China's One Child Policy: Sex Preferences, Fertility, and Female Labor Supply

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Abstract

During the past two decades, the rural Chinese economy has experienced tremendous changes. Both the rural economic reform that generated millions of off-farm employment opportunities for rural residents, and the demographic transition that took place at the same time, will presumably encourage female labor participation. This paper relies on the instrumental variable method as an identification strategy and uses the sex of the first born child as an instrument, to examine the causal effect running from fertility to labor supply. We find in the OLS estimate a strong negative relationship between fertility and the female labor supply, but the relationship disappears in the 2SLS estimate. Thus, fertility decline does not cause an increase in the nonfarm female labor supply in rural China. In addition, we find that the local family planning rule is endogenous to the local female labor supply.

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1. INTRODUCTION

One of the most important relationships in labor economics is between fertility and female labor supply. Many empirical studies of this relationship have been conducted for the U.S. and other developed countries (Killingsworth and Heckman 1986), but few attempts have been made to examine the situation in developing countries. This paper will examine the fertility—female labor supply relationship in China, a country that has experienced during the past two decades a tremendous economic growth and a remarkable decline in fertility. In addition, we will examine the effect of the one child family planning policy on fertility in China.

The rural economic reform, which has replaced central planning with market forces, has contributed to a phenomenal rate of growth in the economy and provided new income sources and lucrative employment opportunities for rural residents (Perkins 1988). From 1982 to 1990, total employment increased by about 125.7 million, and female employment accounted for 63.2 million, or 50.3% of that increase. During the same period of time China also experienced a historic demographic transition. Before the 1970s, total fertility of China was above 5. It declined notably thereafter and reached a level of less than 2 in 1990-95, when the population

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1 Cain (1966) and Gronau (1973) produced early works in the literature. Nakamura and Nakamura (1990) and Browning (1992) provide comprehensive surveys. Closely related to this line of research is inquiry about how breast-feeding activity interrupts labor supply (Klerman and Leibowitz 1999); the effect of fertility on the male and female wage gap (Gangadharan and Rosenbloom 1996); how child care cost affects female labor supply (Powell 1997), and whether public policy could resolve this problem (Ribar 1995; Averett et al 1997).

2 A comparison between the performance of China and the Eastern European countries generates a debate between big band versus gradualism approaches for the economic transition from a planned to a market economy. See McMillan and Naughton (1991) and Sach and Woo (1996).

3 Even in areas that are predominately agricultural, nonfarm income is now contributing far more than one third of the total household income. Its effect on both income inequality (Rozelle 1994; Here 1994; Benjamin et al 1999) and the level of income (Kung and Lee 2000) is escalating.

4 Urban population is defined as those who live in an urban area or township. In 1984, township was defined according to the population size (over 20000), and according to the share of income from the nonfarm sources (over 10%) (Statistical Yearbook of China 1998). Many areas defined as rural in the past have changed to townships when their share of nonfarm income surged during the economic reform. This explains the substantial increase in the urban labor force from 1982 to 1990.

5 Total fertility is the expected number of children a woman would have when she finishes her fertility cycle.
growth rate was barely above 1%. This demographic transition, whatever its underlying causes, has undoubtedly lessened the constraint on participation in the labor market for married females.

Women in patriarchal countries, are often excluded from the process of development, however. Although numerous non-farm employment opportunities were created in the rural economic reform, nearly one-quarter of the laborers in rural China became redundant (Ho 1994). In areas where nonfarm employment is scarce, men farm and their wives stay at home (Jacka 1997). Many single females who have nonfarm employment often are laid off once they married (Parish et al 1995). In many cases, married women are left to farm while their husbands and sons work off the farm – a phenomenon known as the feminization of agriculture (Huang 1990; Judd 1995; Parish et al 1995; Croll 1997; Jacka 1997; Rozelle et al 2000). Do women prefer to work on the farm because it is more conducive to taking care of their children, or are they unable to obtain wage employment because they have children? This is an important question that we want to address in this paper.

The main problem with such an estimation is that decisions about fertility and female labor supply are jointly made and should be simultaneously estimated. The well-known identification problem is difficult to resolve, particularly to micro level research: i.e., the estimation requires variables that correlate with either fertility or labor supply yet are exogenous.

