. The simultaneity of using SRB to explain policy strength, and policy strength to explain the SRB entails the use of a 2SLS approach.

One problem the study faces is the limitation of the sample size. There are a total of 31 provinces, autonomous regions, and municipalities—almost a minimum required to have any significance. In linear regressions, the small sample size limits the number of coefficient that the model can significantly predict.[7] With a sample size of 31, the number of variables in the SRB and policy strength regressions (equations 1, 2, 3, and 4) must be reduced. Furthermore, many of the explanatory variables may be correlated with each other. Therefore, three methods are used reduce the number of variables: principle components analysis (PCA), forward inclusion, and backward deletion. Each approach reduces the number of explanatory variables in a linear regression, but produces different results. PCA collapses the variables into several principal components—which are each a linear combination of the repressors—while retaining as much of the data variation as possible so that the principle components measure the different "dimensions" of the data. Forward inclusion model selection starts with the predictor having the highest simple correlation with the dependent variable, and on each successive step, adds a variable that produces the largest increase in R^2, and stopping when an additional predictor will not

[7] Although this is a heuristic range, due to the nature and sample size of the study, I decided that five to ten data points are necessary for a significant prediction of coefficients. See: Neter, John, Michael H. Kutner, Chris Nachtsheim, William Wasserman, and Chris J. Nachtsheim. Applied Linear Statistical Models, 4th Edition. McGraw-Hill/Irwin, 1996.

increases R^2 significantly. Backward deletion is the opposite approach; it starts with a full model and on each successive step, deletes the predictor that contributes least to the model (that with the least significance or largest regression weight p-value), stopping when deleting the next variable would produce a significant drop in R^2. Although these three methods will restrict the analysis of the relationship between SRB and specific provincial characteristics, it will not detract from the main goal of finding the relationship between SRB and provincial regulations.

The following are independent variables used in the 2SLS model prior to the PCA, forward inclusion, and backward deletion processes. Together, these variables reveal the economic development, political autonomy, and culture of each province, municipality, and autonomous region. Note, however, that many of them are correlated:

Urbanization. The degree of urbanization has been shown in all my previous literature to significantly impact both the fertility rate and the SRB in China. Urbanization is associated with economic development, increased education levels, and employment activities, especially for women. As a result, urbanization increases the opportunity costs of rearing children as well as decreases strong cultural preference for sons (Lavely & Freedman, 1990).

Agriculture. Like urbanization, the degree of agriculture in a region has been shown to have significant effects on fertility and the sex ratio (Schultz & Zeng, 1995, Lavely & Freedman, 1990; Liu, 2002). Agriculture intensive communities tend to adhere to strong son preferences because of the importance of the male heir to family name and land (Jie, 2002). Moreover, agricultural families also have higher demands for children, who provide a dependable source of labor (Yang, 1994).

Geographical Region. China is divided in to six regions: North, Northeast, East, Central, Southwest, and Northwest. Each region has its own geographical, economic, and cultural characteristics that spread beyond the political boundaries of provinces, municipalities, and autonomous regions. Six binary variables are used to capture the effects of geographical location, economic development, and cultural differences.

Ethnicity and Culture. The cultural composition of China has significant variation. There are fifty-six ethnic minorities and nine groups of dialects in China. Each culture has its own traditions, values, and needs, as well as certain legal privileges. For example, the Chinese government has given minorities exceptions in the one-child policy due to their dying numbers. The percentage of the minority population (non-Han) is included as an explanatory variable.

Population Age Structure. The percentage of population age 65 and above is included as an explanatory variable because it reflects both the need for old age care and the strength of cultural preferences of sons. According to Jie (2002), son preferences in China re especially strong among the elderly.

GDP per capita. The GDP per capital can explain the average individual wealth and is a relatively accurate quantified measure of economic development in a region, as well as the opportunity cost of raising children.

Education. Education levels seem to be negatively correlated with both fertility and the sex ratio at birth. Schultz (2001) and Lavely & Freeman (1994) both found women's education to be the most important factor in fertility decline both in China and other developing countries. Education increases job options and earnings for women, raising opportunity costs of rearing children. Furthermore, education challenges the traditional sexist notions of male supremacy and son preferences. Educated women also know more about their options for contraception, maternal health-care, childcare, and consequences of the regulations. On the other hand, couples with higher education and income also have more access to illegal prenatal sex determination. The percent of women age 15 and over in high school (%highschool) and college (%college) are included as explanatory variables.

Density & Area. The densities and areas of provinces, municipalities, and autonomous regions suggest the breadth of political control. Lower density and smaller areas may indicate weaker needs for authoritative control, whereas higher density and larger areas are more difficult to monitor, especially in terms of registration and one-child regulations. Large area and low density are indicative of the border regions such as Xinjiang, Tibet, and Mongolia, which are also less economically developed and culturally segregated from the heart of China.

Distance from Beijing. The distance from Beijing may be a measure of a region's autonomy. The national government is the overarching entity that governs the family planning and population control programs. Regional governments, though independent in designing their own one-child regulations, are somewhat under the scrutiny and

cooperation of the national commission for family planning. Therefore, the distance from the Beijing capital may correspond to a region's autonomy in the population control arena.

Province, Municipality, and Autonomous Region. Regions are classified by these three kinds of political entities. Unlike provinces and municipalities, autonomous regions have their own set of regulations and own culture discrete from the rest of China. Municipalities are usually economically and politically independent and advanced, despite their small geographical area.

Although these variables are my no means a complete list of a region's characteristics, they are a sufficient combination to describe the economic development, cultural composition, and political climate. Due to the small sample size, all variables will have to be collapsed. Nevertheless, this study is most concerned with the relationship between the sex ratio at birth and the one-child regulations.

4. EMPIRICAL RESULTS

4.1 Statistical Tests

Table 3 and 4 show the data and descriptive statistics for the SRB, regulation rating, number of missing girls, and selected explanatory variable. These numbers verify that the SRB varied widely across the 31 regions, ranging both under and above 107, the upper end of the normal accepted SRB. 107 is roughly one standard deviation below the sample mean of 117.52. The variance of SRB is 108. The skewness, kurtosis, and median (114.58) show a distribution close to normal but slightly skewed to the right.

Jiangxi, Guangdong, and Hainan contribute to the higher end of the SRB range. Chart 2 plots the SRB distribution.

Figure 1: Data

Province	SRB	missing girls	Fertreg	SRBreg	%urban	% agriculture	%minority	Density
Beijing	114.58	285	5	6	77.54	31.49	4.26	822.62
Tianjin	112.97	200	1	2	71.99	41.69	2.64	389.79
Hebei	118.46	3,521	5	6	26.08	80.40	4.31	354.95
Shanxi	112.75	1,084	7	7	34.91	73.04	0.29	210.94
Inner Mongolia Autonomous Region	108.48	239	1	1	42.68	64.72	20.76	200.85
Liaoning	112.17	873	5	4	54.24	54.00	16.02	282.53
Jilin	109.87	301	2	6	49.68	56.49	9.03	145.57
Heilongjiang	107.52	170	2	5	51.54	54.25	5.02	81.15
Shanghai	115.51	348	3	1	88.31	25.38	0.60	2640.17
Jiangsu	120.19	3,165	2	4	41.49	67.86	0.33	700.44
Zhejiang	113.11	1,275	2	6	48.67	77.89	0.85	451.45
Anhui	130.76	6,048	2	5	27.81	80.40	0.63	429.41
Fujian	120.26	1,844	8	4	41.57	79.39	1.67	285.91
Jiangxi	138.01	5,576	1	2	27.67	77.40	0.27	248.05
Shandong	113.49	2,923	2	2	38.00	73.15	0.68	579.39
Henan	130.30	10,318	0	2	23.20	81.80	1.22	549.81
Hubei	128.02	3,517	1	1	40.22	72.03	4.34	324.26
Hunan	126.92	4,721	5	4	29.75	79.90	10.21	304.06
Guangdong	137.76	9,663	5	2	55.00	68.82	1.42	485.78
Guangxi Zhuang Autonomous Region	128.80	4,510	8	2	28.15	82.52	38.34	203.91
Hainan	135.04	1,024	5	6	40.11	74.13	17.29	23.20
Chongqing	115.80	965	3	6	33.09	78.62	6.42	375.00
Sichuan	116.37	3,088	0	5	26.69	81.39	4.98	89.33
Guizhou	105.37	-171	8	8	23.87	85.54	37.85	207.35
Yunnan	110.57	1,365	3	2	23.36	84.52	33.41	108.80
Xizang Autonomous Region	97.43	-154	5	1	18.93	85.95	94.07	0.21
Shaanxi	125.15	2,304	8	8	32.26	77.16	0.49	175.34
Gansu	119.35	1,512	3	2	24.01	80.78	8.69	65.69
Qinghai	103.52	-80	5	2	34.76	71.67	45.51	7.17
Ningxia Hui Autonomous Region	107.99	78	1	1	32.43	71.28	34.53	85.15
Xinjiang Uygur Autonomous Region	106.65	80	5	4	33.82	64.79	59.39	11.59

