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The Impact of the One-Child Policy on Child-Wellbeing and Gender Differential

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Abstract

Although there has been much research on how the One-Child policy affected population growth in China, little is known about how attempts to restrict childbearing have affected Chinese families in other ways. This paper addresses this issue by presenting evidence from the China Health and Nutrition Survey. CHNS is a three-year panel data with detailed information on the One-Child policy variations in 190 communities from 1989 to 1993. This paper explores the relationship between the One-Child policy and the well-being of Chinese children by studying nutritional intakes and anthropometric measures of Chinese children. Of particular interest is how the one-child policy affected intra-household distribution between genders. The results indicate that the one-child policy improved Chinese children' health status in general. However, the majority of the benefits went to boys in families with children of both sexes. Two significant factors that mitigate the gender discrimination are household income and maternal education.

Introduction

When China's one-child policy was implemented in 1979, it set a stringent limit on the number of children each couple could have. Ever since its establishment, this policy has stirred a huge controversy and prompted numerous studies on how it affected China's fertility level. However, little is known about how attempts to restrict childbearing have affected Chinese families in other ways. One stated purpose of the one-child policy, as expressed by Chinese government, was to improve the health of the population in China. Therefore, it would be of interest to know whether or not this purpose has been achieved.

The one-child policy could potentially affect the well-being of Chinese children through fertility reduction. The policy artificially increased the price of quantity of children. Assuming that parents derive utility from quantity of children along with quality of children, it is reasonable to expect that the one-child policy improved children's well-being (quality of children) because parents would substitute quantity for quality (in terms of health) of children in reaction to this price increase. This substitution effect therefore indicates a positive relationship between the one-child policy and well-being of Chinese children.

In addition to the general impact on all children, the relative well-being of male and female children could be potentially affected when quantity of children in a family decreased. The values that parents place on each child of both genders could vary significantly based on their birth orders.[i] There are evidences that discrimination against girls is concentrated in the higher birth orders. Especially in China, although there is a strong son preference culture, daughters are not totally undesirable. Most Chinese families want to have a daughter in addition to a son.[ii] Therefore, if there are a smaller number of girls in a family (most likely one under the policy), girls could be treated as well as their male siblings. Combining these impacts, both boys and girls should benefit from the one-child policy, while the girls in China are in a position to benefit more.

However, the above impact of the one-child policy on children's well-being through fertility reduction is confounded by the selective nature of this fertility reduction. First, supposing that the inherent healthiness is heterogeneous in a population, fertility reduction could potentially alter the distribution of inherent healthiness of the population. Fertility reduction resulted from the one-child policy is not uniform across the subpopulations. If the one-child policy leads to more reduction of better endowed children, then there is negative birth selection. Otherwise, there is positive birth selection. As demonstrated later in this paper, changes in the inherent healthiness of the population could inflate or deflate the relationship between the one-child policy and well-being of children through the quantity-quality tradeoff. Second, fertility decline resulted from the one-child policy is not gender neutral. In respond to the stringent one-child policy, the strong son preference culture in China manifests itself in a highly skewed sex ratio of newborn children. This strong form of prenatal sex discrimination make many potentially discriminated girls disappear altogether. Therefore, observed positive relationship between girls' consumption and the one-child policy may simply be the result that only more valued girls are born and observed in the sample.

Reduced form estimates based on the existing population of children would therefore demand a careful interpretation. A positive relationship would indicate that surviving children are better off in places with strong policy than ones with weak policy, instead of a straight forward causal relationship linking the one-child policy and the well-being of children in general. However, this is not to say that these results are not important. Increased sex ratio has caused speculation about tradeoff between prenatal sex selection and postnatal sex-discrimination. An appealing hypothesis out of this is that prenatal sex selection would help reduce or even eliminate the postnatal sex discrimination. Estimates based on the sex-selected population of children would provide a test to this hypothesis. Given the sex-selected sample, would we still detect sex discrimination?

However, to derive any inference on the quantity and quality tradeoff along with the intensity of son preference based on birth orders would require estimates controlling for the selection process generating the non-random sample of children.

This paper explores the relationship between the one-child policy and the well-being of Chinese children by studying nutritional intakes and anthropometric measures of Chinese children. The following questions are addressed: First, what is the impact of the one-child policy on the health status of Chinese children? Answers to this question would provide evidence to the quantity–quality tradeoff theory of fertility. Second, how did the one-child policy affect the intra-household allocation in China? Specifically, did the decrease in family size help improve girls' well-being? Third, as a result of prenatal selection, how do surviving girls fare compared to their male counterpart? Did the prenatal discrimination substitute for postnatal discrimination?

I estimate individual-level reduced form demand relations for nutritional intakes and anthropometric measures for all children, thus permitting estimates of the role of the one-child policy and socioeconomic variables on the well being of

Chinese children in general. In addition, separate individual-level reduced form demand relations for boys and girls are estimated to detect gender differences. Furthermore, I estimate household fixed effect models using children with siblings to analyze intra-household distribution characteristics of Chinese families, exploring how the one-child policy and socioeconomic variables affect the gender differential controlling for unobserved household and community characteristics.

The results show that the one-child policy improved Chinese children' health status in general. Parents apparently substituted child quality for child quantity. However, the majority of the benefits went to boys instead of girls in families with children of both sexes. Therefore, prenatal discrimination did not completely eliminate postnatal discrimination. Two significant factors that mitigate the gender discrimination are household income and maternal education.

In addition to inferences on the one-child policy, the paper also serves to present evidence on the determinants of children's nutritional status. Mother's education and other variables are analyzed.

This paper is organized as follows: The first section reviews the literature. Section two describes the data. Section three presents the theoretical and empirical models. Section four presents results. Section five concludes.

Literature and background

Various aspects of fertility reduction, children's well-being and gender bias related to this paper have already been examined both theoretically and empirically in the research literature. Researchers have been interested in understanding the underlying forces of the rising sex ratio phenomenon (Das Gupta and Bhat [1997]), the potential consequences of this phenomenon on the welfare of female children (Goodkind [1996], Davies and Zhang [1997]), specifically how the one-child policy affected Chinese children (Short et al [2001], Poston and Falbo [1990]). Below we review each paper in detail.

Das Gupta and Bhat [1997] examined two forces underlying the phenomenon of increased sex ratio at birth in son preference cultures experiencing fertility decline. They labeled these forces as "Intensification Effect" and "Parity Effect", respectively. A "Parity Effect" leads to less gender bias. Differential treatments of girls are usually concentrated in higher parities. Smaller family size reduces parental ability to discriminate against higher order birth girls. An "Intensification Effect" contributes to more gender bias. It happens when a family's desire for a number of children declines more quickly than their desire for a number of sons. Because parents have fewer boys due to smaller family size, gender differential could increase as a result. The increased sex ratio of newborn children indicates that an "Intensification effect" outweighs a "Parity effect".

Goodkind [1996] examined the hypothesis that prenatal sex discrimination substitutes for postnatal sex discrimination by studying the relationship between trends in sex ratios at births and trends in the sex ratios of infant and early childhood deaths in East Asian countries which have strong son preference cultures. He found evidence to support his hypothesis in some of the countries. However, China was an exception--prenatal and postnatal sex discrimination both increased, which Goodkind attributed to the pressure created by the one-child policy. However, early childhood mortality can be seen as a continuation of prenatal sex discrimination. Families that do not successfully practice prenatal sex discrimination, resort to negligence during their children's early childhood to accomplish their desired sex ratio. What would be more interesting to know would be whether parents discriminate against those girls who actually managed to survive the sex selection process.