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6 The Chinese government plans to stabilize the population between 1.5 billion and 1.6 billion by 2030 (Xinhua Business Weekly, 24 Nov. 1997).
7 Other Asian countries, such as Hong Kong, Taiwan, Singapore, and Japan have experienced a similar demographic transition during the same time period, but they have no coercive family planning policy (Johnson 1994; Schultz 1997). In China, economic development and gender equality may also explain the fertility decline in the 1990s (Moore 1998).
8 A survey conducted by the State Birth Planning Committee reported that women who practiced family planning spent 20% of their time on housework, and those who did not practice family planning spent 38% of their time on housework. Thus, family planning allows married females more time in labor market. Sing Tao Daily (Toronto), 22nd September 2000.
9 There is still a marked difference in the labor participation rate between male and female even in some developed Asian countries. For instance, in South Korea, Taiwan, Singapore, and Hong Kong, the male participation rate in 1994 was still 30% higher than the female (Chu 1997).
10 Hong (1997) finds that males devoted more time to farming activities although females have a higher participation rate. The conclusion regarding the feminization of agriculture in China is still premature.
Variables that are usually significant in either the fertility or labor supply equation, namely, the educational attainment of the parents, the years of on-the-job training, the work experience, the residential origins of the couples before they married, household wealth, and the ethnicity of the family, are invariably correlated with decisions about both fertility and labor supply, and these variables therefore fail the requirement of identification. Recent studies in this line of research rely primarily on the instrumental variable method to identify the effect of fertility on labor supply. These studies include reference to the incidence of twins (Rosenzweig and Wolpin 1980a; Rosenzweig and Wolpin 1980b; Bronars and Groeger 1994; Gangadharna and Rosenbloom 1996; Jacobson et al 1999) and to the sex of the first two children (Angrist and Evans 1998).

The family planning policy launched in the early 1980s in China may provide a clue to resolve the identification problem. Scattered anecdotal evidence and village level case studies have documented considerable variation in the content and enforcement of the policy across both time and space. This was confirmed by the chief official responsible for family planning policy in 1984, i.e., that local family rules should be formulated according to local conditions. Whether

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11 Cain and Dooley (1979) use the aggregate data to estimate a simultaneous equation model for female labor supply, wage rates, and fertility. See also Fleisher and Rhodes (1979). As an alternative strategy, McCabe and Rosenzweig (1976) regress both fertility and labor supply against a common set of exogenous variables.

12 Schultz (1978) uses the wife’s residential origins at age16 and the schooling of both spouses as instruments for fertility. Arguably these variables are endogenous to labor supply.

13 A common drawback of both identification strategies is that they resolve the problem for people who have two children or more, and in the case of the twins method, an even smaller subset of people who have twins births in the first pregnancy. For instance, only 87 out of 12,605 women in Rosenzweig and Wolpin’s (1980b) sample have twin births in the first pregnancy. Rosenzweig and Wolpin (2000) criticize both methods for implicitly assuming that the instruments have no child-rearing cost effect and preference effect on labor supply. Rosenzweig and Wolpin (1980b) find that couples with a twin birth ultimately have only .15 child more than other people. This suggests that fertility adjustment has taken place later in their life. Should the adjustment be correlated with labor supply, the validity of this instrument will become questionable.

14 See Banister (1987) for an account of the early development of the policy. There is a debate about whether the policy was tightening (Aird 1990) or loosening (Greenhalgh et al 1994) in the late 1980s.

15 Zhang (1999) reports that family planning rules might vary from village to village. Short and Zhai (1998) produced the first paper that used the village level data to show variations in family planning rules.
or not the formulation of local family rules is independent of the local labor supply is important to the identification problem.

In this paper, we propose to use the sex of the first born child as an instrument to estimate the effect of fertility on female labor supply. In China, where the preference to have sons is strong, households whose first born child is a boy are less likely to have another child. This variation in the propensity for fertility arguably is independent of the decision about labor supply. Comparing to using the incidence of twins and the composition of sex of the children as instruments, one merit of the instrument in this paper is that families with only one child are incorporated into the analysis.

We use a publicly available dataset from the Chinese Health and Nutrition Survey (CHNS) for the empirical analysis. While a strong negative relationship is found between fertility and labor supply in the OLS estimation, this relationship completely vanishes in the 2SLS estimation when the sex of the first born child is used as an instrument. This clearly depicts a sorting scenario, namely that women who prefer to work more also prefer to have fewer children. When both the sex instrument and the family rule are used as instruments, the inverse relation between fertility and female labor supply reappears. This difference in result suggests that probably one instrument is not exogenous to the female labor supply. We use an over identifying test to test for the exogeneity of the instruments and reject the null hypothesis that the local family policy rule is exogenous to female labor supply. We provide three explanations for the endogeneity of the family rule.