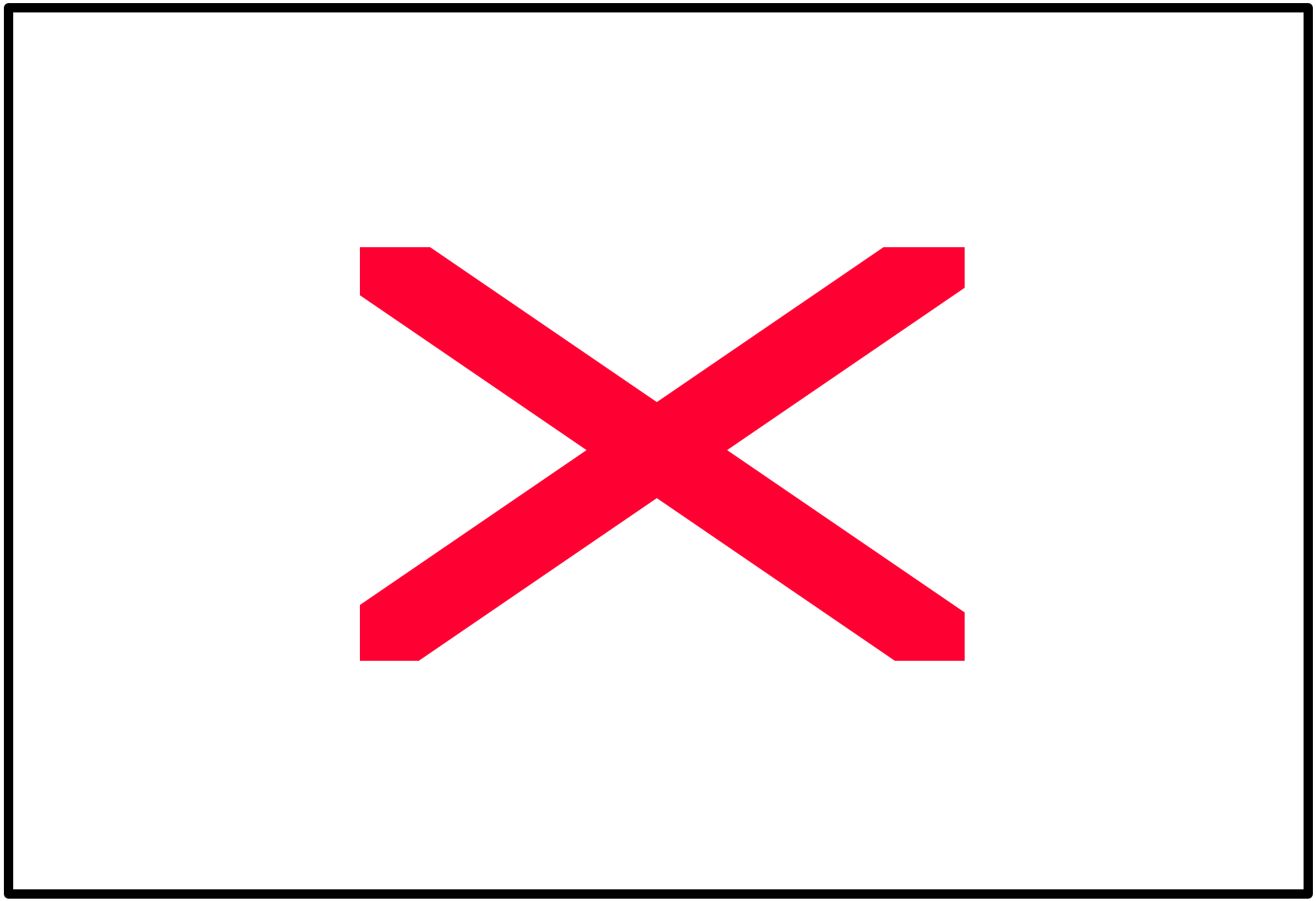
Figure 1: Data Continued

Province	Age65	gdppc	%highschool	%college	km to Beijing	area	Muni-cipality	Autonomous Region
Beijing	8.90	22000	24.12	17.55	0	16,800	1	0
Tianjin	9.18	17940	21.85	9.44	125	11,920	1	0
Hebei	7.96	7663	11.34	2.85	250	190,000	0	0
Shanxi	6.81	5137	12.62	3.74	375	156,300	0	0
Inner Mongolia Autonomous Region	6.75	5872	14.69	4.06	420	118,300	0	1
Liaoning	8.60	11226	13.93	6.52	580	150,000	0	0
Jilin	6.29	6842	15.86	5.18	830	187,400	0	0
Heilongjiang	6.04	8562	14.63	5.06	1000	454,600	0	0
Shanghai	14.05	34426	23.87	11.34	1000	6,341	1	0
Jiangsu	10.25	11773	13.76	4.13	1040	106,190	0	0
Zhejiang	10.25	13461	11.46	3.40	1080	103,600	0	0
Anhui	8.12	4867	8.21	2.47	875	139,400	0	0
Fujian	7.93	11601	11.27	3.17	1500	121,400	0	0
Jiangxi	6.90	4838	10.71	2.81	1190	166,900	0	0
Shandong	8.20	9555	11.75	3.55	350	156,700	0	0
Henan	7.44	5444	10.79	2.88	600	168,350	0	0
Hubei	6.73	7188	13.30	4.12	1000	185,900	0	0
Hunan	8.07	5639	11.84	3.12	1250	211,800	0	0
Guangdong	7.76	12885	14.03	3.88	1790	177,901	0	0
Guangxi Zhuang Autonomous Region	8.18	4319	10.37	2.59	1960	220,150	0	1
Hainan	7.47	6849	13.69	3.47	2180	339,200	0	0
Chongqing	8.80	5200	9.28	3.03	1380	82,400	1	0
Sichuan	8.24	4805	8.20	2.67	1430	480,000	0	0
Guizhou	6.51	2662	6.34	2.14	1650	170,000	0	0
Yunnan	6.63	4559	7.27	2.23	2000	394,100	0	0
Xizang Autonomous Region	6.18	4559	3.85	1.41	2420	12,284,000	0	1
Shaanxi	6.73	4607	13.10	4.43	850	205,600	0	0
Gansu	5.62	3838	10.76	2.91	1130	390,000	0	0
Qinghai	4.91	5068	11.44	3.63	1250	722,797	0	0
Ningxia Hui Autonomous Region	4.86	4839	12.14	4.11	830	66,000	0	1
Xinjiang Uygur Autonomous Region	4.98	7470	13.27	5.64	2290	1,660,400	0	1

2000 and 2001 data from sources: Tabulation on the 2000 Population Census of the People's Republic of China, China Population Statistics Yearbook 2002, and China Statistical Yearbook 2002

Table 4: Descriptive Statistics

	Range	Min.	Max.	Mean	Mean Std. Error	Std. Deviation	Variance	Skewness	Skewness Std. Error	Kurtosis	Kurtosis Std. Error
SRB	40.58	97.43	138.01	117.52	1.87	10.40	108.25	0.40	0.42	-0.53	0.82
# missing girls	10489.00	-171.00	10318.00	2277.16	487.63	2715.01	7371283.21	1.64	0.42	2.53	0.82
regulation rating	3	0	3	1.61	0.14	0.80	0.65	0.02	0.42	-0.36	0.82
%urban	69.38	18.93	88.31	39.41	2.97	16.53	273.14	1.44	0.42	1.95	0.82
%agriculture	60.57	25.38	85.95	70.27	2.74	15.23	231.97	-1.63	0.42	2.30	0.82
%minority	93.80	0.27	94.07	15.02	3.89	21.66	469.28	2.13	0.42	5.03	0.82
density	2639.96	0.21	2640.17	349.67	84.93	472.89	223628.41	4.01	0.42	19.21	0.82
age65	9.19	4.86	14.05	7.59	0.33	1.84	3.38	1.37	0.42	3.95	0.82
gdppc	31764.00	2662.00	34426.00	8570.77	1162.42	6472.07	41887652.31	2.60	0.42	8.11	0.82
%highschool	43.97	7.14	51.11	37.15	1.98	11.04	121.83	-1.25	0.42	1.35	0.82
%college	15.44	1.02	16.46	3.63	0.54	3.01	9.08	3.04	0.42	10.91	0.82
km to Beijing	2420	0	2420	1117	114.97	640.12	409749.46	0.31	0.42	-0.50	0.82
area	12277659	6341	12284000	640144	391912.39	2182075.82	4761454885542.92	5.41	0.42	29.70	0.82
autonomous region	1	0	1	0	0.07	0.37	0.14	1.94	0.42	1.87	0.82
municipality	1	0	1	0	0.06	0.34	0.12	2.33	0.42	3.65	0.82



The first t-test rejects the hypothesis that the mean SRB is normal. The t-statistic of 5.631 is significant, clearly showing that the SRB in China is higher than normal. A second t-test rejects the hypothesis that there are no missing girls[8] in China. In fact, among the 31 regions, there is a mean of 2277 missing girls in the year 2000. Table 5 reveals the results.

Table 5

H_0	H_A	t	df	Sig.	Mean Difference
SRB = 107	SRB > 107	5.631	30	0	10.52
No. of Missing Girls = 0	No. of Missing Girls > 0	4.67	30	0	2277.16

This study hypothesizes that the strength of regional one-child regulations influences the SRB. For the third test, the 31 regions were divided into two groups according to their policy strength with respect to SRB reduction, i.e. based on their SRBreg score. 24 regions fall into the weak regulation group (*weak* group), and 7 fall into the strong regulation group (*strong* group). Levene's test fails to reject the assumption of equal variances in SRB for the two groups on a 0.05 significant level[9]; consequently a standard independent samples t-test is applied to examine the difference of SRB means between the two groups. Table 6 displays the results. The weak group had a mean of 118.50; the strong group had a mean of 114.15. The t-test was not significant at the 0.1 or 0.05 level, and therefore the hypothesis of equal means between the two groups cannot be rejected. The t-test was repeated by dividing the groups according to their fertility

[8] Missing girls = (no. male births)/107 – (no. female births).

regulation strength (fertreg). The SRB means for the two groups were both 117.5, but the t-test was statistically insignificant. Again, the hypothesis of equal means cannot be rejected.

Table 6 also lists the results of Levene's test and t-test for missing girls and the fertility rate of women age 15 to 49. All results were statistically insignificant. The t-tests indicate that the stronger regulations do not associate with lower SRB's or lower fertility.

Table 6: Strong Group vs. Weak Group

Variable	Weak SRB Regulation / Strong SRB Regulation	Mean	Std. Dev.	Std. Error Mean	Levene's test for equality of variances: F	Sig.	t-test for equality of means: t	d.f.	Sig. (2-tailed)	mean Difference
SRB	weak	118.50	10.89	2.22	0.551	0.464	0.972	29	0.339	4.35
	strong	114.15	8.35	3.16						
Missing girls	weak	2496.25	2917.75	595.58	1.085	0.306	0.828	29	0.415	970.25
	strong	1526.00	1836.27	4694.05						
Fertility (women 15-49)	weak	1.27	0.33	0.07	0.659	0.423	0.016	29	0.987	0.0026
	strong	1.26	0.46	0.18						

Variable	Weak Fertility Regulation / Strong Fertility Regulation	Mean	Std. Dev.	Std. Error Mean	Levene's test for equality of variances: F	Sig.	t-test for equality of means: t	d.f.	Sig. (2-tailed)	mean Difference
SRB	Weak	2416.94	2765.19	670.66	0.008	0.927	0.311	29	0.758	309.51
	Strong	2107.43	2746.51	734.04						
Missing girls	Weak	117.55	9.09	2.21	1.782	0.192	0.015	29	0.988	0.0576
	Strong	117.50	12.17	3.25						
Fertility (women 15-49)	Weak	1.19	0.31	0.08	0.588	0.449	-1.250	29	0.221	-0.1592
	Strong	1.35	0.40	0.11						

[9] In this paper, "statistically significant" requires a minimum significance level of 0.05.

4.2 Two Stage Least Squares Model

A two-stage least squares model is used to deal with the simultaneity of SRB and policy strength as explanatory and dependent variables. Due to the small sample size, which limits the number of coefficients the models can predict, principle components analysis is used to collapse the eleven explanatory variables into three uncorrelated principle components (see Appendix B).