Davies and Zhang [1997] theoretically explored the substitution hypothesis between prenatal and postnatal sex discrimination by analyzing the influence of endogenizing gender on female consumption. By employing a specific functional form, they demonstrated that girls' consumption could be the same as that of their brothers if gender control were practiced. Therefore, in theory, prenatal discrimination could completely eliminate postnatal discrimination.

Short et al [2001] examined the impact of the one-child policy on the welfare of Chinese children, as well as that of gender bias. Their findings indicate that children with fewer siblings are more likely to receive care from both parents. The influence is more obvious for boys. In addition, girls who live in communities where couples are allowed to have a second child if their first is a girl are more likely to receive care from parents than girls living in other communities (those only allowing one child or allowing two children regardless of gender). In contrast, boys appear to be universally welcomed regardless of policy. The latter result is rather curious. The authors tried to explain this curiosity away by arguing that though the policy itself is born of son preference, it may serve to equalize the value of the girls and boys, rather than to reinforce girls' disadvantages. However, their results are likely to be biased since number and sex of children are included as explanatory variables. Those variables are endogenous ones that are jointly determined along with childcare choice variables.

Poston and Falbo [1990] studied the scholastic and personality characteristics of only children and children with siblings in Changchun, Jilin province in China. They found that only children performed significantly better than children with siblings on academic measures, however, they scored similarly on personality ratings. Also, girls were found to perform better in academics, as well as having higher personality ratings. However, their results are also potentially biased because they used only child as an explanatory variable, along with parental expectation.

Theoretical model

The theoretical model in this paper is based on the quantity-quality model of fertility, with an extension on sex selection. In China, since gender preference manifests itself in terms of skewed sex ratio at birth, sex becomes a choice variable instead of an exogenous variable. This paper models quantity and quality tradeoff with explicit sex selection following the tradition of Davies and Zhang (1997). The departure point between this model and theirs is that a more general functional form is employed. Davies and Zhang (1997) employed Cobb-Douglas function as their functional form. This model employs the CES function. The choices of different functional forms turn out to be essential on different theoretical predictions on the substitution hypothesis.

Assume parents' utility takes the following form:

$$U = C\{(aQ_s^r + bQ_d^r)^{\frac{1}{rs}} + (dN_s^g + hN_d^g)^{\frac{1}{gs}}\}^s \qquad (1)$$

Where

C: Parental consumption

Q_s: Quality of sons

Q_d: Quality of daughters

N_s: Number of sons

N_d: Number of daughters

α, β, δ, γ: Preference parameters

ρ,γ,σ: Substitution parameters

Define

$$\{(aQ_s^r + bQ_d^r)^{\frac{1}{rs}} + (dN_s^g + hN_d^g)^{\frac{1}{gs}}\} = M$$

$$(aQ_s^r + bQ_d^r)^{\frac{1}{r}} = Q \qquad (dN_s^g + hN_d^g)^{\frac{1}{g}} = N$$

We have

$$U = C(Q^{\frac{1}{s}} + N^{\frac{1}{s}})^s = M^s$$

Parents derive utility from their own consumption and children. Children are described by a two level CES utility function. On the first level, parental utility depends on not only the number of children they have but also the quality of children they have. Q and N are quality and quantity of children, respectively. Substitution parameter σ determines the tradeoff between them. On the second level, quality and quantity of children depend on, respectively, quality of sons and daughters, and quantity of sons and daughters. Substitution parameters ρ determine tradeoffs between quality of sons and daughters. Substitution parameter γ determines tradeoffs between quantity of sons and daughters. Parental son preference can be defined by setting a >β and $d > h$.

Parents face the budget constraint

$$A = p(Q_s N_s + Q_d N_d) + P_n(N_s + N_d) + P_q(Q_s + Q_d) + P_c C \quad (2)$$

Where

P_c: Price of parental consumption

P_n: Price related to quantity of children, independent of quality of children

P_q: Price related to quality of children, independent of quantity of children

p : Price related to both quality of children and quantity of children

A: Family resources

FOCs are

$$C: \quad M = lP_c$$

$$Q_s: \quad CM^{(s-1)}Q^{(\frac{1}{s}-1)}aQ_s^{(r-1)} = l(P_q + pN_s)$$

$$Q_d: \quad CM^{(s-1)}Q^{(\frac{1}{s}-1)}bQ_d^{(r-1)} = l(P_q + pN_d)$$

$$N_s: \quad CM^{(s-1)}N^{(\frac{1}{s}-1)}dN_s^{(g-1)} = l(P_n + pQ_s)$$

$$N_d: \quad CM^{(s-1)}N^{(\frac{1}{s}-1)}hN_d^{(g-1)} = l(P_n + pQ_d)$$

First order conditions imply that

$$\frac{a}{b}\left(\frac{Q_s}{Q_d}\right)^{r-1} = \frac{P_q + pN_s}{P_q + pN_d}$$

$$\frac{d}{h}\left(\frac{N_s}{N_d}\right)^{g-1} = \frac{P_n + pQ_s}{P_n + pQ_d}$$

This model does not have a closed form solution. Therefore, we cannot solve for explicit N_s, N_d, Q_s and Q_d. However, by assuming relative magnitude of N_s and N_d, we can get the relative magnitude of Q_s and Q_d. Table one is a summary of those derivations. It lists three possible scenarios, which are sufficient to illustrate the argument of this paper.

Q / N	$r=1$ (Perfect substitute)	$r=0.5$	$r=0$ (Cobb Douglas)
$g=1$ (Perfect substitute)	$N_s > N_d$ $Q_s > Qd$	$Q_s > Q_d$	$Q_s > Q_d$
$g=0.5$	$N_s > N_d$	$(N_s > N_d)$ or $(N_s <= N_d$ & $Q_s > Q_d)$	$(N_s > N_d)$ or $(N_s <= N_d$ & $Q_s > Q_d)$
$g=0$ (Cobb Douglas)	$N_s > N_d$	$(N_s > N_d)$ or $(N_s <= N_d$ & $Q_s > Q_d)$	$(N_s > N_d)$ or $(N_s <= N_d$ & $Q_s > Q_d)$

When both r and g are equal to one, parents treat dN_s and hN_d as perfect substitutes as well as aQ_s and bQ_d. If $a > \beta$ and $d > h$, parents have more sons than daughters, and better quality sons than daughters. However, this is the only case that we get such a clear-cut scenario.

Consider the case where r and g are equal to zero. There are two scenarios. First, if a family has fewer sons than daughters, it will invest more quality in sons. However, this scenario is not very realistic if sex is a choice variable. If parents have perfect control over their children's sex and they prefer boys, it is not likely that they will have more girls than boys. Empirically, we also observe most of the time, N_s is greater than N_d. However, when $N_s > N_d$, we cannot be sure whether Q_s is greater than, equal to or smaller than Q_d. The relationship between Q_s and Q_d depend on the relative magnitudes of δ and γ, and N_s and N_d. Knowledge of son preference alone is not sufficient enough to determine that Q_s is greater than Q_d.

The theoretical model therefore does not give a definite prediction on how parents would act if they have both daughters and sons given the presence of son preference and sex selectivity behavior.

Empirical models

This paper estimates the reduced form demand relations for individual nutrient intake and health status as a function of the one-child policy, household characteristics, individual endowment and environmental factors. These reduced form relations are consistent with the constrained maximization of a unified household preference function or with the household bargaining framework.