The remainder of the paper is organized as follows. In section two, we present a one period static model for the determination of fertility and female labor supply. The main purpose of this model is to illustrate the simultaneity problem in estimating the relationship between fertility and labor supply, and the fundamental idea of the identification strategy we use. In addition, this model provides a framework to examine the role of family rules in identifying the fertility and labor supply relationship, and the effect of the cash penalty on female labor supply. Section three
describes the data, the development of the family planning policy, and the information regarding fertility and female labor supply in our sample. This discussion provides evidence of a son preference that supports the validity of our instrument. Section four presents the results of the OLS estimate and the 2SLS estimate. Section five presents conclusions and further extensions of this paper.
2. A Model for Fertility and Female Labor Supply

2.1 The Basic Model

We used a one period static model to explain the determination of female labor supply and fertility. The basic structure of the model comes from Willis (1973). Assume that the wife maximizes the utility function that depends on household consumption of goods $C$, the number of children she has $N$, and the leisure time $l$, which is defined as the time spent at home.

$$U = U(C, N, l) \quad (1)$$

$C$: the household level of total consumption  
$N$: the number of children they have  
$l$: the leisure time

Assume that the wife is responsible for taking care of the children and producing household consumption goods, and that time is required to produce these goods. The husband’s labor income is assumed to be exogenous to the wife’s labor supply. Thus the nonlabor income, from the woman’s perspective, is equal to the sum of the household wealth and the husband’s labor income. For simplicity, assume that the household equalizes the quality of its children, so we do not deal with the problem of the quality-quantity trade off in the model. A particular assumption we made is that the number of children in a family depends on the sex composition of the children.

$$N = N(S) \quad (2)$$

$S$: the sex of the child

In particular, we assume the following inequality holds:

$$MU_{nh=m} < MU_{nh=f} \quad (3)$$
The marginal utility of having one more child when the family already has a boy is less than the marginal utility of having one more child when the family already has a girl. Thus, the slope of the indifference curve for a person if she has a boy already is flatter than the slope of the indifference curve for the same person if she has a girl already. To the extent that the woman has a strong preference for a boy, she will continue to have more children until she finally has a boy.

The following are the constraints that women are facing:

\[
P_c^* C + P_n^* N = A + (T - I) * w \tag{4}
\]

\[
T = I + t \tag{5}
\]

\[
I = t_c + t_n \tag{6}
\]

A: nonlabor income
T: total time the wife has
I: leisure time
tc: time spent on producing household goods
tn: time spent on taking care of children
t: time spent on labor market participation
w: market wage for the wife
Pc: price for the household goods
Pn: price for the children’s goods.
w*: shadow wage

Equation (4) is the total wealth constraint. The total expenditure on inputs for household consumption goods and children’s goods is equal to the sum of the nonlabor income and the income from wife’s labor supply. Equation (5) is the time constraint. The total time of the wife is equal to the sum of the time spent at home and the time spent on her labor supply. Equation (6) states that the time spent at home is equal to the sum of the time spent in producing household consumption goods and the time spent on child care.\(^\text{16}\)

Use the Lagragnean method

\[
\text{Max } U (C, N, I) + \lambda [P_c^* C + P_n^* N - A - (T - I) * w]
\]

\(^{16}\) For most rural people, farming is the last resort, which could be considered a fixed cost of moving into wage employment.
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\[ U_C = \lambda P_C \quad (7) \]
\[ U_N = \lambda P_n \quad (8) \]
\[ U_l = \lambda w \quad \text{if} \quad t>0 \]
\[ = \lambda w^s \quad \text{if} \quad t=0 \quad (9) \]
\[ P_C^* C + P_n^* N = (T - l) * w + A \quad (10) \]

By rearranging Equation (7), Equation (8), and Equation (9), we obtain the following optimization conditions. When the wife works on the labor market, she will equalize the per dollar marginal utility in household consumption, children, and leisure when she stayed at home, evaluated at the market price, as in Equation (11). When the wife does not work in the labor market, she will evaluate the above marginal conditions according to the shadow wage, as in Equation (12).