These three PC's capture the socioeconomic, political, and cultural characteristics of a region, and are inserted in the SRB regression, the Fertreg regression (measuring policy strength with respect to the fertility reduction goal), the SRBreg regression (measuring policy strength with respect to the SRB reduction goal), and the complete 2SLS model. PC_i denotes a principle component, k is a constant, and resid stands for the residuals from models 2 and 3:

Model 1) $SRB = k_1 + \beta_1 PC_1 + \beta_2 PC_2 + \beta_3 PC_3$

Model 2) $Fertreg = k_2 + \beta_4 PC_1 + \beta_5 PC_2 + \beta_6 PC_3 + \alpha_1 SRB$

Model 3) $SRBreg = k_3 + \beta_7 PC_1 + \beta_8 PC_2 + \beta_9 PC_3 + \alpha_2 SRB$

Final Model) $SRB = k_4 + \beta_{10} PC_1 + \beta_{11} PC_2 + \beta_{12} PC_3 + \beta_{13} resid_2 + \beta_{14} resid_3$

Model 1 uses the characteristics of a region to predict the SRB; model 2 uses the characteristics of a region to predict the score of regulations aimed at reducing fertility rates (fertreg); model 3 uses the same characteristics to predict the strength of regulations aimed at reducing SRB (SRBreg). The three principle components appear in all models because many of the same explanatory variables predict the three dependent variables,

and are correlated with each other. Furthermore, if some explanatory variables were included in model 2 and 3 but not model 1, then the final 2SLS model would not control for the variables that were omitted in model 1.

Table 7 reports the three principle components. PC_1 mostly captures the socioeconomic development characteristics of a region; the explanatory variables most extracted in PC_1 include %urban, gdppc, %agriculture, %highschool, density, age65, municipality, and %college. PC_2 mostly covers %minority, area, and autonomous region, and seems to define the political and cultural autonomy of a region. Autonomous regions, by definition, have special powers of self-rule and high concentrations of ethnic minorities[10] that differ from the national majority of Han decent. In China, different regulations often apply to autonomous regions and minorities, including the population and family planning regulations. The area also suggests the political control needed for a region—large areas may indicate weaker political control and legislature because of the physical expanse. Together, these three variables seem to distinguish between the remote border provinces from the other regions in China. Finally, PC_3 captures the remainder of what was not extracted in PC_1 and PC_2. However, there is no clear overarching category for PC_3.

The PCA approach encapsulates a large majority of the explanatory variables while simultaneously removing the bias problem. Yet, in using principle components, one cannot determine the effects of individual explanatory variables on SRB and regulation strength. At most, the coefficient for PC_1 may signify the effect of general socioeconomic development on the dependent variables, and the coefficient for PC_2 the

effect of general political and cultural autonomy. Fortunately, the coefficient for the residuals in the final 2SLS model can be used to analyze the effect of regulation strength on the SRB after controlling for the socioeconomic, political, and cultural characteristics of a region.

Table 7: Principle Components Analysis

	Principle Component		
explanatory variable	1	2	3
%urban	0.915	0.225	-0.121
gdppc	0.902	0.317	0.182
%agriculture	-0.868	-0.306	0.301
%college	0.798	0.319	-0.386
density	0.785	0.194	0.448
age65	0.743	0.047	0.573
municipality	0.738	0.324	0.047
%highschool	0.669	-0.297	-0.327
km to Beijing	-0.570	0.399	0.372
%minority	-0.593	0.754	-0.110
Area	-0.439	0.715	0.143
Autonomous Region	-0.399	0.630	-0.332

Table 8 shows the results of model 1: SRB regressed on the three principle components. The value of R-square is 0.331, which suggests that not much of the variation in the SRB can be explained by the three principle components, i.e. the socioeconomic, political, and cultural characteristics of regions. Nonetheless, the ANOVA test shows that the three principle components jointly make a significant difference in the SRB. Of all coefficients, only β_2 is significant at the 0.05 level, and PC_2 is the only principle component that has a statistically significant correlation (-0.503)

[10] http://en.wikipedia.org/wiki/Autonomous_region

with SRB. The results indicate that SRB is influenced by political and cultural autonomy, captured in PC_2 and other omitted factors, but not by socioeconomic development.

Table 8: Model I

Correlations (2-Tailed Sig.)

	SRB	PC1	PC2	PC3	Residuals
SRB	1.000 (.)	0.096 (.303)	-0.503 (.002)	0.261 (.078)	0.818 (.000)
PC1		1.000 (.)	0.000 (0.500)	0.000 (0.500)	0.000 (1.000)
PC2			1.000 (.)	0.000 (0.500)	0.000 (1.000)
PC3				1.000 (.)	0.000 (1.000)
Residuals					1.000 (.)

Model Summary

	R	R-Square	Adjusted R-Square	Std. Error of Estimate
	0.575	0.331	0.256	8.97212

ANOVA

	Sum of Squares	df	mean square	F	Sig.
Regression	1074.024	3	358.008	4.447	0.012

Coefficients

	Unstandardized Coefficient			
	B	Std. Error	t	Sig.
k	117.522	1.611	72.93	0.000
PC1	1.000	1.638	0.611	0.547
PC2	-5.237	1.638	-0.3197	0.004
PC3	2.715	1.638	1.658	0.109

Table 9 shows the results of model 2: Fertreg regressed on the three PC's and SRB. The R-square for this model is even lower, only 0.051, signifying that not more

than 5% of the variance in regulation strength can be explained by the SRB, socioeconomic, political, and cultural characteristics denoted by the principle components. Moreover, the ANOVA test illustrate that the three PC's do not jointly make a statistically significant difference in regulation strength, which signifies that one or more of the PC's is not related to the regulation strength. Examining each of the coefficients individually, none of the variables are significantly related with the regulation strength for fertility reduction. Evidently, the strength of a regulation aimed at reducing fertility has little to do with the characteristics of the region.

Table 10 reveals the results of model 3: SRBreg regressed on the three PC's and SRB. Again, the R-square for this regression is low, with the variables explaining only 10% of the variance in regulations strength. The ANOVA test indicates that the three PC's and SRB do not jointly make a difference in the SRBreg, and is supported by the statistically insignificant individual t-statistic for each PC and the SRB variable. Although none have statistical significance on the 0.05 level, PC2 is statistically significant on the 0.10 level. This indicates some negative correlation between PC2 and SRBreg, suggesting that regions with more political and cultural autonomy have weaker regulations for controlling the SRB. This is consistent with border regions who may have weaker son preferences and lower incomes, and therefore find sex-selection procedures less attractive or affordable, and do not require harsh regulations to control the SRB.

Table 9: Model 2

Correlations (2-Tailed Sig.)

	Fertreg	PC1	PC2	PC3	SRB
Fertreg	1.000 (.)	-.161 (.193)	.143 (.221)	-.037 (.421)	-.029 (.438)
PC1		1.000 (.)	0.000 (0.500)	0.000 (0.500)	.096 (.303)
PC2			1.000 (.)	0.000 (0.500)	-.503 (.002)
PC3				1.000 (.)	.261 (.078)
SRB					1.000 (.)

Model Summary

	R	R-Square	Adjusted R-Square	Std. Error of Estimate
	0.227	0..051	-.095	2.585

ANOVA

	Sum of Squares	df	mean square	F	Sig
Regression	9.414	4	2.353	.352	.840

Coefficients

	Unstandardized Coefficient			
	B	Std. Error	t	Sig.
k	1.613	6.532	.247	.807
PC1	-.416	.475	-.875	.390
PC2	.444	.554	.801	.430
PC3	.045	.495	.092	.928
SRB	.017	.055	.312	.758

Table 10: Model 3

Correlations (2-Tailed Sig.)

	SRBreg	PC1	PC2	PC3	SRB
SRBreg	1.000 (.)	.004 (.492)	-.262 (.077)	.015 (..468)	-.013 (.472)
PC1		1.000 (.)	0.000 (0.500)	0.000 (0.500)	.096 (.303)
PC2			1.000 (.)	0.000 (0.500)	-.503 (.002)
PC3				1.000 (.)	.261 (.078)
SRB					1.000 (.)

Model Summary

	R	R-Square	Adjusted R-Square	Std. Error of Estimate
	.320	.102	-.036	2.026

ANOVA

	Sum of Squares	df	mean square	F	Sig
Regression	12.142	4	3.035	.740	.574

Coefficients

	Unstandardized Coefficient			
	B	Std. Error	t	Sig.
k	8.822	5.120	.1.723	.097
PC1	0.050	.372	.134	.894
PC2	-.745	.434	-1.715	.098
PC3	.146	.388	.375	.711
SRB	-.043	..043	.982	.335

The final 2SLS model inserts the residuals from model 2 and 3 into the final model. The results in Table 11 illustrate that the three principle components and the residuals do jointly make a difference on the SRB at the 0.10 significance level, but not on the 0.05 level. Still, compared to model 1, statistical significance has declined, and R-square remains unchanged. Furthermore, the coefficients for the PC's are unaffected by the insertion of model 2 and 3's residuals. The coefficients for the residuals are both 0

Table 11: Final 2-Stage Least Squares Model

Correlations
(2-tailed Sig.)

	SRB	PC1	PC2	PC3	Resid. From Model 2	Resid. From Model 3
SRB	1.000 (.)	0.096 (.303)	-0.503 (..002)	0.261 (.078)	.000 (.500)	.000 (0.500)
PC1		1.000 (.)	0.000 (0.500)	0.000 (0.500)	0.000 (0.500)	0.000 (.500)
PC2			1.000 (.)	0.000 (0.500)	0.000 (0.500)	0.000 (1.000)
PC3				1.000 (.)	0.000 (0.500)	0.000 (.500)
Resid. from Model 2					1.000 (.)	0.000 (1.000)
Resid. from Model 3						1.000 (.)

Model Summary

	R	R-Square	Adjusted R-Square	Std. Error of Estimate
	0..575	.331	.197	9.324

ANOVA

	Sum of Squares	df	mean square	F	Sig
Regression	1074.024	5	214.805	2.471	.060

Coefficients

	Unstandardized Coefficient			
	B	Std. Error	t	Sig.
k	117.522	1.675	70.176	.000
PC1	1.000	1.702	.587	.562
PC2	-5.237	1.702	-.3076	.005
PC3	2.715	1.702	1.595	.123
Resid. from Model 2	.000	.913	.000	1.000
Resid from Model 3	.000	1.165	.000	1.000

and statistically insignificant, demonstrating that one-child regulation strength is unrelated to the SRB. One cannot conclude that stronger regulations reduce SRB or that weaker regulations increase SRB. The only important variable is again PC2, representing political and cultural autonomy. One must assume that in addition to economic development, political autonomous, cultural values, and regulation strength, other factors must affect the sex ratio at birth.