The reduced form equations are

$$(N,H)_{ihc} = a_i + b_h + c_c + b_1 x_{ihc} + b_2 x_{hc} + b_3 x_c + m_{ihc} \qquad (3)$$

where

N	Nutrient intakes
H	Health status
i	ith individual in a household
h	A household within a community
c	A community
x_{ihc}	Individual characteristics of a child: age, sex, and birth order
x_{hc}	Household characteristics: mother's education, household income, water source, sanitary conditions
x_c	Community characteristics: one-child policy, stratum, provinces
a,b,c	Unobserved individual, household, and village specific fixed effects, respectively
m	Disturbance term

Equation (1) implicitly assumes that all individuals within a household respond identically to changes in income or other household and community characteristics. Since we are interested in gender differential, we allow the coefficients of the reduced form equation to vary across gender groups. Therefore, equation (1) is estimated separately for boys and girls.

$$(N,H)^{d}_{ihc} = \quad a^{d}_{i} + b^{d}_{h} + c^{d}_{c} + b^{d}_{1}\ x_{ihc} + b^{d}_{2}\ x_{hc} + b^{d}_{3}\ x_{c} + m_{ihc} \qquad (4)$$

where d represents either boys or girls.

The individual fixed effects include genetic endowments that may vary across members of a family, such as immunity to certain diseases and metabolic rates. These genetic endowments are likely to be correlated with family income. The household fixed effects include cooking and cleaning habits, which is also correlated with the household income level and mothers' education level. Community fixed effects include the quality of health facilities and climatic characteristics. Due to the fact that communities with a stricter one-child policy often have higher development, it is very likely that the quality of health facilities is correlated with the strength of the one-child policy.

The reduced form estimates would be biased if the omitted variables in the reduced form equations were correlated with other explanatory variables. Therefore, it is reasonable to believe that we are omitting variables that are correlated with the right hand side variables. Therefore, we will turn to a household level fixed effect model in the next section.

So, in this section we investigate gender bias with a household level fixed effect model. This is the model:

$$(N,H)_{ihc} - \overline{(N,H)_{hc}} = \qquad (5)$$
$$(a_i - a_j) + b_1(x_{ihc} - \overline{x_{hc}}) + b_2\ x_{hc}(x_{ihc} - \overline{x_{hc}}) + b_3\ x_c(x_{ihc} - \overline{x_{hc}}) + m_{ihc} - \overline{m_{hc}}$$

where $(N,H)_{ihc}$ refers to the nutritional and health status of the ith child in family h in community c. The variables with horizontal bars on top of them represent the mean values of children in that family. Both the household and the community fixed effect dropped out. The individual fixed effect does not drop out. However, it does not pose any harm to the coefficients as long as the individual endowments are randomly distributed. This functional form enables us to get rid of both the household fixed effect and the community fixed effect. Because those two effects are why the cross-sectional results are possibly biased, the household fixed effect model will attain unbiased results.

The difference between siblings in the same household is determined by their individual characteristics, such as birth order, age and gender. In addition, it is hypothesized that the effects of these individual characteristics could be modified by the household and community level variables. Therefore, interaction terms between individual characteristics and household and community level variables are included.

Data

I have used the China Health and Nutrition Survey (CHNS) for my analysis. This survey was conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill, along with the Institute of Nutrition and Food Hygiene, and the Chinese Academy of Preventive Medicine. Data was collected in 1989, 1991, and 1993. As well, the survey used a multistage, random cluster process. 190 communities were chosen from eight provinces which vary substantially in geography, economic development, public resources, and health indicators. In total, it drew a sample from about 3800 households with a total of 16,000 individuals. The

CHNS has multiple components. This paper uses information from the following surveys: household, nutrition, physical examination, community and ever-married women.

I consider the CHNS to be an excellent data source for studying the effects of the one-child policy on Chinese families.[iii] First of all, detailed policy information was collected from 167 communities. Usually, detailed information on the one-child policy has been only collected and studied within a very limited area, perhaps 5 villages. The CHNS enables us to conduct studies with rich information on local practices of the one-child policy.

Second, policy information was collected for both rural and urban communities. One third of the communities are urban communities. This will be the first paper to ever evaluate the effects of the one-child policy on urban residents.

Third, the CHNS is a panel data. This means that it records the changes in the population policy over a period of several years. Compared to cross-sectional data, its representation of the population policy is more reliable since population policies in China change quite often as indicated by the literature, and by data from the CHNS. An index incorporating a longer period of information collecting is more representative than a single year observation when characterizing the general policy.

Finally, instead of just studying a single dimension of policy, the CHNS provides information on multiple dimensions of this policy. It gives monetary fines for birth above quota, subsidies for one child families, conditions under which the policy can be relaxed and enforcement indicators.

Three consecutive days worth of detailed household food consumption information was collected. The number of household members and visitors was recorded at each meal. Household food consumption was determined by examining changes in inventory from the beginning to the end of each day, in combination with a weighing and measuring technique. All processed foods (including edible oils and salt) remaining after the last meal prior to the initiation of the survey were weighed and recorded. As well, all purchases, home production, and processed snack foods were recorded. Whenever foods were brought into the household unit, they were weighed, and that preparation waste (e.g., spoiled rice, discarded cooked meals fed to pets or animals) was estimated when weighing was not possible. At the end of the survey, all remaining foods were again weighed and recorded. Because wastage was measured, the information gathered consists of nutritional intakes, rather than nutritional availability. This distinction is very important in nutrition intake literature[iv].

In addition, individual dietary intake for 3 consecutive days was collected for every household member, regardless of age or relationship to the household head. Individual dietary intake for the same 3 consecutive days was surveyed. This was achieved by asking individuals each day to report all food consumed away from home on a 24-hour recall basis, and the same daily interview was used to collect at-home individual consumption.

The collection of both household and individual dietary intake made it possible to check the quality of data collection by comparing the two. Thus, each individual's average daily dietary intake (calculated from the household survey), was compared with his or her dietary intake based on the 24-hour recall data. Where significant discrepancies were found, the household and the individual in question were revisited and again asked about their food consumption in order to resolve these discrepancies.

The nutrition information used in this study is based on data calculated by the CHNS staff. Average daily calorie intake (kcal), protein intake (gram), fat intake (gram) and percentage fat intake are all calculated based on a three-day average. Calorie intake represents the basic energy intake for a person. It is the most commonly used measures for nutrition intake in developing countries because food security is a common problem in those countries. Protein intake and fat intake are less commonly used and indicate more the taste and non-caloric aspects of nutrition intakes than basic caloric energy. Percentage fat intake measures the percentage of energy coming from fat intake. It is an indicator of how "expensive" the diet is, instead of how 'adequate' the diet is.

Besides nutrition information, individuals were also given physical exams each year to collect physical information. Children' health status is represented by height for age. Height for age is considered by nutritionists to be an indicator of longer run health status and welfare (Waterlow et al. [1977], Martorell and Habicht [1986]). Height was converted into a standardized height-for-age z score using the ANTHRO program provided by Center for Disease Control and Prevention. The z scores indicate the number of standard deviations that a reference child is below or above the NCHS mean for his/her height[v].

I have restricted the sample to include children 6 years old and younger only. That is because the nutrition intakes and health status of such young children best suits the purpose of this study. First, their activity levels are not likely to vary much due to their young age. Second, their physical development is similar, i.e., there is no significant gender difference in terms of both nutrition requirement and physical development. The first two factors determine that their needs do not differ as much as adults' do. Third, they mainly receive things from adults. Few of them can yet act aggressively on their own behalf so their nutrient intakes are completely due to parental allocation. Last but not least, they were born after 1982. They are the only generation that was born under the influence of the one-child policy.

Another benefit of employing those young children's data is the ability to avoid the endogeneity problem most analyses face when analyzing adults' nutrition. Because children's nutrition has no impact on household income, household income is not an endogenous variable in this analysis.