\[ \frac{U_C}{P_C} = \frac{U_N}{P_n} = \frac{U_l}{w} \quad \text{if} \quad t>0 \quad (11) \]
\[ \frac{U_C}{P_C} = \frac{U_N}{P_n} = \frac{U_l}{w^s} \quad \text{if} \quad t=0 \quad (12) \]

After solving this problem, we will have a set of demand equations for the household consumption goods \( C \), the total number of children \( N \), and the labor supply of the woman \( t \), as a function of the parameters that include the prices for the inputs of the household consumption goods \( P_C \), the price for the children’s goods \( P_n \), the market wage rate \( w \), the nonlabor income \( A \), conditional on the sex composition of the children \( S \).

\[ C^* = f \left( P_C, P_n, w, A \mid S \right) \quad (13) \]
\[ N^* = g \left( P_C, P_n, w, A \mid S \right) \quad (14) \]
\[ t = h \left( P_C, P_n, w, A \mid S \right) \quad (15) \]

We can view Equation (4) as a production possibility set in which the production of \( C \) and \( N \) are constrained by the amount of income and time the wife has.
In the following, we use diagrams to discuss the determination of the optimal consumption and the number of children. Assume that the time intensity of the production of household goods and of child care are not the same. More specifically, assume that child caring is more time intensive. Having more children means that the woman has less time available for the labor market and therefore less income. Thus, a higher level of household consumption is associated with more time spent on the labor market. We draw a PPF for \( C \) and \( N \) at a given level of \( w, P_c, P_n, \) and \( A \). When these parameters change, the PPF will shift. The optimal household consumption, denoted as \( C^* \), and the optimal number of children, denoted as \( N^* \), are determined at the tendency point between the PPF and the indifference curve. The slope of the PPF measures the trade-off between labor supply and fertility. What we observed in reality, however, are the equilibrium points of fertility and labor supply when the value of other parameters changes, and the position of the PPF is adjusted.

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17 The actual problem is complicated by the participation decision of the woman in the labor market. There are two types of budget constraints that the woman may face: one when she does not participate in labor market, and the other when she participates. For simplicity and without the loss of generality, we assume that a higher level of consumption is associated with a higher level of labor supply. The reason for using consumption instead of directly using labor supply is that labor supply is considered a "bad," not a good, in the model.
2.1.1 When the preference of the agent does not change

When the wage increases, the PPF will shift upward, with the value of the x-axis largely determined by the maximum number of children a woman could possibly bear. Assuming that a child is a normal good, when the wage increases, the income and the substitution effect on the demand for children will work in opposite directions. Depending on the magnitude of these two effects, it is possible to find a positive, a negative, or no relationship between female labor supply and fertility. In the diagram below we assume that the substitution effect of a wage increase is greater than the income effect, and so female labor supply is inversely related to fertility.

2.1.2 When the Preference of the Agents change

The preference of people for children may be correlated with their wages. If people with higher wages also prefer to have fewer children, there will be a negative relationship between fertility and labor supply. One explanation for this correlation is that women with higher wages have usually received higher education. They may prefer that their children receive more education, which means a higher cost per child for the educated woman. In the diagram below, we draw a clear inverse relationship between fertility and labor supply, which arguably is what we are observing in the cross section data.
2.2 Using the sex of the child as an instrument

This problem of sorting can be resolved if we can vary the preference of the person without changing the position of the PPF. If the preference for children depends on the sex of the children, the sex of the first born child will provide a clue to the resolution of this problem. Under the assumption in Equation (3), the indifference curve of a woman when she has a boy is flatter than the indifference curve of the same person when she has a girl. In the diagram below, the woman maximizes her utility by choosing $C^*$ amount of household consumption and $n^*$ number of children if the first born child is a boy. If the first born child is a girl, she will choose $n_1$ children and $C_1$ level of consumption. The ratio of the change in fertility $\Delta n$ to the change in consumption $\Delta C$, which is associated with a change in labor supply, provides an approximation to the slope of the PPF. Basically, this is the idea behind the Wald estimator in the instrumental variable method. In the diagram below we draw an inverse relationship between fertility and
labor supply, a result that depends crucially on the curvature of the PPF. In the next diagram we draw the case when the PPF is relatively flat.

2.2.1 When the production possibility frontier is flat

When the slope of the PPF is flat, the inverse relationship may be too weak to be identified empirically. The question is why does a woman not need to adjust her labor supply when she has one more child? First, the additional cost of the child, for items such as food and clothing, may be reasonably low in rural areas, given the fact that the woman already has had a child. Second, there may be a fixed cost for entering the labor market. If the fixed cost is high, the woman may be better off staying at home. Third, the woman may need a part-time job. In our data, less than 5% of women were working at part-time jobs. This indicates perhaps that part-time jobs are not widely available in rural China.