5. CONCLUSION

5.1 Regulations

The results of the statistical tests confirm that one-child policy strength do not affect or correlate with the sex ratio at birth. The only factors that seem to affect both the SRB and the strength of regulations is political and cultural autonomy. Yet, in a country enduring a strict population control campaign, it seems ironic to conclude that regulations do not affect the SRB and that the SRB is not a factor in the design of the one-child regulations. In a further investigation of the one-child regulations (see Appendix C), I find that policies do not use a strategic combination of different exemptions, rewards, and punishments to coerce compliance. Rather, either rewards or punishments are used as the main artillery against out of plan births and prenatal sex selection. Regulations lack a strong system of incentives and disincentives to compel couples to adhere to the rule. Hence, regulations can hardly deter couples who insist on having a son or another child. As a result, regulations are futile in fighting against the cultural and traditional inclination to demand many children, especially sons.

5.2 Regional Characteristics

China created the One-Child Policy in 1979 to combat its rising population, but it did not anticipate the imminent problem of imbalanced sex ratios across the nation. This study revisits China's challenge of the rising sex ratio at birth. Like the State Family Planning Commission and other research papers, it shows that the SRB deviates significantly from the normal ratio, and consequently, a large number of girls are missing in China's provinces, municipalities, and autonomous regions. In light of socioeconomic, cultural, and political characteristics, this study aims to find the determinants of one-child regulation strength, and the relationship between regional one-child regulations and the SRB. The results suggest the following: 1) political autonomy and culture are the only factors associated with both regulation strength and SRB; 2) socioeconomic development does not contribute to either regulation strength or the SRB; and 3) regulation strength does not significantly affect the SRB.

Socioeconomic Development. Socioeconomic development, which has been the most important cause of fertility decline in industrialized countries across the world (Schultz, 2001), does not appear to play a significant role in the SRB or regulation strength. The weak regulation groups do not have a higher mean SRB than the strong regulation groups. In the 2SLS model, the effects of socioeconomic development variables—%urban, %agriculture, gdppc, %college, density, municipality, and %highschool—were indeterminable due to the small sample size, but instead captured in PC_1. Yet, the results show that PC_1 is insignificant in predicting or regulation strength. One cannot conclude that provinces, municipalities, or autonomous regions do not design their one-child

policy's exceptions, incentives, and disincentives of based on socioeconomic characteristics.

Surprisingly, socioeconomic development also appears to be an inconsequential determinant of a region's SRB. In both the first and final regression, PC_1 has statistically insignificant correlations and coefficients in relation to the SRB. These results are consistent with Gu & Roy (1995),who found the SRB to displayed an inverted U-shape relationship with socioeconomic development. Breaking down the socioeconomic factors, only the variable %highschool had a statistically significant correlation with SRB[11], suggesting that when the percentage of women age 6+ who have graduated from highschool increases by 1%, the SRB increases by 0.324. The meaning of this result is elusive. While previous research concludes that women's education is the most important factor in reducing fertility, its effects on the sex ratio is inconclusive. On one hand, education demystifies superstitions and traditional values that encourage son preferences, increases opportunity costs of raising children, and elevates the value of women in both the family and workforce, all of which would lower the SRB. On the other hand, education also increases the wages of women and the knowledge and network necessary for them to find ways to circumvent the one-child policy and to pay for illegal practices such as prenatal sex-determined abortions. In addition, Zhang & Sturm's findings (1994) suggest that socioeconomic development may increase the risks couples are willing to take in order to have a son..

In light of the status of women, it appears that highschool education increases the ability of women satisfy their son preferences, and is more or less ineffective in reducing

[11] Correlations can be found in Appendix B.

traditional patriarchal and sexist ideology. Interestingly, college education has a negative but insignificant correlation with SRB. Therefore, the results of this study question the differences between women's high school and college education.

Political Autonomy & Culture. Political Autonomy and ethnicity appears to be the only conclusive factors for both SRB and regulation strength. The regression and correlation analyses produce statistically significant results for the variables PC_2, %minority, area, and autonomous regions, and suggest that the more political autonomy and ethnic minorities a region has, the lower their SRB and stronger their regulations in aiming to reduce fertility and SRB.

The percentage of ethnic minorities had statistically significant correlations with the SRB and the number of missing girls. When the percentage of ethnic minorities increases by 1 percent, the SRB decreases by 0.54, and the number of missing girls decreases by 0.38. One possible explanation for the correlations may be that ethnic minorities have different traditional cultural values. While the Han majority has deep roots in Confucianism, son preferences, and patriarchy, the same may not apply to other ethnic groups, who have their own culture and languages. In fact, with the exception of Guangxi Zhuang Autonomous Region, the lowest SRB's belong to the regions with at least 20% ethnic minority, with Tibet housing the highest percentage of minority (94.07%) and lowest SRB (97.43).

Furthermore, ethnic minorities tend to live in more remote regions. I found statistically significant correlations among the variables %minority, area, and autonomous region. This indicates that minorities tend to live in the expansive border

regions of China: Inner Mongolia Autonomous Region, Guangxi Zhuang Autonomous Region, Guizhou, Yunnan, Tibet Autonomous Region, Qinghai, Ningxia Hui Autonomous Region, and Xinjiang Uygur Autonomous Region. Geographical segregation through location and area may have helped minority cultures refrain from assimilating Confucian patriarchal ideology from mainstream Han culture. Likewise, the lower density and larger area of these regions imply that unlike other regions, their population growth rate was not a strain to resources. Gu & Roy (1995) suggested that dramatic drops in fertility rates are a cause in the rise of the SRB. However, implementation of the one-child policy did not have dramatic effects on these regions as compared with the rest of the country. Therefore, the fertility rate may not have declined severely, and SRB did not rise significantly.

In terms of family planning, these border regions appear to have stronger one-child regulations. In model 2, PC_2 has the only statistically significant coefficient and correlation with respect to SRBreg. The findings indicate that culturally and politically autonomous regions design stronger one-child policies. First, these border regions tend to have higher concentrations of ethnic minorities, who receives special treatment from the national government. Therefore, many regional one-child regulations provide specific exemptions for ethnic minorities. Second, these border regions have statistically significant correlations with density (negative) and area (positive). The lower density and larger area—in addition to geographical borders like mountains and deserts segregating the inner and western regions—increase the difficulty of administering the one-child policy, and in thus requiring these border regions to have more pertinent exceptions, beneficial incentives, and harsh disincentives, i.e. stronger regulations.

Nonetheless, the link between stronger policies and lower SRB's is incomplete. One cannot conclude that the border regions' stronger one-child regulations, after controlling for socioeconomic development, cause their low SRB's. The final model shows that regulation strength has neither a statistically significant correlation nor a statistically significant coefficient with respect to SRB. Rather than merely regulation strength, one should also examine the administration, implementation, and enforcement of regulations in these border regions factors of their low SRB's. As mentioned above, minorities and autonomous regions tend to be characterized by political autonomy. Their governments may have different approaches to the one-child policy, include different regulations, administration, implementation, and enforcement. Obviously, the strength of regulations would not matter without tactful implementation, efficient administration, and strict enforcement. Therefore, in addition to cultural differences, the lower SRB of the border regions may be attributed to their political autonomy. Unfortunately, the results fail to show what specific aspects of political autonomy influence SRB.

5.3 Implications

The national government placed the responsibility of one-child policy in the hands of provincial, municipal, and autonomous governments. The results show that overall, the strength of one-child regulations is not determined by socioeconomic development, but rather cultural and political autonomy. In turn, regulation strength does not affect the sex ratio at birth. Instead, the only determinants for SRB are cultural and political autonomy. Socio-economic development does not have a clear association with SRB.

The high sex ratio at birth is a recently recognized side effect of the one-child policy—an unanticipated yet inevitable consequence of fertility and population control. The realities of an imbalanced society are beginning to appear as the first generation of only-children reaches marriage and childbearing age. Regional governments have been actively revising their family planning regulations to address this problem. Although this cross-sectional examination of provinces, municipalities, and autonomous regions shows that the strength of one-child regulations (as of 2001) are uncorrelated with the SRB, it does not denote that over time, stronger regulations may reduce the SRB. In fact, many of the regions only recently revised their regulations, some as late as 2001—the same time that the rest of the data was taken. Therefore, the data may represent the conditions prior to revision rather than the results of the revisions, and it may take years before the effects of stronger revised regulations appear.

Strong regulations are nevertheless a useful weapon against the rising SRB. Regional governments should utilize policies in family planning programs because patriarchal ideology is slow to change. Son preferences, deeply rooted in Confucian traditions, remain a culprit for the high sex ratio at birth, and without strong policies that prohibit prenatal sex-determined abortions and mis-registration of female babies, seem unlikely to change at a pace necessary to reduce the SRB. Stricter one-child regulations and more strategic combinations of exceptions, rewards, and punishments can effectively discourage prenatal sex-selection procedures and out of plan births, aiding both a reduction in SRB and fertility rates. In addition to regulation strength, administration, implementation, and enforcement are also important aspects. Variations in government investment create differences in both quality and quantity of services, publicity, and

education provided by family planning programs. More strategic investment is likely to help reduce the SRB by educating citizens about the benefits of having daughters, alleviating social pressures to bear sons, increasing awareness of contraceptive options, publicizing the consequences for following and breaking regulations, and enhancing supervision of child-bearing couples. Other researchers (Jie, 2002, Lavely & Freedman, 1990, Zeng et al., 1993) find that the vagueness of regulations and inadequate enforcement allows couples to circumvent the system, especially in bribing doctors to perform prenatal sex determination, and officials to misreport birth registration. Hence, regional governments need not only strong one-child regulations, but also more strategic investment in family planning services, and implementation and enforcement of regulations.