Despite the effort to ensure accuracy by the survey staff, some data seems to be highly implausible. The following procedures were used to get rid of extreme values. A standardized calorie intake value was constructed by regressing daily calorie intake on children's age, age square, age cubic and age quadruple. Then a ratio was constructed by dividing the children's actual calorie intakes with the standardized measure. If the actual intakes are 2 times more than the standard consumption or less than 25 percent of the standard consumption, they are deemed unreliable and deleted. 62 out of 3035 observations (2 percent) were deleted according to this procedure. If the calorie intakes were deemed unreliable, other nutrient information was discarded as well. Standardized nutrition intakes are used as dependent variables. Unreliable values for height for age were detected and discarded based on the standards recommended by the ANTHRO program[vi].

In total, information on 920 girls and 1129 boys was available for nutrient intake variables. There were 907 girls and 1140 boys for height for age z scores. The sample statistics is shown in table one. These simple tabulations show that only children do much better than children with siblings, in terms of fat intake and height for age z scores. The average values of height for age z scores for children with siblings are between -1.3 to -1.5 for boys and girls respectively, indicating that a sizable proportion of children with siblings are mildly malnourished. Gender difference is most prominent in terms of height for age z scores when girls with siblings are compared to boys with siblings. The difference between the two averages is statistically significant.

Table one. Nutritional intakes and anthropometric measures of Chinese Children

	All	Boys			Girls		
		All	Only boys	Boys with siblings	All	Only girls	Girls with siblings
Daily calorie intake (kcal)	1304.74	1319.67	1300.55	1331.37	1287.37	1236.65	1327.74
Daily protein intake (g)	40.43	41.24	42.08	40.50	39.48	39.61	39.93
Daily fat intake (g)	36.10	36.53	42.31	31.58	35.59	39.71	33.10
Daily percentage fat intake	24.85	25.06	28.47	21.88	24.61	27.86	22.39
Age (months)	48.41	48.35	47.51	50.09	48.36	46.35	50.99
Height for age z scores	-1.19	-1.15	-0.73	-1.34	-1.23	-0.71	-1.45

Table two: statistics for height for age

	All		Boys		Girls	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Fine for extra child (log)	7.63	0.74	7.65	0.75	7.62	0.73
Two children allowed	0.29	0.45	0.30	0.46	0.27	0.44
Second child allowed if first is a girl	0.39	0.49	0.35	0.48	0.43	0.50
Mother's age	30.56	3.88	30.64	3.77	30.46	4.03
Mother's education: primary	0.21	0.40	0.20	0.40	0.21	0.41
Mother's education: Junior high	0.41	0.49	0.41	0.49	0.42	0.49
Mother's education: Senior high & above	0.20	0.40	0.21	0.41	0.19	0.39
Mother's height	156.04	5.17	156.47	5.24	155.51	5.04
Household registration type (1 if rural)	0.75	0.43	0.73	0.44	0.77	0.42
Household income (log)	6.70	1.20	6.72	1.17	6.67	1.24
Faucet water	0.18	0.39	0.17	0.38	0.20	0.40
Ground water	0.47	0.50	0.47	0.50	0.47	0.50
Non-sanitary environment	1.82	0.64	1.83	0.64	1.81	0.64
City	0.08	0.27	0.09	0.28	0.07	0.25
Town	0.16	0.36	0.17	0.38	0.13	0.34
Suburb	0.13	0.33	0.11	0.32	0.14	0.35
LiaoNing	0.09	0.29	0.09	0.29	0.09	0.29
JiangSu	0.13	0.34	0.15	0.36	0.11	0.31
ShanDong	0.06	0.24	0.06	0.23	0.07	0.25
HeNan	0.17	0.37	0.16	0.37	0.18	0.38
HuBei	0.21	0.41	0.20	0.40	0.22	0.41
HuNan	0.13	0.34	0.13	0.33	0.13	0.34
GuangXi	0.15	0.35	0.16	0.37	0.13	0.33

Table three: statistics for nutrition intakes

	All		Boys		Girls	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Fine for extra child (log)	7.62	0.72	7.64	0.73	7.59	0.71
Two children allowed	0.30	0.46	0.30	0.46	0.30	0.46
Second child allowed if first is a girl	0.38	0.49	0.36	0.48	0.41	0.49
Mother's age	30.83	3.86	30.94	3.80	30.70	3.92
Mother's education: primary	0.19	0.39	0.18	0.39	0.19	0.39
Mother's education: Junior high	0.42	0.49	0.43	0.50	0.41	0.49
Mother's education: Senior high & above	0.21	0.41	0.22	0.41	0.20	0.40
Mother's height	156.06	5.18	156.43	5.29	155.62	5.01
Household registration type (1 if rural)	0.75	0.43	0.74	0.44	0.77	0.42
Household income (log)	6.71	1.23	6.75	1.19	6.65	1.27
Faucet water	0.18	0.39	0.18	0.38	0.19	0.40
Ground water	0.48	0.50	0.48	0.50	0.48	0.50
Non-sanitary environment	1.81	0.65	1.82	0.65	1.80	0.64
City	0.08	0.27	0.09	0.28	0.07	0.25
Town	0.15	0.36	0.17	0.38	0.13	0.34
Suburb	0.13	0.34	0.12	0.33	0.15	0.36
LiaoNing	0.09	0.29	0.09	0.29	0.10	0.30
JiangSu	0.12	0.32	0.13	0.34	0.10	0.30
ShanDong	0.09	0.29	0.09	0.29	0.09	0.29
HeNan	0.14	0.35	0.14	0.34	0.15	0.36
HuBei	0.21	0.41	0.20	0.40	0.23	0.42
HuNan	0.12	0.33	0.12	0.33	0.13	0.33
GuangXi	0.16	0.36	0.18	0.38	0.13	0.34

Dependent Variables:

Nutritional intake and anthropometric measures have been used extensively to document children's well-being and gender bias.

Chen et al (1981) shows that for children aged 0 to 4 in Bangladesh, the male to female ratio of caloric intake is 1.16, and that of protein intake is 1.14. Garcia and Pinstrup-Anderson (1987) report that boys receive significantly more calories than girls.

Das Gupta (1987) shows that for 0 to 4 year old children in India, both males and females are given roughly the same caloric intake. However, while girls are given more cereal, boys are given more milk and fats, which are more valued and more nutritious.

Behrman and Deolailikar (1988b) found that the response of the nutrients to price changes differs significantly among types of individuals, with smaller adjustments in the nutrients intake of girls in response to changes in the basic staples price, and larger adjustments in the nutrient intakes of girls in response to other changes. Female children are made to accept the greater nutritional burden of adjustment to unfavorable price movements (and by the same token, receive the greater nutritional bonus in response to favorable price changes), while the other family members' nutrients consumption is allowed to fluctuate much less.

Although both measures are used as a representation of children's well-being, they are not exactly the same. Nutrient intakes are better measures than anthropometric measures in terms of being indicators of intra-household distribution. Parents decide how much each child consumes. Anthropometric measures, on the other hand, are determined by many other factors. They are determined by household allocation on other health inputs, for example, medical care provided to each child when ill. Other than household allocation inputs, anthropometric measures are also determined by genetic endowments and environmental factors.

One-child policy variables

One-child policy variables in general are expected to have a positive impact on the nutritional intake and anthropometric measures, through household size reduction. It is also hypothesized that the one-child policy would reduce gender differential by improving girls' consumption more than boys' consumption.