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18 We do not consider the production role of the children in the family. As far as the price of farm inputs and farm technology are not correlated with the sex of the first born child, there is no bias in our estimation below.
2.3 The Effect of Family Rule

2.3.1 Exogenous Rule

The incorporation of the family rules and the cash penalty into the analysis produces some complications. We first discuss how the family rule that allows a couple to have a second child when the first one is a girl – “first girl second child” rule – affects our analysis. If this rule is strictly and uniformly enforced in the whole country, we will observe that people whose first born child is a girl will have a second child, and people whose first born child is a boy will have one child only. The sex of the first born child provides a good measure of the slope of the PPF.\(^{19}\)

In reality this rule is only applicable in some part of the country. If the decision about the application of this rule is not correlated with the local labor supply, we can still measure the slope of the PPF by this rule. The reason is that fertility will be low in areas where couples are not allowed to have a second child conditional on the sex of the first born child. In areas where this rule is approved, those couples with a girl as first born child will have a second child. Thus, this rule will provide a prediction similar to that produced by using the sex of the first born child, though the prediction is weaker than is the case when the rule is uniformly enforced in the whole country.

\(^{19}\) In this case, there is no geographical variation in family planning rule, and this rule cannot be used to measure the slope of the PPF.
2.3.2 Endogenous Rule

When the approval of the “first girl second child” rule is correlated with the local labor supply, the rule will fail the requirement of identification. For instance, if the rule is approved in areas where female labor supply is low, and is disapproved where female labor supply is high, what the rule manifesting is the effect of labor supply on fertility. In Appendix I, I showed how changing the exogenous assumption of the rule will bias the measurement of the slope of the PPF. There are three consistent explanations to explain why the “first girl second child” rule will be endogenous to the local labor supply.

First, in rural China, where the labor market is still in the nascent stage of development, a higher labor supply may imply that more working opportunities are available to women. The opportunity cost of having a child will be higher in those areas, and women may prefer to have fewer children. Even if the family rules are stringent, they may be more likely to be enforceable. Cadres may set stringent policy rules, expecting to fulfill their duties and obtain higher economic rewards, or even a fast promotion. Second, if a higher female labor supply implies a higher demand for female labor, cadres could increase the female labor supply by adopting stringent policy rules. Third, the demand for female labor is probably correlated with the level of income. It is conceivable that the setting of family planning rules and the level of cash penalty provide a
mechanism for cadres to exact rents from the villagers. Cadres may set stringent rules in prosperous areas, but then allow people to have children above the quota, and collect the fine (Qian 1997). We turn to the setting of the cash penalty in the following discussion.

2.4 The Effect of Penalty

The discussion is about the effect of the cash penalty on the use of the sex of the first born child to measure the slope of the PPF. More specifically, we will show that, in some cases, a woman may be induced to work when her first born child is a girl. In areas where the “first girl second child” rule is approved, the penalty will not have this effect. People whose first born child is a boy will prefer fewer children, and they are unlikely to pay the fine in order to have another child. People whose first born child is a girl are allowed to have a second child without paying the fine. In areas where people are not allowed to have a second child, the cash penalty may have an adverse effect on using the sex of the first born child to measure the slope of the PPF. We will focus the following discussion on areas where the “first girl second child” rule is applicable.

Assume that cadres are maximizing the utility function that depends on the value of the cash penalty from the above quota birth, and the fulfillment of the birth quota.

\[ U = U (R, V) \]

\[ R \] is the revenue from above quota births, which is the product of the cash penalty per above quota birth and the number of above quota births. \( V \) is the violation function for allowing people to have an above quota birth. Assume that cadres receive some utility from the value of the cash penalty, but also receive punishment because of allowing people to have above quota birth. The total utility for the cadres is the sum of the following two terms.

\[ U = \alpha \ F^*(n-n^*) - (1-\alpha)^* (n- n^*)^\beta \]  \hspace{1cm} (17)

\( n \): demand for children
\( n^* \): birth quota
In this case, $\alpha$ is the weight on the cash penalty, and $1-\alpha$ is the weight on the violation. Assume that the punishment by the higher level government increases with the deviation from the birth quota, i.e. $\beta \geq 1$.