The consequences of a high sex ratio at birth are finally materializing in present day China. The most mainstream concern is the "marriage squeeze" in which cohorts of men outnumber women, creating an unstable society. However, a more prevalent concern is the treatment of women in Chinese society. This study shows that the sex ratio at birth has not improved despite the current wave of economic development and urbanization, and may worsen as the one-child policy continues to emphasize fertility decline and raise the sex ratio. As in traditional Chinese culture, women continue to be seen as inferior to men. Daughters are worth less than sons, given lower quality education and treatment, and become victims of abandonment or sex-selective abortions. Women who bear daughters also turn into victims of their family and society. Fortunately, China has realized the problem of rising SRB, and has since worked to reduce it while containing low fertility rates. Government officials, demographic researchers, and family planning

officials have openly advocated for the advance of women through education[12], condemned the use of ultra-B machines for prenatal sex-determination, and attacked the traditional ideology of male superiority as antiquated and backward[13]. Since the International Conference on Population and Development (ICPD) in 1994, China has installed activities to improvement women's status in society, and to enhance their ability to participate in the market economy. The "Spring Bud Project" helps drop-out girls go back to school; the "Happiness Project" aids impoverished mothers in rural areas; "Women Perform Meritorious Deeds" and "Re-employment Project" help laid-off female workers find jobs, bringing women's roles into full play[14].

The emerging consequences of high sex ratios, along with education against male-superiority, improvements in women's social status, influence from the international community, and strengthening of the one-child policy, offer the possibility that the high sex ratio will be reversed over time.

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[12] "The National Family Planning Program of China, 1995-2000." State Family Planning Commission.

[13] "Notification on Addressing in a Comprehensive Way the Issue of Rising Sex Ratio at Birth, Document #30." 1998. See w*ww.unescap.org/pop/database/law_china/ch_record020.htm*

[14] See Speech by Mr. Zhang Weiqing, Minister in Charge of the State Family Planning Commission of China, at the Population Council, July 2, 1999. See www.unescap.org/pop/database/law_china/ch_record023.htm.

APPENDIX A: REGULATION SCORES

Beijing

Revised 2000

E1	first child is disabled both husband and wife are only children and have only 1 child couple is diagnosed as sterile and becomes pregnant after adopting a child remarried couple and has only 1 child	0
E2	2 or more brothers are rural citizens, with only 1 brother able to bear a child and the other's) do not adopt Border area minorities who have received permission to have a second child from local family planning depts. above the county level and have transferred to work in Beijing Male rural citizen marries a woman who has no brothers and settles down in wife's family and promises in written form to support her parents Rural couple with husband or wife as a 2nd class wounded/disabled soldier or loses basic ability to work Rural citizens who live in remote mountains and whose main source of income is farm production, have only 1 child, and have practical living difficulties.	0
R1	10 RMB/month until only child reaches 19 increase maternal leave for 3 more months, but delay 10 RMB/month reward for 3 years Subsidized childcare and medical fees for child until 18 yrs. Old One time 1000 RMB reward when wife reaches 55 and/or husband reaches 60 Priority in old age social security in rural areas	1
R2	additional 7 days of wedding leave 30 additional days of maternity leave or reward worth 50% of maternal fees private commercial companies decide own rewards for late marriages/births rural/unemployed have village/district government decide awards If in financial difficulty, can reduce community service requirement or receive aid in job search	1
R3	unspecified rewards	0
P1	1000 to 50,000 RMB fine depending on circumstances for having 1st out of plan birth 20,000 to 100,000 RMB fine for having 2nd out of plan birth revocation of rewards and one-child certificate no promotion for 3 years rural couples who are government officials will be dismissed, and social security will be revoked if violated outside Beijing, cannot return to Beijing	1
P2	monthly fees during the whole gestation period, and when gestation period is over, pay other fines out of marriage births under jurisdiction of local government	0
P3	unspecified	0
P4	2000 to 20,000 RMB fine for agencies with out of planned births and unfinished family planning book 200 to 20,000 RMB fine for illegal prenatal sex determination or misreporting of birth punishments according to court	1

Tianjin

Revised 1998

E1	first child is disabled	

	both husband and wife are only children and have only 1 child remarried couple and has only 1 child couple is diagnosed as sterile after 5 years with out a child, and wife becomes pregnant after having adopted a child and reached 35.	0
E2	both parties are returned overseas Chinese or residents of Hong Kong, Macau, or Taiwan who have lived in Tianjin for less than 6 years Ethnic immigrants who have received approval for 2nd birth before moving to Tianjin rural disabled veterans husband marries into rural family with no son and takes care of his parents-in-law rural couple has infertile brothers couples living in mountainous areas short of labor force and having only 1 daughter	0
R1	reward worth 50% of fees until child is 14 rural couples who cannot afford tax can do community service rural couples and children get special care from government agencies that reach their goals may be eligible to be an "advanced agency."	0
R2	7 additional days for wedding leave priority in housing reward equal to 1 month's worth of salary pay 50% of taxes or increase maternity leave by 30 days 7 additional days of paternity leave, may be eligible for more rewards from local government	1
R3	unspecified	0
P1	fines rewards revoked and all fees must be paid by the couple government employees pay 20% of income for 5 year if 1 out of plan birth; 30% or more for 7 years if 2+ out of plan births <500 RMB fine for not registering	0
P2	unspecified	0
P3	unspecified	0
P4	agencies do not get to be "Advanced agencies" fines determined by departments	0

Hebei

Revised 1997

E1	first child is disabled Pregnant after legally adopting a child both parties are only children and have only 1 child remarried couples with 1 child disabled veteran	0
E2	ethnic minority with only 1 child returning overseas Chinese, or Hong Kong, Taiwan, Macau residents with only 1 child mineworkers with 5 years or more underground experience and only 1 daughter farmers who live on plains or hills and have only 1 daughter fishermen who have only 1 daughter husband marries into rural family with no son and has only 1 child special circumstances approved by local government	0
R1	5 RMB/month reward until child reaches 18 additional 30 day maternity leave priority in child care, nursery school, grammar school, hospital, housing, job search, old age care	0
R2	15 days paid wedding leave	1

	45 days paid maternity leave	
R3	unspecified	0
P1	one-time fine per person worth not less than 1 year of salary for government employees, 2.5 times salary for rural couples 2nd out of plan birth increase fines by 50 to 100% fees or illegal adoption no benefits, cannot be named "advanced worker"	1
P2	annual fee worth 2 months of salary	1
P3	unspecified	0
P4	cannot be named "advanced unit" 500 to 10,000 RMB fine for each out of plan birth 500 to 3000 RMB fine for each illegal prenatal sex determination or illegal mis-registration punishments by government	1

Shanxi

Revised 1999

E1	first child is disabled both parties are single children Pregnant after diagnosed as infertile and legally adopting a child remarried couple with only 1 child from previous marriage, with 2 children belonging to one party, or with each party having one child from previous marriage	0
E2	minorities or returned overseas Chinese rural couples with 1 daughter rural couples who have lived in poor outskirts for 7+ years with 1 child husband marries into rural family with no son and has only 1 child rural couple where the husband has infertile brother over 30 years old	0
R1	monthly reward of no less than 10 RMB until child is 16 subsidized education and medical fees for child retirement reward for parents priority in rural subsidies encouragement from government reduced education fees for rural families increased allocation of rural social security priority for rural children in exams old age security when rural mother reaches 40	1
R2	1 month paid wedding leave 4 moths paid maternity leave, 15 days paternity leave if sterilization after birth: 6 months rest vacation rural exemption of community service work	1
R3	one time reward of 1000 to 3000 RMB	1
P1	1st out of plan birth: fine worth 20% of income for 7 years, not less than 5000 RMB 2nd out of plan birth: 40% of income for 14 years, not less than 20,000 RMB fines for illegal adoption positions revoked for government employees rural couples lose allocation of land	0
P2	fine of 1000 to 3000 RMB	1
P3	unspecified	1
P4	2000 to 5000 RMB fine for unit for illegal procedures 5000 to 10,000 RMB fine for unit for mis-registration and altering book figures 500 to 200 RMB fine for not fulfilling family planning goal	1

Inner Mongolia

Revised 1995

E1	first child is disabled legally adopted a child and pregnant after 5 years disabled veteran	1
E2	mineworker for 5+ years and has 1 daughter Mongolian minorities registered farming couples	1
R1	government should provide better services and rewards 5 to 10 RMB/month reward until child reaches 14 20 RMB/month for rural families with 1 daughter, 30 more days maternity leave, and child care subsidies	0
R2	15 days wedding leave 30 days maternity leave, 10 days paternity leave other rewards	0
R3	unspecified	0
P1	regulations and fines subject to multiple of average regional income no government benefits or services for 5 years	1
P2	unspecified	0
P3	unspecified	0
P4	unspecified	0

Liaoning

Revised 1997

E1	first child is disabled remarried couple	1
E2	both live in rural areas, and one is an only child with 1 child both are ethnic minorities, wife is rural farmer, and has 1 child both are farmers and have 1 child both are farmers and one party is ethnic minority and has 1 child rural couples with infertile brother(s)) rural couple where husband marries into wife's son-less family both are islanders and have 1 child	0
R1	10 RMB/month reward until 14 for urban couples, 5 to 10 RMB/month for rural couples care from government for impoverished or retired couples 5 RMB/month retirement reward	0
R2	7 days wedding leave 60 days maternity leave	1
R3	rewards	0
P1	5000 to 50,000 RMB fine for 1st out of plan birth 10,000 to 100,000 RMB fine for 2nd out of plan birth 1000 to 5000 RMB fine for illegal adoption <150,000 RMB fine for 2nd birth for unmarried couples 5% of salary for 1 year or no less than 5000 RMB for government employees	1
P2	1000 to 5000 RMB fine for early childbirth (mother is 20 years or younger) 1000 to 5000 RMB fine for unmarried couples	1
P3	unspecified	0
P4	small fines for not performing required checkups or sterilization procedures in specified period 100 to 500 RMB fine for each out of plan birth revocation of the title "advanced unit" 1000 to 5000 RMB fines for illegal surgical procedures or misreporting	1

Jilin

Revised 1997

E1	first child is disabled couple is diagnosed as infertile, adopts child, then becomes pregnant both parties are only children remarried couples	0
E2	ethnic minorities rural couples with 1 daughter rural couples with one party as only child rural couple where husband marries into wife's family and takes care of her parents rural couple with infertile siblings who do not have children rural disabled veterans remarried couples who work in the farm, stock, or fishery industries and have 1 daughter	0
R1	4 to 8 RMB/month reward until child is 18 years old retirement rewards for parents rural couples get rewards and encouragement priority in hospital, education, etc 50% of maternal care fees paid for by government	0
R2	20 days wedding leave 30 days maternity leave	0
R3	200+ RMB reward	0
P1	one time fine worth 2 to 5 times the average income of the region	1
P2	one time fine worth 1 to 2 times the average income of the region	1
P3	punishments from local government	0
P4	10,000 to 30,000 RMB fine other heavy monetary fines	1