The one-child policy variables[vii] included in this study are "Fines for extra children", "Whether two children are allowed" and "Whether a second child is allowed if the first is a girl". The "Fines for extra children" is taken from average values over the three-year period. The other two variables take on values that represent the most lenient policy available during that same period.

Due to the competing nature of theories and evidence, we don't have a priori on the signs of the one-child policy variables in terms of gender differentials.

Mother's education

Mother plays a central role in food preparation and child rearing. Therefore, mother is regarded as the most important health worker in the family. Mother's performance of these tasks may depend on how educated she is—the more her education, the more informed she is of nutrition needs for optimum health.

Therefore, mother's education is expected to improve children's nutrition intake and health status.

The results of mother's education on nutrient intakes are quite mixed. Some studies report that mother's education has no impact on nutrient intakes at all (Sirilaksana [1982 and 1986], Ward and Sander [1980] and Behrman and Deolalikar [1990], Garcia and Pinstrup-Anderson [1987]). Other studies report positive effects on nutrient intakes (Valenzuela [1978], Behrman and Wolfe [1987a 1989] and Wolfe and Behrman [1987, 1991]).

Similarly, several studies have shown the importance of mother's education in improving the anthropometric measures of children (Deolailikar in Kenya [1996], Strauss in Cote d'Ivoire [1990], Barrera in Philippines [1990], Handa in Jamaica [1999]. All used height for age as a measure of child health), although others found no significance at all (Garcia and Pinstrup-Anderson [1987]).

Besides the general impact, mother's education could also indicate gender differences in parental preference in resource allocation towards their children. Mother's education can influence one gender in particular, and therefore increase or decrease gender bias. Bhuiya et al. [1986] reported a significant positive impact of mother's education on boys', but not on girl's, health in Matlab, Bangladesh. Thomas [1994] found that mother's education strongly impacts daughters' height in the United States and Brazil.

Mother's education is represented by dummy variables indicating whether the mother has completed primary school, junior high school or senior high school and above. The base category is illiterate.

Household income

Despite numerous studies, there is little agreement on the impact of household income on calorie intakes (Strauss and Thomas [1995]). Conventional wisdom states that low nutrient intakes are a consequence of low incomes. When income rises, nutrient intakes are going to increase correspondingly. However, many studies have challenged this view by demonstrating that income elasticity of demand for calorie is essentially zero. As income rises, households only purchase additional taste and non-calorie nutrients.

The impact of household income on health status is weak. Most studies show that income has no impact on health status (Barrera [1990], Behrman and Wolfe [1986], Wolfe and Behrman [1987], Thomas, Strauss and Henriques [1990]).

However, the source of income does seem to matter in terms of gender bias. Thomas [1994] reports that, in Brazil, women's non-labor income has a positive impact on the health of her daughter but not on that of her son.

The income measure in this study has been adjusted for the household equivalence scale. Children are assumed to consume only half as many resources as adults do.

Genetic background and environmental factors

Children's height not only depends on socioeconomic conditions, but also on genetic endowments. Exclusion of the individual genetic endowment in cross-sectional OLS estimates could lead to biased results. An often-used variable to control for individual genetic endowment is mother's height (Thomas, Strauss and Henriques [1990], Strauss [1990] and Horton [1988]). This study also uses mother's height as a control for genetic background. Mother's height is expected to increase children's height.

Households differ in physical environment. Two factors are controlled for household environment, water source and sanitary conditions. The water source is represented by the dummy variables indicating tap water, underground water or other. The sanitary conditions are represented by a continuous variable with a higher value signifying not sanitary.

Other variables

Single year age dummies represent children's age, allowing for age non-linearity. The literature suggests that children's age matters for height for age z scores. Younger children from developing countries are better off than their older siblings against the NCHS standards. Age is not included in the nutrition intake equations because nutrition intakes are standardized based on this sample, instead of standards from the U.S. or some other source.

Household registration type could affect children's nutritional intake due to differential benefits available to households with different registration types. People with urban registrations are guaranteed a fixed amount of food allocation, while people with rural registrations are not. It follows that children with rural registrations are expected to have lower nutrition intakes and health status.

Provincial variables could affect both children's nutrition intake and their health status in several ways. These variables may affect nutrition intakes because of different eating habits in different localities. They may also affect nutrition intakes for girls, due to differences in son preference. Furthermore, they may be important determinants in children's height. It is generally believed in China that northerners are taller than southerners.

Stratum variables are also included in the analysis, indicating whether people live in a city, suburb, town or village.

Individual level cross-sectional results

Table four to eight present results on the reduced form demand equations for nutrient intakes and height for age z score. Each equation is estimated for the entire sample and for girls and boys separately. The results for girls and boys sample are quite different. Therefore, the following discussion focuses on the two different samples instead of the entire sample.

On nutrient intakes

Monetary fine for above-quota children significantly improved boys' protein intake, fat intake and percentage fat intake. It had no significant impact on girls' nutrient intake levels, even though the direction was positive. In addition, in communities where a second child was allowed if the first was a girl, boys had less fat than ones in communities where only one child was allowed.

Mother's education increased fat intake and percentage fat intakes for girls for every level of education relative to illiterate. The impact of mother's education on boy's nutrition intake was much weaker. Still, boys consumed significantly percentage fat intake if their mothers have at least junior high degree.

Contrary to conventional wisdom, income had no influence on children's calorie intake. Nor did it increase protein intake. However, it did increase the fat intake and percentage fat intake for both boys and girls. In terms of nutritional intake, income did not seem to have a differential impact.

On height for age z score

The results on the height for age z scores are quite different from the nutrient intakes. Monetary fine for above-quota children was positively correlated with girls' heights, but not boys. Contrary to the hypothesis, both "Two children allowed" and "Second child allowed if the second child is a girl" were positively correlated with girls' heights, although only at 10 percent of significance. Mother' education had no influence on height for age z scores for either gender. Household income shows a clear differential impact on gender. It was significantly positively correlated with girls' height, but not boys' heights. Children's endowment was important in predicting children's height. Mother's height improved both girls and boys' height by similar magnitude. Environmental factors, water source and sanitary environment did not appear to have impact on children's height. Children's age has a significant impact on how well it does compared to the NCHS means. Children aged 0 and 2 have significantly higher height for age z score than older children. Child aged 1 are not significantly different from older children probably due to the weaning effect.

Discussion

The individual level regressions yielded some interesting results. First, the one-child policy did not have a differential impact on boys and girls' basic energy intakes. However, it had different impacts on their protein, fat and percentage fat intakes. Male's consumption of those nutrients was significantly and positively correlated with “Fine for extra child”. Although girls’ consumption were also positively correlated with “Fine for extra child”, the coefficients were not significant. Those results provide the evidence that the one-child policy improved Chinese children’s wellbeing by increased resources. However, those extra resources mainly benefited boys. Boys were treated better in areas where one-child policy was the toughest. Part of the reasons that girls are not really discriminated against in terms of calorie is because Chinese on average had an adequate per capita calorie intake back in the early 1990s (Johnson [1994]). Since there was no basic food shortage, girls were not discriminated against. Instead, they were discriminated against in terms of non-caloric and more nutritious food.

Second, although mother’s education benefited boys and girls’ fat consumption, mother’s education had a more positive impact on girls’ consumption. This could be due to several reasons. Mothers with higher education are likely to have lower or no son preference. Compared with less educated mothers, they would treat their daughters better. In addition, mothers with higher education are likely to have a higher bargaining power in the family so that she can allocate more foods to daughters.