Assume that $n$ is a decreasing function of the level of the penalty. Here we assume that the birth quota $n^*$ is set by a higher level government. Obviously, the value of $n^*$ has considerable effect on how the local policy rules are set. We examine the endogenous nature of the birth quota in a separate paper.

\[
n = n(F) \quad (18)
\]

\[
\frac{\partial n}{\partial F} < 0 \quad (19)
\]

\[\text{FOC} \]

\[
\frac{\partial U}{\partial F} = \alpha (n-n^*) + \alpha F \left( \frac{\partial n}{\partial F} \right) - \beta (1-\alpha)^* (n- n^*) \beta^{-1} \left( \frac{\partial n}{\partial F} \right) = 0 \quad (20)
\]

\[
F^* = \frac{\beta (1-\alpha)^* (n- n^*) \beta^{-1} \left( \frac{\partial n}{\partial F} \right)}{\alpha^* \left( \frac{\partial n}{\partial F} \right)} - \frac{\alpha (n-n^*)}{\alpha^* \left( \frac{\partial n}{\partial F} \right)} \quad (21)
\]

\[
F^* = \frac{\beta (1-\alpha)^* (n- n^*) \beta^{-1} \left( \frac{\partial n}{\partial F} \right)}{\alpha} - \frac{(n-n^*) \left( \frac{\partial n}{\partial F} \right)}{\alpha^* \left( \frac{\partial n}{\partial F} \right)} \quad (22)
\]

2.4.1 When Cadres are concerned only about the punishment from the higher level government

When the enforcement of the family rule is the only concern, $\alpha$ will be equal to zero. From Equation (20), $F$ will be set at $\infty$. This means that the local government will set the cash penalty to a prohibitive level that is affordable for no one in the village. If suitable medical services for safe abortion are available, cadres can enforce the rule perfectly. In the diagram below, we draw a case when the cash penalty is extremely high. People will prefer fewer children regardless of the sex of the first born child. In this case, women will not adjust their labor supply to pay the cash penalty.
2.4.2 When the revenue is the only concern

In China, part of the rewards for the cadres that implement the local family policy comes from the cash penalty, and the collection of the cash penalty is also considered a target for the implementation of the family policy. This arrangement conceivably has given cadres incentive to set the cash penalty according to local economic conditions. In an extreme case, when cadres are concerned only about maximizing the revenue from above quota births, $\alpha$ will be equal to 1.

$$F^* = - \frac{(n-n^*)}{\partial n / \partial F}$$

(23)

$F^*$ will depend on the demand for children in the village $n$, the quota set by higher level government $n^*$, and the responsiveness of the change in the demand for children to the change in the cash penalty $\partial n / \partial F$.\footnote{If we normalize $n^*$ to zero, this is reduced to a monopoly revenue-maximizing problem in that price will be set where the demand elasticity is equal to one.}

2.4.3 When cadres care about both the revenue and the punishment

If $0 < \alpha < 1$, $F^*$ will decrease with $\alpha$. When more weight is assigned to revenue maximization, the cash penalty will decrease from a prohibitive level to a level that maximizes
the value of the cash penalty. $F_0$ will increase with $\beta$. When the punishment from the higher level of government is more severe, the cash penalty will be set at a higher level to reduce, if not eliminate, above quota births.

$$\frac{\partial F_0}{\partial \alpha} = -\frac{\beta^* (n- n^*)^{\beta-1}}{\alpha^2} < 0 \quad (24)$$

$$\frac{\partial F_0}{\partial \beta} = \frac{(n-n^*)^{\beta-1} (1-\alpha)}{\alpha} + \frac{(n-n^*) (1-\alpha) \beta \log(n-n^*)}{\alpha} > 0 \quad (25)$$

In the diagram below, the PPF of those who violated the family rule will shift inward because they have to pay the cash penalty. The cash penalty is set to a level such that the woman is better off to pay the cash penalty to have a second child than to have one child only. The family may pay the cash penalty by reducing household consumption by $\Delta C$ as in the diagram below. Alternatively, they may pay the cash penalty by increasing the female labor supply– the induced labor supply effect. In the latter case, the sex of the first born child will be correlated with the female labor supply.
The following table summarizes what we have discussed about the impact of family policy rules and the cash penalty on using the family rule and the sex of the first born child to measure the slope of the PPF.