Heilongjiang

Revised 2000

E1	both parties are returned overseas Chinese or Hong Kong, Taiwan, Macau residents both parties are only children remarried couples	1
E2	both parties are farmers with only 1 child or live in remote areas with only 1 child ethnic minorities	1
R1	monthly reward worth no less than 10 RMB until child is 18 years old rural couples receive priority in housing and care priority in hospital and schools 3% increase in social security one time compensation for old age care worth 1 month of salary	1
R2	15 days wedding leave 1 years worth of community service work for rural residents 6 months maternity leave, 5 to 10 days paternity leave	1
R3	one time reward of 300 RMB	0
P1	unspecified	0
P2	unspecified	0
P3	1000 to 3000 RMB fine	1
P4	3000 to 10,000 RMB fine for illegal surgical procedures 500 to 1000 RMB fine for illegal use of family planning's financial resources 1000 to 3000 RMB fine for other misconducts	1

Shanghai

Revised 1997

E1	couple is diagnosed as infertile, adopts child, then becomes pregnant first child is disabled both parties are only children both parties are returned overseas Chinese ethnic immigrants who received approval prior to coming to Shanghai remarried couples	0
E2	rural disabled veteran fishermen rural couple where husband marries into wife's family, takes care of her parents, and has 1 child	1
R1	unspecified monthly reward until child is 16 subsidized child care housing subsidy for urban residents land allocation for rural residents retirement benefits priority in employment reduce taxes and other fees by 50%	1
R2	1 week wedding leave 15 days maternity leave, 3 days paternity leave	0
R3	unspecified	0
P1	no subsidies for maternal or child care unpaid maternity leave other fees revocation of one-child certificate and benefits 1st out of plan birth fine with 3 times average income of region 2nd out of plan birth: 4 to 6 times average income of region no additional allocation of land or housing additional punishments by local government	1
P2	unspecified	0
P3	unspecified punishment by local government and court	0
P4	unspecified punishment by local government and court	0

Jiangsu

Revised 1997

E1	first child is disabled disabled veteran with one child remarried couples one party is a returned overseas Chinese or lived in Hong Kong, Taiwan, or Macau and has 1 child one party is the 2nd generation of only child, or both parties are only children and they have 1 child couple has brother(s)) who are infertile and they have 1 child husband marries into wife's family who has no sons	0
E2	miners couples who live in remote areas and have 1 daughter fishermen	1
R1	no less than 40 RMB/year reward until child is 14 priority in hospital, maternity care, school, employment, housing, and other benefits 50% of fees paid for if both parents work, 100% of fees paid for if only 1 spouse works	0

	50% increase in retirement reward, but no more than salary	
R2	7 days wedding leave 15 to 30 days maternity leave, 3 to 7 days paternity leave exemption from community service work	0
R3	unspecified reward	0
P1	revocation of one-child certificate and all benefits 1st out of plan birth: fine worth 3 times the salary of each spouse from the previous year 2nd out of plan birth: fine worth 4 to 6 times salary of each spouse from previous year punishments from local government	1
P2	fine worth salary of each spouse from previous year	1
P3	unspecified	0
P4	500 to 2000 fine for misreporting 5000 to 10,000 RMB fine for illegal use of prenatal sex determination procedures and abortions punishments according to local governments	1

Zhejiang

Revised 1995

E1	first child is disabled both parties are only children and have 1 child diagnosed as infertile and gets pregnant after adopting a child remarried couples	0
E2	miners rural couples with one party as second generation only child rural couple where wife has only sisters and husband lives with the wife to take care of her parents fishermen rural couples with one party as government official	0
R1	100 RMB/year reward until child is 14 unspecified rewards, encouragement, and care from government qualified for increase in rural old age social security qualify for housing and land allocation	0
R2	12 days wedding leave	0
R3	unspecified rewards	0
P1	fine worth 20 to 50% of husband and wife's combined salary for 5 years higher fines for more out of plan births	1
P2	fine worth 10 to 50% of husband and wife's combined salary until legal period has been reached and registration complete	1
P3	unspecified	0
P4	2000 to 10,000 RMB fine per individual involved in prenatal sex determination procedures and abortions 2001 to 10,000 RMB fine per unit for prenatal sex determination procedures and abortions title of "Advanced unity" revoked 500 to 10,000 RMB fine for other misconducts punishments by government and court	1

Anhui

Revised 1995

E1	first child is disabled both parties are only children	

	has an adopted child and wife become pregnant after age 35 siblings of couple will not have or adopt children disabled veteran remarried couples	0
E2	miners with 1 daughter ethnic minorities returned overseas Chinese rural couples where husband marries into wife's family rural couple with one party as only child Wife from the rural Dashan district and has 1 daughter	0
R1	5 RMB/month for son, 6 RMB/month for daughter until age 14 50% of child care fees paid for priority in hospital, school, employment special care from government 5% increase in pension	1
R2	20 days wedding leave 30 days maternity leave exemption from community service work for 1 year	1
R3	unspecified rewards and encouragement	0
P1	1000 RMB fine for first out of plan birth fine worth 10% of combined monthly salary for 7 years for 2nd out of plan birth fine worth 15% of combined monthly salary for 14 years for 2nd out of plan birth demotion at workplace no benefits at workplace	0
P2	fine worth 10% of combined monthly salary for 1st out of plan birth fine worth 20% of combined monthly salary for 2nd out of plan birth 500 to 3000 RMB fine for other unregistered activities	0
P3	unspecified	0
P4	3000 to 10,000 RMB fine for responsible individual punishments from government and court	1

Fujian

Revised 1997

E1	both parties are only children first child is disabled pregnant after diagnosed as infertile and adopting a child one party is martyr's offspring disabled veteran remarried couples one party belongs to 2nd generation of only children husband marries into wife's family, takes care of her son-less parents husband's brother(s)) are infertile returned overseas Chinese	0
E2	Couples living in remote areas miners ethnic minorities	1
R1	4 to 5 RMB/month reward until child is 14, or <400 RMB one time reward rewards from local governments priority in hospital, school, employment, housing, etc. qualified for social security increased pension special encouragement for women headed households	1

R2	wedding leave 15 days 130 to 180 days maternity leave	1
R3	unspecified	0
P1	fine worth 200 to 300% of pervious year's combined salary for first out of plan child fine worth 400 to 600% of previous year's combined salary for 2nd out of plan child ten years with no oil rationing confiscation of land	1
P2	fine worth 60 to 100% of previous year's combined salary no promotion or benefits at workplace if government employee	1
P3	unspecified	0
P4	cannot be titled "Advanced Unit" for the year 1000 to 5000 RMB fine for responsible individual	1

Jiangxi

Revised 1997

E1	both parties are only children and have 1 daughter only child died only child is disabled disabled veteran with 1 daughter remarried couple	0
E2	miners ethnic minorities returned overseas Chinese rural couples with 2 daughter husband marries into wife's family and takes care of her son-less parents husband has infertile brothers	0
R1	unspecified monthly reward priority and subsidies in hospital, schooling, employment, and housing	0
R2	15 days wedding leave 30 days maternity leave, 7 days paternity leave	0
R3	unspecified	0
P1	fine worth 10 to 20% of annual income for 10 years 5 years of no benefits or promotions at work revocation of rewards and one-child certificate rural couples cannot be employed by government or receive benefits for 5 years	1
P2	all fees paid by couple, revocation of one-child certificate and rewards	0
P3	unspecified	0
P4	punishments from government and court, no more than 30,000 RMB	0

Shandong

Revised 1998

E1	both are only children first child is disabled pregnant after diagnosed with infertility and having adopted a child offspring of martyr disabled veteran with 1 daughter	0
E2	miner fishermen ethnic minorities rural couple where husband marries into wife's family and takes care of her son-less parents rural couples with infertile siblings	0

	rural couples who live on the islands of Shandong farming households headed by wife and daughter returned overseas Chinese	
R1	no less than 10 RMB/month reward until child is 14 rewards and encouragement from local government government employees increase 5% of retirement benefits priority in hospital, schooling, employment, urban housing, land allocation	1
R2	2 weeks wedding leave 2 months maternity leave	1
R3	unspecified rewards	0
P1	500 to 1000 RMB fine for 1st out of plan birth 1000 to 2000 RMB fine for 2nd out of plan birth 3000 to 10,000 RMB fine for 3rd out of plan birth revocation of rewards and one-child certificate no promotions or benefits at work for 5 years	0
P2	unspecified	0
P3	punishments from government and court	0
P4	500 to 3000 RMB fine punishments from government and court	0

Henan

Revised 2000

E1	first child is disabled pregnant after diagnosed as disabled and adopted a child disabled veteran remarried couples	0
E2	returned overseas Chinese miners rural couples with 1 daughter and one parent is disabled rural couple where husband marries into the wife's family and takes care of her son-less parents inhabitants of remote areas ethnic minorities	0
R1	unspecified rewards and encouragement	0
R2	unspecified	0
R3	unspecified	0
P1	unspecified	0
P2	unspecified	0
P3	unspecified	0
P4	unspecified	0

Hubei

Revised 1997

E1	first child is disabled pregnant after adopting child	1
E2	returned overseas Chinese rural couple both 2nd generation only children men marrying into wife's rural household rural disabled veteran rural and disabled rural and only 1 daughter	0

R1	8 RMB/month reward until child is 14 priority in land allocation and housing, hospital, schooling, employment, medical care additional rewards for rural citizens from local government	0
R2	15 days wedding leave 30 days maternity leave	0
R3	unspecified	0
P1	revocation of one-child certificate and awards monthly fine worth 20% of monthly salary for 5 years no promotions, bonuses, or benefits at work government employees pay fine worth 30 to 60% of annual income for 5 years	1
P2	monthly fine of 15 to 30 RMB until one year anniversary of legal period is reached	0
P3	unspecified	0
P4	punishments from government and court	0

Hunan

Revised 1999

E1	first child is disabled pregnant after legal adoption both are only children	1
E2	returned overseas Chinese rural couples with one spouse as only child rural couple with one spouse as the offspring of a martyr or disabled veteran rural couple where husband has infertile brother(s)) rural couples with one spouse as government employee and other as farmer ethnic minorities	0
R1	no less than 5 RMB/month reward until child is 14 priority in maternal care, hospital, schooling, employment, 5% increase in old age benefits	1
R2	12 days wedding leave 30 days maternity leave	0
R3	unspecified rewards from government	0
P1	revocation of one-child certificate and rewards 500 to 3000 RMB fine government employees fined 200% of previous year's salary or 5000 RMB if salary is less than 5000 RMB 2nd out of plan child: fees increase 1/5 to 2% and fines worth 200 to 600% of salary	1
P2	50 RMB fine for qualified but approved second child 500 to 1000 RMB fine for early births	1
P3	unspecified	0
P4	2000 to 5000 RMB per out of plan child 500 to 3000 RMB fine for illegal prenatal sex determination procedures or misreporting	1