Third, household income had no influence on basic energy intakes, while it had a significant impact on tasty and non-caloric food. Both boys and girls benefited from higher household income equally. However, household income improved girls’ height more significantly. This result could be due to two reasons. It could be that the health production of boys and girls are different. Girls may react to nutrition more than boys. Or it could be due to other factors associated with income. Household with higher income likely treated their daughters equally in terms of not only nutritional intake but also health services. Suppose households with lower income treat their daughters and sons unequally for health services, household income will make a difference on girls' height.

Based on the comparison between nutrient intakes and health status, we can see that nutrition intakes do not translate into health status proportionately. Nutrient intake is just one of the inputs in the health production functions. Although both the one-child policy and the income variables did not increase girls' nutrition intake directly, they improved girls' height significantly. Similar for boys, the extra intakes of nutrients did not improve their heights either.

Table four: Daily calorie intake

	All	Female	Male
Fine for extra child	0.013	0.009	0.021
	(0.018)	(0.020)	(0.021)
Two children allowed	-0.027	-0.004	-0.046
	(0.029)	(0.033)	(0.041)
Second child allowed if first is a girl	-0.035	-0.031	-0.039
	(0.027)	(0.033)	(0.037)
Mother's education: Primary	-0.052**	-0.046	-0.065*
	(0.025)	(0.035)	(0.038)
Mother's education: Junior high	-0.037*	-0.050	-0.028
	(0.023)	(0.032)	(0.033)
Mother's education: Senior high & above	-0.062**	-0.060	-0.063*
	(0.028)	(0.042)	(0.037)
Mother's height	0.003*	0.002	0.003
	(0.001)	(0.002)	(0.002)
Household registration type (1 if rural)	-0.018	-0.034	-0.005
	(0.028)	(0.036)	(0.037)
Household Income	0.006	0.009	0.002
	(0.007)	(0.008)	(0.010)
Faucet Water	-0.038	-0.004	-0.062*
	(0.029)	(0.036)	(0.035)
Underground water	0.009	0.011	0.010
	(0.020)	(0.025)	(0.028)
Non-Sanitary environment	0.002	0.005	-0.002
	(0.018)	(0.021)	(0.022)
City	0.004	-0.058	0.043
	(0.045)	(0.052)	(0.057)
Town	0.038	0.034	0.041
	(0.041)	(0.053)	(0.041)
Suburb	-0.012	0.031	-0.053
	(0.028)	(0.036)	(0.032)
Observations	2049	920	1129
R-squared	0.04	0.06	0.05
Standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			
Controlled variables: mother's age and provincial variables			

Table five: Daily protein intake

	All	Female	Male
Fine for extra child	4.076*	3.291	5.295**
	(2.071)	(2.351)	(2.366)
Two children allowed	2.461	4.222	0.891
	(3.117)	(3.915)	(4.411)
Second child allowed if first is a girl	-0.739	-1.316	-0.393
	(3.294)	(3.791)	(4.343)
Mother's education: Primary	-2.784	-5.036	-1.857
	(3.044)	(4.070)	(4.062)
Mother's education: Junior high	-0.307	-3.479	1.782
	(2.622)	(3.601)	(3.709)
Mother's education: Senior high & above	-0.065	0.384	-1.032
	(3.533)	(4.936)	(4.691)
Mother’s height	0.451**	0.196	0.541**
	(0.188)	(0.264)	(0.242)
Household registration type (1 if rural)	-2.305	-3.296	-1.925
	(3.753)	(4.364)	(5.067)
Household Income	0.442	1.234	-0.709
	(0.843)	(0.964)	(1.176)
Faucet Water	2.399	7.774	-0.615
	(4.047)	(4.939)	(4.417)
Underground water	3.413	5.130*	2.361
	(2.417)	(2.875)	(3.088)
Non-Sanitary environment	-2.625	-2.739	-2.909
	(2.032)	(2.376)	(2.446)
City	4.325	-6.339	10.822
	(5.857)	(6.941)	(7.124)
Town	8.258*	4.845	10.207**
	(4.551)	(5.796)	(4.647)
Suburb	0.053	6.583	-6.432
	(3.441)	(4.223)	(4.393)
Observations	2049	920	1129
R-squared	0.06	0.07	0.07
Standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			
Controlled variables: mother’s age and provincial variables			

Table six: Daily fat intake

	All	Female	Male
Fine for extra child	7.565**	4.412	11.050***
	(3.231)	(4.267)	(3.591)
Two children allowed	-3.214	6.450	-10.676
	(6.835)	(7.634)	(8.517)
Second child allowed if first is a girl	-11.525*	-4.689	-17.044**
	(6.376)	(6.735)	(8.448)
Mother's education: Primary	7.091	14.018**	0.623
	(4.362)	(6.957)	(5.735)
Mother's education: Junior high	12.727***	18.435***	9.130
	(4.420)	(6.602)	(5.800)
Mother's education: Senior high & above	11.742**	19.530**	5.318
	(5.477)	(7.962)	(6.681)
Mother’s height	0.665**	0.876*	0.484*
	(0.284)	(0.488)	(0.280)
Household registration type (1 if rural)	-7.632	-8.250	-7.292
	(5.919)	(6.215)	(8.031)
Household Income	6.552***	6.483***	6.534***
	(1.364)	(1.662)	(1.633)
Faucet Water	-4.664	5.926	-14.146**
	(6.299)	(8.081)	(6.456)
Underground water	4.406	8.962**	-0.767
	(3.523)	(4.519)	(4.467)
Non-Sanitary environment	-7.251**	-4.750	-9.645***
	(3.214)	(4.672)	(3.431)
City	27.697***	20.788*	31.931***
	(9.199)	(10.932)	(10.976)
Town	15.666**	15.567	15.825*
	(7.756)	(10.225)	(8.137)
Suburb	14.999**	21.944***	6.787
	(5.911)	(6.812)	(6.737)
Observations	2049	920	1129
R-squared	0.22	0.19	0.26
Standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			
Controlled variables: mother’s age and provincial variables			

Table seven: Daily percentage fat intake

	All	Female	Male
Fine for extra child	0.068**	0.040	0.097***
	(0.027)	(0.036)	(0.028)
Two children allowed	0.010	0.095	-0.050
	(0.053)	(0.069)	(0.060)
Second child allowed if first is a girl	-0.060	-0.004	-0.100*
	(0.047)	(0.058)	(0.057)
Mother's education: Primary	0.102***	0.154***	0.058
	(0.037)	(0.054)	(0.043)
Mother's education: Junior high	0.156***	0.209***	0.124***
	(0.036)	(0.051)	(0.043)
Mother's education: Senior high & above	0.158***	0.221***	0.107**
	(0.040)	(0.052)	(0.052)
Mother’s height	0.003	0.007**	0.001
	(0.002)	(0.003)	(0.002)
Household registration type (1 if rural)	-0.060	-0.062	-0.057
	(0.044)	(0.053)	(0.056)
Household Income	0.059***	0.057***	0.062***
	(0.010)	(0.012)	(0.012)
Faucet Water	-0.007	0.064	-0.071
	(0.048)	(0.061)	(0.053)
Underground water	0.028	0.060	-0.010
	(0.032)	(0.040)	(0.035)
Non-Sanitary environment	-0.077***	-0.064*	-0.093***
	(0.026)	(0.038)	(0.027)
City	0.249***	0.232***	0.261***
	(0.065)	(0.086)	(0.076)
Town	0.104	0.074	0.126*
	(0.064)	(0.077)	(0.073)
Suburb	0.139***	0.153***	0.109**
	(0.043)	(0.047)	(0.053)
Observations	2049	920	1129
R-squared	0.29	0.26	0.33
Standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			
Controlled variables: mother’s age and provincial variables			