<table>
<thead>
<tr>
<th>Rule</th>
<th>Penalty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prohibitive level</td>
</tr>
<tr>
<td></td>
<td>1. Rule can be used as an instrument</td>
</tr>
<tr>
<td></td>
<td>2. Penalty has no effect on female labor supply</td>
</tr>
<tr>
<td>Randomly assigned</td>
<td>1. Rule can be used as an instrument</td>
</tr>
<tr>
<td></td>
<td>2. Penalty has no effect on female labor supply</td>
</tr>
<tr>
<td>Endogenous to labor supply</td>
<td>1. Rule cannot be used as an instrument</td>
</tr>
<tr>
<td></td>
<td>2. Penalty has no effect on female labor supply</td>
</tr>
</tbody>
</table>

We have three replies to the induced labor supply argument. First, the “first girl second child” rule seems to be correlated with the level of income – i.e., this rule is more likely to be approved in poor areas, and in those areas women are far less likely to have wage employment. Thus, poor women are more likely to be in areas where the “first girl second child” rule is approved, and they do not have to adjust their labor supply to have a second child. Second, if the penalty is set at the optimal level to allow only a subset of people to have a second child, it is probably affordable only to the wealthy people in the poor areas. Presumably, they can pay the cash penalty out of their nonlabor income,\(^\text{21}\) and in these cases they do not have to adjust their labor supply. In appendix II, we show that there is no evidence in our data set to support the hypothesis of induced female labor supply.

\(^{21}\) If all the people are able to pay the fine and have a second child, there should be no difference in the mean number of children between areas that approve or do not approve this rule. We find that the mean number of children in areas that approve this rule is greater than the mean number of children in areas that do not approve this rule, however. This means that the penalty is set at a level that restrains some people from having a second child.
3. Data and Descriptive Statistics

3.1 The Survey

The data we used come from the China Health and Nutrition Survey (CHNS) conducted by the University of North Carolina and the Institute of Nutrition and Food Hygiene of the Chinese Academy of Preventive Medicine during three successive periods – 1989, 1991, and 1993. Eight provinces that well represented the geographical diversity and income variations of China were carefully chosen, including Liaoning, a prosperous, heavy industry based northern province, Henan, an agriculture based middle income eastern province, and Guizhou, a poor southwestern province (see Figure 1). Samples were collected from 8 urban and 16 rural locations in each province. Our analysis is based on the household fertility history in the 1993 household survey and on the local family planning rules contained in the 1993 community level survey. There were 1,375 women in rural areas and 629 women in urban areas. We excluded childless women from the analysis for the reason that they might have a different orientation about working in the labor market. This exclusion reduced the sample to 1,315 women in rural areas and 609 women in urban areas.

3.2 The Labor Supply and Fertility Information in the Data

We used the total number of children ever born to a woman to measure fertility behavior. Descriptive statistics in Table 1 reveals some distinctive patterns.

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22 A fourth wave of surveys was conducted in 1997, but the data have not yet been made available.
23 For a detailed description of the design and the implementation of the survey, see Lynn (1993).
24 While the panel dimension of the data set could be explored to eliminate individual level heterogeneity, a four years period is too short a period to reflect the long run fertility behavior.
First, there is remarkable difference among provinces in total fertility. For instance, women in Hubei, Guangxi and Guizhou have higher fertility rates than women in Liaoning and Jiangsu.\footnote{25 For an account of the provincial differences in fertility, see Banister (1987) and Pang (1997).}

Second, total fertility is lower in urban than in rural settings; the average number of children in urban area is 1.55. This contrasts strikingly with rural women who on average have 2.25 children. More than 73% of the rural women have 2 children. A one child family is clearly more prevalent in urban, whereas families in rural areas prefer to two child families. This urban-rural fertility gap may also be explained by the differences in the enforcement of the one child policy, a point that we will elaborate more in later sections, and by the difference in the costs and benefits of raising a child in these two settings.

In rural areas, children are productive assets to the family starting early in their lives. They help by carrying water, collecting firewood, rearing livestock, sharing family chores with their mothers, and farming to certain extent. The costs of raising a child, such as clothing, education, food, and medical care, are reasonably low. Second, the family in rural China will receive addition arable land with the birth of a child. This land readjustment policy simply reduces the cost of having a child, and encourages the family to have more children (Johnson 1994). Third, unlike urban areas, where pension plans have been well established, social security programs are largely unavailable in rural China. The importance of children as providers of income security for their parents rose in rural areas when a major source of social security – the commune system – was dismantled during the economic reform.\footnote{26 Land entitlement is a source of social security in rural areas.} This lack of social security programs in rural areas encourages higher fertility.