Guangdong

Revised 1998

E1	first child is disabled remarried couples childless for 5+ years after marriage and pregnant after adoption both are only children	0
E2	ethnic minorities both are farmers, and have 1 daughter miners	0

	fishermen	
R1	10 RMB/month reward until child is 14 priority in hospital, employment, schooling, housing 35 additional day of maternity leave, 10 days of paternity leave. 5% increase in retirement benefits	1
R2	10 days wedding leave 15 days maternity leave	0
R3	unspecified	0
P1	1st out of plan birth: fine worth 30 to 50% of previous year's combined income for 7 years 7 years of no medical benefits	1
P2	fine worth 30 to 50% of previous year's combined income for 1 to 3 years	1
P3	unspecified	0
P4	punishment from government and court 1000 to 3000 RMB fine	0

Guangxi Zhuang Autonomous Region

Revised 1994

E1	disabled veteran both are only children one spouse is the offspring of a martyr	1
E2	ethnic minorities rural couples with 1 daughter rural couple where husband marries into wife's family rural couple with infertile siblings	0
R1	increase maternity leave by 20 days unspecified benefits 5% increase in retirement benefits Priority in hospital, schooling, employment, housing	1
R2	12 days wedding leave 14 days maternity leave	0
R3	10% increase in retirement benefits additional benefits	1
P1	revocation of one-child certificate and rewards 2000 to 50,000 RMB fine punishments from government and workplace no benefits or promotions at work for 7 years	1
P2	500 to 2000 RMB fine for 1st out of plan child 1000 to 30,000 RMB fine for 2nd out of plan child	1
P3	unspecified	0
P4	1000 to 5000 RMB fine by individual punishments from government and court	0

Hainan

Revised 1995

E1	first child is disabled remarried couple pregnant after diagnosed as infertile and adopted a child both are only children	0
E2	ethnic minorities can have 2, 3 under special circumstances	0
R1	20 to 30 RMB/month reward until child is 14 priority in hospital, schooling, employment	

	6 months maternity leave 5% increase in old age benefits 10 to 20% increase in salary for government employees	1
R2	unspecified	0
R3	unspecified rewards and encouragement	0
P1	urban fine worth 100% of combined monthly salary for first out of plan child urban fine worth 200 to 300% of combined monthly salary for 2nd out of plan child rural fine worth 100% of region's average monthly salary for 1st out of plan child for rural fine worth 200 to 300% of region's average monthly salary for 2nd out of plan child government employees no benefits or promotions for 3 years	1
P2	500 RMB monthly fine until legal period is reached	1
P3	unspecified	0
P4	fine worth 10 to 20% of unit's revenues punishments from government and court	1

Chongqing Municipality

Revised 1998

E1	first child is disabled both are only children remarried pregnant after being infertile for many years and ;legally adopting a child	0
E2	rural couple where husband marries into wife's family rural couple where one spouse is the only child of a martyr rural disabled veteran rural and disabled rural couple with infertile brother(s)) rural couple where one spouse is 2nd generation only child rural remarried couple with one widow and one childless spouse Dashan district inhabitants with 1 daughter returned overseas Chinese	0
R1	5 to 10 RMB/month reward until child is 14 priority and subsidy in hospital, school, employment, housing, rural old age care 5% increase in old age benefit	1
R2	10 days wedding leave 20 days maternity leave	0
R3	unspecified reward	0
P1	first out of plan child: fine worth 200 to 300% of previous combined annual income, or 300 to 500% of average income of region, not less than 3000 RMB revocation of one-child certificate and rewards	1
P2	100 RMB fine	0
P3	unspecified	0
P4	2000 to 6000 RMB fine for district department 1000 to 5000 RMB fine for unit 300 to 1000 RMB fine for individuals punishments from government and court	1

Sichuan

Revised 1997

E1	first child is disabled both are only children	0

	pregnant after being infertile and legally adopting a child remarried couples	
E2	returned overseas Chinese rural couple where one spouse is only child of a martyr rural disabled veteran rural couple with infertile brother(s)) rural couple where one spouse is 2nd generation only child inhabitants of certain mountainous areas and have only 1 daughter rural couple where husband marries into wife's family	0
R1	5 to 10 RMB/month reward until child is 14 priority in health and medical care rewards from government	0
R2	10 days wedding leave 20 days maternity leave	0
R3	unspecified	0
P1	one time fine worth 20 to 30% of 7 years salary, no less than 2000 RMB for first out of plan birth fines and fees revocation of one-child certificate and rewards	0
P2	30 to 50 RMB fine until legal period is reached for early births 300 RMB fine for qualified but unregistered birth	0
P3	unspecified	0
P4	fine worth 5 to 10 times illegal income or 1000 to 2000 RMB punishment from government and court	1

Guizhou

Revised 1998

E1	first child is disabled both are only children pregnant after 5 years of infertility after marriage and legally adoption a child remarried	0
E2	rural couple with 1 daughter ethnic minorities rural couple where husband marries into wife's family	1
R1	one time reward of 100 to 500 RMB and monthly reward of no less than 5 RMB until child is 14 priority in schooling, employment, and healthcare retirement benefits 90 additional days maternity leave	1
R2	10 days wedding leave 30 days maternity leave	0
R3	500 RMB reward	1
P1	farmers and urban citizens: fine worth 200 to 500% of average regional income private corporation employees: fine worth 400 to 1000% of regional average income revocation of one-child certificate and rewards	1
P2	fine worth 30% of monthly income until legal period is reached 2 years of no promotions or benefits	1
P3	unspecified	0
P4	fine worth 30% of unit's annual revenue 1000 to 5000 RMB fine for illegal prenatal sex determination or related abortions 200 to 5000 RMB fine for illegal procedures	1

Yunnan

Revised 1997

E1	first child is disabled pregnant after diagnosed as infertile and legally adopting a child both are only children disabled veteran	0
E2	rural couples with proven need for 2nd child returned overseas Chinese ethnic minorities	1
R1	5 to 10 RMB/month reward until child is 14 priority in hospital, school, employment 5% increase in retirement benefits	1
R2	15 days wedding leave 15 days maternity leave	0
R3	unspecified rewards	0
P1	both husband and wife demoted 2 status levels at work fine worth 30 to 40% of income for 7 years unpaid maternity leave revocation of one-child certificate and rewards no additional allocation of land no benefits no titles for 7 years	1
P2	unspecified penalties	0
P3	unspecified	0
P4	200 to 3000 RMB fine for unit punishments from government and court	0

Tibet (Xizang) Autonomous Region

Revised 1992

E1	first child is disabled both are only children pregnant after infertile for 5+ years after marriage and legally adopting a child disabled veteran remarried	0
E2	Han government official marrying an ethnic minority minorities working in outskirts	1
R1	50 RMB per couple 5 RMB/month reward until child is 14 priority in hospital, schooling, employment 15 RMB subsidies in child care and nursery school, maternal care 1 year maternity leave, 6 months before and 6 months after birth, paid 65% salary grain and oil stipend	1
R2	1 week wedding leave	0
R3	unspecified rewards	0
P1	revocation of one-child certificate and rewards 3000 RMB fine, sterilization, and unpaid hospital stay for first out of plan birth, Han couples 5000 RMB fine, 6 years no promotion or benefits at work for 2nd out of plan birth, Han couples 300 RMB fine, 2 years no promotion or benefits at work for 1st out of plan birth, minorities 600 RMB fine, 3 years no promotion or benefits at work for 2nd out of plan birth, minorities 300 RMB fine for all urban couples	1

	500 RMB fine for 1st out of plan birth, 2 years of no promotions or benefits for non-Han cadres 1000 RMB fine for 2nd out of plan birth, 3 years of no promotions or benefits for non-Han cadres sterilization	
P2	150 RMB fine for 1st time 500 RMB fine for 2nd time 50% of income in month of birth for illegal marriage age, no benefits or rewards	1
P3	unspecified	0
P4	punishments from government and court	0

Shaanxi

Revised 1997

E1	first child is disabled pregnant after 5 years of infertility and legally adopting a child both are only children remarried couples	0
E2	ethnic minorities returned overseas Chinese rural couples where husband marries into wife's family rural couple with one disabled spouse rural couples who live in remote mountainous areas rural couples with only 1 daughter and family has legitimate needs for another child	0
R1	no less than 5 RMB/month reward until child is 14 priority in industries exemption from 10 years of community service work for rural couples 30 additional days maternity leave increased retirement benefits	1
R2	20 days wedding leave 15 days maternity leave	0
R3	200 to 1000 RMB reward, 5 % increase in retirement benefits	1
P1	20 to 30% of income for 7 years for 1st out of plan birth 30 to 40% of income for 14 years for 2nd out of plan birth no promotions or benefits for 5 years revocation of one-child certificate and rewards	1
P2	no less than 1000 RMB fine 50 to 100 RMB/month fine until abortion if conceived without registration	1
P3	unspecified	0
P4	2000 to 5000 RMB fine for individuals involved punishments from government and court 5000 to 10,000 RMB fine for the unit illegal prenatal sex determination procedures and abortions, no promotions or benefits for unit for 3 years	1

Gansu

Revised 1997

E1	first child is disabled pregnant after diagnosed as infertile for 5 years and legally adopting a child remarried couples disabled veteran	0

E2	returned overseas Chinese rural couple with 1 daughter rural ethnic minorities rural couples where men marry into wife's family and takes care of her son-less parents	0
R1	5 RMB/month reward until child is 14 priority in housing, schooling, maternity care, child care, employment rewards and encouragement from government increase maternity leave by 50 days, paternity leave by 5 days 2 years exemption from rural community service work	0
R2	100 days maternity leave	1
R3	unspecified	0
P1	fines worth no less than 30% of combined annual income for 7 years for 1st out of plan birth fines worth no less than 40% of combined annual income for 14 years for 2nd out of plan birth no benefits or promotions for 7 years for government workers no welfare benefits and no relocation for 5 to 7 years for rural citizens revocation of one-child certificate and rewards	1
P2	unspecified	0
P3	unspecified	0
P4	200 to 3000 RMB fine for individuals	0

Qinghai

Revised 1992

E1	first child is disabled pregnant after diagnosed as infertile and adopts child both party are only children disabled veteran remarried disabled spouse	0
E2	rural ethnic minorities returned overseas Chinese ethnic minority herders (3 children)	0
R1	7 RMB/month reward until child is 14 free nursery school and child medical fees until 7 years old 60% of child healthcare fees paid for until age 14 priority in housing, school, employment	1
R2	15 days wedding leave 15 days maternity leave	0
R3	unspecified	0
P1	revocation of one-child certificate and rewards 1000 to 1500 RMB one time fine fine worth 25% of combined income for 7 years; if one spouse rural or unemployed pay 30 to 50% for 7 years; if both parties unemployed/rural pay 500 to 800 RMB fine cannot be government official if rural resident	1
P2	300 to 500 RMB fine no benefits for 1 year	1
P3	unspecified	0
P4	3 years without rewards or promotions punishment from government and court	0