Table eight: Height for age z score

	All	Female	Male
Fine for extra child	0.196***	0.268***	0.140
	(0.070)	(0.087)	(0.088)
Two children allowed	0.092	0.283*	-0.038
	(0.132)	(0.146)	(0.194)
Second child allowed if first is a girl	0.246*	0.225*	0.289
	(0.127)	(0.134)	(0.188)
Mother's education: Primary	0.021	-0.168	0.168
	(0.140)	(0.164)	(0.183)
Mother's education: Junior high	-0.068	-0.245	0.086
	(0.115)	(0.151)	(0.156)
Mother's education: Senior high & above	-0.082	-0.208	0.043
	(0.129)	(0.161)	(0.174)
Mother’s height	0.056***	0.054***	0.055***
	(0.006)	(0.009)	(0.009)
Household registration type (1 if rural)	-0.155	-0.135	-0.203
	(0.125)	(0.148)	(0.179)
Household Income	0.046	0.088**	0.017
	(0.030)	(0.040)	(0.048)
Faucet Water	0.030	0.168	-0.063
	(0.118)	(0.154)	(0.170)
Underground water	0.002	-0.038	0.051
	(0.084)	(0.106)	(0.117)
Non-Sanitary environment	-0.078	-0.094	-0.064
	(0.067)	(0.084)	(0.098)
City	0.363*	0.152	0.426
	(0.213)	(0.264)	(0.289)
Town	0.312**	0.466**	0.174
	(0.137)	(0.203)	(0.195)
Suburb	-0.074	-0.115	-0.082
	(0.108)	(0.144)	(0.171)
Observations	2047	907	1140
R-squared	0.23	0.23	0.25
Standard errors in parentheses			
* significant at 10%; ** significant at 5%; *** significant at 1%			
Controlled variables: Children’s age (single year dummies), mother's age and provincial variables			

Household Level Fixed effect results

Table ten to fourteen present results from the household level fixed effect model. For each dependent variable, two models are estimated. In the basic model, only individual characteristics are included. In the extended model, interaction terms between individual and household and community level variables are included

Individual characteristics include gender, age and birth order. Children's age has been shown to have a negative influence on their height for age z scores (Horton [1986], Deolalikar [1996]).

Birth order has also been shown to have a negative impact on children's height for age z scores (Horton [1986], Behrman [1988a]). Children from earlier sibling positions are more advantageous relative to those from later sibling positions. One explanation is that additional children put a strain on family resources. If this hypothesis is true, higher income and maternal education could help alleviate this problem. To test this idea, children's birth order is interacted with household income and mother's education. Some of the studies suggest that the effect of birth order may be nonlinear [Horton 1986]. It is argued that the middle children are the most disadvantaged, since the latter born children eventually receive additional resources as the older children either leave home, or earn income. Because our sample is restricted to families with very young children only, non-linearity is not a concern.

Gender difference is our main interest. We further hypothesis that gender difference could be modified by household and community characteristics. Therefore, interaction terms between gender and household and community characteristics are included. To control for regional difference for gender preference, we used the interaction term between gender and location variables as well.

Necessarily, children from one-child families are dropped out. The sample population include children from families who have at least two children with nutritional or health status information available in a given year.

On nutrient intakes

None of the basic models for nutrient intakes explains any variations in the dependent variables. Both birth order and gender remain insignificant for all four models.

I experimented interacting birth order with income and mother's education but neither proves to be significant either (results not shown). This result is not consistent with the literature. The difference could be due to the relative smaller family size in this sample. The average birth order in this sample is 3 and below. 97 percent sample is 1.82. In contrast, the average birth order in Horton [1986] is close to 4.

The calorie and protein equations are little explained under the extended models either. However, the extended model is different from the basic one in both the fat intake equation and percentage fat intake equations. In the extended model, both the female variables turn to be positive, indicating better treatment for girls compared to boys.

“Fine for extra child” is positively correlated with boys' consumption on fat and percentage fat intake. Mothers' education, however, becomes insignificant on girls' percentage fat intake. It is significant, but only at 10 percent on the percentage intake model.

On height for age

Unlike nutrient equations, female is highly significant in the height for age basic model. Compared to their male siblings, females on average are .24 standard deviations shorter than their male sibling. Birth order remains insignificant for height for age equation. Children younger than one year old have significantly higher height for age z scores than all the other age groups. This finding is consistent with the literature.

In the extended model, however, the negative sign on female disappeared. Similar to the reduced form equation results, family income strongly improved girls' height for age z scores.

Neither the one-child policy nor mothers' education have any impact on girls' height for age, similar to the individual level estimates.

Discussion

The family level fixed effect results are quite similar to the individual level results. "Fine for extra child" was significantly associated with higher intake of fat for boys in both models. Mother's education lost much of its significance level in both models. Income improved girls' height-for-age z score in both models.

Conclusion

This paper evaluates the indirect impact of the one-child policy on the well being of Chinese children, with a focus on gender differential. It employs two models, an individual one and a household fixed effect one to estimate in which direction the one-child policy affects children's health status, in addition to other socioeconomic factors.

Combining the results from both the individual model and the household fixed effect model, we are able to determine the major determinants of nutrition intake and nutritional status of young children in China born after the one-child policy was established. Three factors are most influential in determining Chinese children', especially girls' health status.

First, family income increases fat intake for both boys and girls. However, higher income is especially beneficial to girls. Higher family income increases girls' height for age. This evidence suggests that girls still bear the marginal status in the family. If the family's resource is constrained, the well being of girls will suffer.

Second, mothers' education is important in terms of intra-household allocation. A highly educated mother treats her daughter better. This evidence is supportive of the household bargaining model. Mothers with higher education probably have higher bargaining power in the household. Her own higher status in the family will help elevate daughters' status as well.

Third, one-child family affects intra household allocation significantly by putting negative pressure on female children's consumption. This suggests that there is actually intensification effect suggested by Das Gupta and Bhat (1997). When families are forced to have fewer boys, they treasure them more. Therefore, prenatal discrimination does not necessarily replace postnatal discrimination[1].

However, it would be wrong to conclude that girls fare worse than before the one-child policy was established. First, in the reduced form equation, although girls'

[1] Some people may argue that if a family residing in a strict one-child policy areas has more than one child, this family is likely to have stronger son preference than the average households in that community. However, this scenario will only render our prior interpretation invalid if son preference of that household is stronger than the son preference of households residing in areas with weaker one-child policy.

consumption was not positively linked to the one-child policy, it was not negatively linked to it either. Second, the results on income variable suggest that household resource is a key factor in girls' wellbeing. Fewer children in a household will reduce resource competition, therefore benefiting female children. The positive correlation between the one-child policy and well being of male children only suggest that those female children are getting a lower share of the extra resources due to the reduced family size.

The results in this paper present evidence related to two hypotheses. First, it supports the hypotheses that parents trade off quality and quantity of their children. By reducing family size, the one-child policy significantly improved children's well-being. Second, it refutes the hypothesis that prenatal sex discrimination eliminates postnatal sex discrimination. Sex selection in China did not totally eliminate the need for discrimination treatment for girls after births.