Ningxia Hui Autonomous Region

Revised 1991

E1	both are only children pregnant after diagnosed as infertile and legally adopted a child remarried	1
E2	ethnic minorities returned overseas Chinese miners some ethnic minorities can have 3 farming couple with 2 disabled children southern mountain area residents	0
R1	8 RMB/month reward until child is 14 40 additional days maternity leave, 10 additional days paternity leave exemption from 2 years of community service work priority in hospital, schooling, employment, housing, social security, land allocation, and government encouragement rewards from government	0
R2	15 days wedding leave 14 days maternity leave	0
R3	unspecified	0
P1	fine worth 1o to 30% of monthly income until child is 14 5 years of no promotions and benefits, cannot move into larger house sterilization 7 years of non-government employment revocation of one-child certificate and rewards	1
P2	unspecified punishments from government and court	0
P3	unspecified	0
P4	criticism from government cannot be titled "Advanced unit" for 2 years punishments from government and court	0

Xinjiang Uygur Autonomous Region

Revised 2003

E1	disabled veteran pregnant after being infertile and adopting 1 (Han) or 2 (minority) children both are only children one spouse is only child of martyr first child is disabled remarried couples	0
E2	miners special exemptions for remarried ethnic minorities	1
R1	10 RMB/month reward until child is 16 5% increase in retirement benefits or one time 2000 RMB reward exemption from 1 year of community service work rewards from government	1
R2	20 days wedding leave 30 days maternity leave, 15 days paternity leave	0
R3	unspecified	0
P1	fine worth 100 to 800% of local average income revocation of one-child certificate and rewards	1
P2	fined according to average local income	1
P3	unspecified	0
P4	10,000 to 30,000 RMB fine punishments from government and court	

	complicated system of monetary fines cannot be titled "advanced unit" for two years or receive benefits	1

APPENDIX B: FACTOR REDUCTION

Three methods were tried to reduce the number of explanatory variables: forward inclusion, backward deletion, and principal components analysis. After performing all three approaches, PCA is finally selected for the 2SLS model. The reasons are as follows. First, the forward inclusion approach for the SRB regression yields area as the only explanatory variable. Based on my literature review, son preferences are the main reason for high SRB's, and the area of a region does not logically cause or correlate son preferences. Furthermore, the R-square is 0.151, which means that only 15% of the total sample variation of the SRB is explained by area. The forward inclusion regression for regulation strength is likewise inconclusive. Only area and %highschool are included as explanatory variables. Although previous studies found education for women highly influential to fertility, the low R-square value of 0.298 shows that these two variables are insufficient in explaining either SRB or regulation strength. Also, there is a statistically significant correlation of –0.526 between area and %highschool, which indicates bias in the regression.

The backward deletion approach also has the problem of bias due to high correlations between variables. When regressing SRB with the backward deletion method, %minority and distance to Beijing are the two explanatory variables. Although R-square is higher this time—0.48—the correlation between explanatory variables is also higher—0.614. The regulation strength regression yields %agriculture, area, and municipality as the three explanatory variables, with R-square equal to 0.361. The

correlation between %agriculture and area is 0.206. The results from the forward inclusion and backward deletion methods are displayed in Table 12; the correlations between variables are listed in Table 13.

The PCA approach eliminates the bias problem by collapsing all the explanatory variables into uncorrelated principle components. In a first run of the PCA method, all

Table 12: Best Regression—Forward Inclusion & Backward Deletion

	Dependent Variable			
	SRB		Regulation Rating	
	Forward	Backward	Forward	Backward
Explanatory Variables	area	%minority km to Beijing	area %highschool	%agriculture area municipality
R	0.388	0.718	0.546	0.601
R-Square	0.151	0.515	0.298	0.361
Sum of Squares	489.585	1673.89	5.765	6.988
df	1	2	2	3
Mean Square	489.585	836.945	2.495	2.329
F	5.148	14.892	4.292	5.086
Sig.	0.031	0	0.047	0.006

explanatory variables are included, in addition to dummy variables for geographical locations: North, Northeast, East, Central South, Southwest, and Northwest. The PCA yielded six principle components, which is still too many for a sample size of 31. I

Table 13: Correlations Between Variables

(2-Tailed Sig.)

	SRB	Missing girls	%urban	%agri-culture	%minority	density	age65	gdppc	%high-school	%college	km to Beijing	area	Auto. Region	Muni-cipality
	1	0.782	-0.062	0.188	-0.543	0.108	0.214	-0.027	0.324	-0.178	0.037	-0.388	-0.328	-0.106
SRB	(.)	0	-0.371	-0.155	-0.001	-0.282	-0.123	-0.443	-0.038	-0.169	-0.422	-0.015	-0.036	-0.286
		1	-0.243	0.335	-0.376	0.065	0.106	-0.142	0.152	-0.312	-0.003	-0.188	-0.218	-0.263
Missing Girls		(.)	-0.187	-0.065	-0.037	-0.727	-0.571	-0.447	-0.414	-0.088	-0.987	-0.312	-0.239	-0.152
			1	-0.938	-0.364	0.659	0.603	0.908	0.586	0.818	-0.399	-0.264	-0.221	0.67
%urban			(.)	0	-0.096	0	-0.005	0	0	0	-0.006	-0.133	-0.287	0
				1	0.241	-0.61	-0.453	-0.835	-0.571	-0.889	0.448	0.206	0.105	-0.667
%agriculture				(.)	-0.096	0	-0.005	0	0	0	-0.006	-0.133	-0.287	0
					1	-0.357	-0.472	-0.316	-0.578	-0.183	0.614	0.737	0.708	-0.208
%minority					(.)	-0.024	-0.004	-0.042	0	-0.162	0	0	0	-0.13
						1	0.831	0.858	0.336	0.486	-0.264	-0.185	-0.235	0.585
density						(.)	0	0	-0.032	-0.003	-0.076	-0.16	-0.102	0
							1	0.774	0.371	0.363	-0.232	-0.208	-0.34	0.562
age65							(.)	0	-0.02	-0.022	-0.104	-0.13	-0.031	0
								1	0.453	0.743	-0.3	-0.15	-0.218	0.684
gdppc								(.)	-0.005	0	-0.051	-0.21	-0.12	0
									1	0.483	-0.443	-0.526	-0.241	0.287
%highschool									(.)	-0.003	-0.006	-0.001	-0.096	-0.059
										1	-0.468	-0.173	-0.087	0.713
%college										(.)	-0.004	-0.176	-0.321	0
											1	0.441	0.325	-0.3
km to Beijing											(.)	-0.006	-0.037	-0.051
												1	0.455	-0.11
area												(.)	-0.005	-0.279
													1	-0.169
autonomous region													(.)	-0.182
														1
municipality														(.)

eliminated the geographic location variables since their effects can be covered by the other explanatory variables.

The second run of the PCA resulted in three principle components that was ultimately used in the two-stage least squares model.

APPENDIX C: CORRELATIONS WITHIN REGULATIONS

I examined the correlations between the policy strength sub-scores to determine the combination of regulations authorities used to balance the two goals of fertility and SRB reduction. Table 14 shows the correlation matrix.

Table 14: Correlation Matrix for One-Child Regulations

				Pearson Correlation 2-Tailed Significance					
	E1	E2	R1	R2	R3	P1	P2	P3	P4
E1	1.000	-0.237	0.166	0.043	-0.022	-0.107	0.095	-0.338	0.130
	.	0.200	0.371	0.820	0.905	0.566	0.613	0.063	0.486
E2	-0.237	1.000	-0.195	0.115	0.169	-0.237	-0.249	0.080	-0.045
	0.200	.	0.293	0.538	0.364	0.200	0.177	0.669	0.808
R1	0.166	-0.195	1.000	0.027	0.327	0.010	0.224	0.155	0.148
	0.371	0.293	.	0.885	0.072	0.957	0.226	0.405	0.426
R2	0.043	0.115	0.027	1.000	-0.060	**-0.453**	-0.160	0.265	0.210
	0.820	0.538	0.885	.	0.749	**0.011**	0.389	0.150	0.256
R3	-0.022	0.169	0.327	-0.060	1.000	-0.022	**0.373**	-0.070	0.156
	0.905	0.364	0.072	0.749	.	0.905	**0.039**	0.707	0.402
P1	-0.107	-0.237	0.010	**-0.453**	-0.022	1.000	**0.403**	-0.338	-0.025
	0.566	0.200	0.957	**0.011**	0.905	.	**0.024**	0.063	0.894
P2	0.095	-0.249	0.224	-0.160	**0.373**	**0.403**	1.000	-0.189	**0.418**
	0.613	0.177	0.226	0.389	**0.039**	**0.024**	.	0.310	**0.019**
P3	-0.338	0.080	0.155	0.265	-0.070	-0.338	-0.189	1.000	0.166
	0.063	0.669	0.405	0.150	0.707	0.063	0.310	.	0.373
P4	0.130	-0.045	0.148	0.210	0.156	-0.025	**0.418**	0.166	1.000
	0.486	0.808	0.426	0.256	0.402	0.894	**0.019**	0.373	.

Evidently, there is statistically significant correlation between the following: P1 and R2, P2 and R3, P2 and P1, and P2 and P4. The correlations suggest that laxer penalty for exceeding the one-child rule is associated with higher rewards for late

marriage and late birth; weaker penalties for early births are associated with higher rewards for voluntary refrain from having more than 1 child; harsher penalties for out of plan birth are associated with harsher penalties for early births; and harsher penalties for early births are associated with harsher penalties for officials. These findings seem to indicate that in general, rewards and punishments do not work together to reduce fertility, and that strong penalties overall are used to control both fertility and SRB.

I had expected stronger scores for P3 and P4 to be positively correlated with stronger scores for E1 and E2, since punishments for sex-selection and exceptions for the one-child rule both attempt to alleviate the high SRB by quelling son preferences. I also expected more exceptions to be positively correlated with R3, with rewards for voluntary refrain from having more than one child countering the increased number of people who can have more than 1 child. The results prove that both my hypotheses were incorrect. The regulations do not appear to have strategic combinations of exemptions, rewards, and penalties to achieve both the goals of fertility and SRB reduction. Rather, either penalties or rewards are the main utility for both goals.

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