Table nine: statistics for household fixed effect

	Nutrition		Height for age	
	Mean	std. Dev.	Mean	std. Dev.
Female	0.49	0.50	0.48	0.50
Birth order	1.77	0.77	1.83	0.80
Interaction term with female				
Fine for extra child	0.23	0.42	0.20	0.40
Two children allowed	0.18	0.39	0.19	0.39
Second child allowed if first is a girl	3.63	3.70	3.50	3.71
Mother's age	15.11	15.53	14.51	15.42
Mother's education: primary	3.17	3.35	3.06	3.34
Mother's education: Junior high	0.10	0.30	0.10	0.31
Mother's education: Senior high & above	0.18	0.38	0.17	0.38
Mother's height	76.51	77.70	73.77	77.54
Household registration type (1 if rural)	0.45	0.50	0.44	0.50
Household income	0.09	0.28	0.08	0.26
Faucet water	0.04	0.20	0.04	0.20
Ground water	0.24	0.43	0.23	0.42
Non-sanitary environment	1.02	1.11	0.98	1.11
City	0.02	0.13	0.02	0.13
Town	0.03	0.17	0.01	0.10
Suburb	0.04	0.20	0.04	0.19
LiaoNing	0.07	0.25	0.08	0.27
JiangSu	0.15	0.36	0.14	0.35
ShanDong	0.07	0.26	0.06	0.25
HeNan	0.09	0.28	0.08	0.27
HuBei	0.01	0.09	0.00	0.07
HuNan	0.04	0.19	0.04	0.20
GuangXi	0.06	0.23	0.05	0.22
Observation numbers	882		874	

Table ten: Family Fixed Effect with daily calorie intake

	1	2
Female	0.0185	0.3917
	(0.0160)	(0.6956)
Birth order	-0.0032	-0.0072
	(0.0111)	(0.0120)
Female * Two children allowed		0.0330
		(0.0805)
Female * Second child allowed		-0.0059
		(0.0800)
Female * fine for an extra child		-0.0306
		(0.0444)
Female * mom edu: primary		-0.0888
		(0.0550)
Female * mom edu: junior		-0.0294
		(0.0486)
Female * mom edu: senior and above		-0.0639
		(0.0615)
Female* mother's height		-0.0023
		(0.0036)
Female* household registration system		0.0278
		(0.0789)
Female * income		0.0265*
		(0.0138)
Female* faucet water		0.1293*
		(0.0744)
Female* ground water		0.0324
		(0.0373)
Female* non-sanitary environment		-0.0144
		(0.0333)
Observations	976	882
Groups	497	451
R square	0.00	0.06
Standard errors in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		
Controlled variables: Female* provincial variables, Female* stratum variables		

Table eleven: Family Fixed Effect with daily protein intake

	1	2
Female	0.8360	67.6026
	(1.9257)	(85.6769)
Birth order	-0.1151	-0.7235
	(1.3317)	(1.4818)
Female * Two children allowed		0.7239
		(9.9200)
Female * Second child allowed		-4.5947
		(9.8510)
Female * fine for an extra child		-8.3496
		(5.4677)
Female * mom edu: primary		-12.5677*
		(6.7763)
Female * mom edu: junior		-1.7881
		(5.9859)
Female * mom edu: senior and above		-4.6892
		(7.5774)
Female* mother's height		-0.1621
		(0.4384)
Female* household registration system		6.9637
		(9.7176)
Female * income		3.1213*
		(1.6983)
Female* faucet water		10.8024
		(9.1591)
Female* ground water		4.1470
		(4.5907)
Female* non-sanitary environment		-1.5497
		(4.1058)
Observations	976	882
Groups	497	451
R square	0.00	0.05
Standard errors in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		
Controlled variables: Female* provincial variables, Female* stratum variables		

Table twelve: Family Fixed Effect with daily fat intake

	1	2
Female	-0.8404	197.1581**
	(1.8676)	(84.2901)
Birth order	1.5096	0.6688
	(1.2915)	(1.4578)
Female * Two children allowed		6.7003
		(9.7594)
Female * Second child allowed		7.7260
		(9.6915)
Female * fine for an extra child		-14.8120***
		(5.3792)
Female * mom edu: primary		-8.8092
		(6.6667)
Female * mom edu: junior		1.3476
		(5.8890)
Female * mom edu: senior and above		5.0415
		(7.4547)
Female* mother's height		-0.6136
		(0.4313)
Female* household registration system		-6.1995
		(9.5603)
Female * income		1.2375
		(1.6708)
Female* faucet water		13.0461
		(9.0108)
Female* ground water		2.4631
		(4.5164)
Female* non-sanitary environment		-3.8085
		(4.0394)
Observations	976	882
Groups	497	451
R square	0.00	0.06
Standard errors in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		
Controlled variables: Female* provincial variables, Female* stratum variables		

Table thirteen: Family Fixed Effect with daily percentage fat intake

	1	2
Female	-0.0302	1.8736**
	(0.0185)	(0.7960)
Birth order	0.0136	0.0149
	(0.0128)	(0.0138)
Female * Two children allowed		0.0632
		(0.0922)
Female * Second child allowed		0.0776
		(0.0915)
Female * fine for an extra child		-0.1364***
		(0.0508)
Female * mom edu: primary		0.0257
		(0.0630)
Female * mom edu: junior		0.0622
		(0.0556)
Female * mom edu: senior and above		0.1316*
		(0.0704)
Female* mother's height		-0.0048
		(0.0041)
Female* household registration system		-0.0646
		(0.0903)
Female * income		-0.0195
		(0.0158)
Female* faucet water		0.0351
		(0.0851)
Female* ground water		0.0057
		(0.0427)
Female* non-sanitary environment		0.0098
		(0.0381)
Observations	976	882
Groups	497	451
R square	0.01	0.07
Standard errors in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		
Controlled variables: Female* provincial variables, Female* stratum variables		

Table fourteen: Family Fixed Effect with height for age z scores

	1	2
Female	-0.2352***	-0.2126
	(0.0872)	(3.6241)
age0	1.0953***	0.9650**
	(0.3922)	(0.4294)
age1	-0.0578	-0.0591
	(0.3261)	(0.3558)
age2	0.1118	0.0390
	(0.2840)	(0.3078)
age3	-0.0524	-0.0988
	(0.2266)	(0.2475)
age4	-0.2761	-0.3287
	(0.1892)	(0.2064)
age5	-0.1286	-0.1462
	(0.1682)	(0.1807)
Birth order	-0.0967	-0.0952
	(0.1396)	(0.1532)
Female * Two children allowed		-0.5858
		(0.4927)
Female * Second child allowed		-0.6609
		(0.4806)
Female * fine for an extra child		-0.2157
		(0.2333)
Female * mom edu: primary		-0.0366
		(0.3048)
Female * mom edu: junior		-0.1230
		(0.2595)
Female * mom edu: senior and above		-0.3054
		(0.3222)
Female * mother's height		0.0023
		(0.0191)
Female * household registration system		-0.0001
		(0.4674)
Female * income		0.2648***
		(0.0738)
Observations	958	874
Groups	490	445
R square	0.10	0.18
Standard errors in parentheses		
* significant at 10%; ** significant at 5%; *** significant at 1%		
Controlled variables: Female* provincial variables, Female* stratum variables		

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[i] Mathematically, consider a utility function in which parents derive utility from the number of sons in the form $N_s^{1/2}$ and the number of daughters in the form of $N_d^{1/3}$. Assuming that N_s is equal to N_d, the marginal utility of sons versus that of daughters increases as N gets larger.

[ii] The ideal family composition is to have a first boy and a second girl with the second preference being for two boys, suggested by survey. (Xu and Yu, 1990).

[iii] For a very detailed description on CHNS one-child policy data, see Short and Zhai (1998).

[iv] See Strauss and Thomas (1995)

[v] A child whose anthropometric measures are more than minus two standard deviations from the NCHS mean is considered mildly malnourished.

[vi] Data are considered inaccurate if height for age is three deviations above the NCHS mean or five standard deviations below the NCHS mean.

[vii] Although more information was collected in the survey, previous research conducted by the author (2002) indicated that these two are the significant factors in influencing childbirth.