The information regarding wage employment is presented in Table 2. The urban-rural wage employment gap is remarkable. While only 242 or 18% of women in the rural sample have
wage employment, nearly 454, or 75% of the married women in urban areas, have wage employment. Most of them are unskilled workers (40% in rural and 30% in urban), skilled workers (16% in both rural and urban), and service workers (14% in rural and 19% in urban) employed in state owned enterprises, or in small and large collectives. The average ages of the married women are, respectively, 36.96 and 36.66 in rural and urban areas. The mean age of their having their first child is similar, 23.08 in rural areas and 24.63 in urban areas. The women in urban areas on average received 8.68 years of education, about 3 years more than women rural areas. The differences in the mean number of weeks worked, the hours worked per week, and the annual income from wage employment come primarily from differences in the participation rate. When we compare the subset of women with wage employment in rural and urban areas, the differences in these labor market measures are indeed not significant; urban dwellers have a 10% wage premium.

Over 80% of the women in urban areas who married after 1978 have one child only, and the family planning policy would probably have been strictly enforced in those areas. Other factors are not expected to have had a significant effect on fertility, We will therefore focus on the fertility behavior of rural women.

3.3 The Family Planning Policy and The Demographic Transition in China in the Past Four Decades

During the past five decades in China, there were four waves of birth control campaigns (Figure 2). The first campaign was launched in 1957 when Mao commanded a zero rate of the population growth (Aird 1978). Because of the lack of the required contraception technology,

27 Wage employment here refers to nonagricultural wage employment. We excluded those with wage employment in the fields of farming, fishing, and hunting.

28 Mao did not have a clear position on population control. He even thought that rapid population growth in the early 1950s was a proof of the superiority of socialism (Wang 1999). It was Zhou Enlai who saw the pressing need for population control. Disputes among the top leaders rendered the first two campaigns ineffective (Wong 1984).
the campaign had an insignificant effect on fertility. After the commencement of the Great Leap Forward (GLF) movement, this campaign ended abruptly in 1958. The second birth control movement, which targeted rural areas, was launched in 1962. This campaign lasted for four years until the beginning of the Cultural Revolution in 1966.

In the early 1970s, the third birth control campaign, which emphasized later marriage, wider spacing between children, and fewer children (Wan, Xi, Shao,) was launched. The Chinese government began to allocate more resources to family planning policy. Total fertility dropped continuously from 5.8 in 1970 to 2.73 in 1978 (United Nations 1997). This was still far from enough to achieve the targeted total population of 1.2 billion by the end of the century (Lee and Wang 2000). By the end of 1979, the Chinese government finally launched its fourth family planning policy, which was targeted mainly to urban dwellers; it was known as the one child policy. In the beginning, people were advised to have one child, to have two children at most, and were prohibited to have three or more children. Later, each couple was allowed to have only one child.

The one child policy has three elements— the policy rules, the incentives, and the disincentives. There were few exceptions in the beginning, but people were subsequently allowed to have a second child under some conditions. For instance, men and wives whose first born child is a girl, who both come from a one child family, or who have special occupations, have sometimes been allowed to have a second child. The main incentive for families to have one child is the one child certificate. This grants families several privileges: the child will have access to better education and health care, job security, better housing, and food and cash subsidies, until

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29 In 1970, the Chinese government allocated 203 million yuan (at the current price) for family planning. This rose to 4.8 billion yuan (at the current price) in 1990 (Pang 1997, p. 544). In the Marriage Law in 1950, the minimum age for women to marry was 18. During this campaign, women were advised to marry after 23. The percentage of women first married under 18 dropped from 28.8 in 1960 to 16.2 in 1970. In 1975, only 5.9% of women married before age 18 (United Nations 1997).
30 Chinese officials revealed that this policy was strictly enforced only in four cities, namely Beijing, Shanghai, Guangzhou, and Chongqing, and two provinces, Sichuan and Jiangsu. (Ming Po Daily, 1 February 2000).
they reach the age of 14. On the other hand, families that have more children than they are allowed will receive penalties; they may lose the bonus, the opportunity for promotion, and even their jobs. The child is denied immediate registration, and thereby lose the right to receive land. From 1980 to 1984, the policy was strictly implemented. Total fertility dropped from 2.61 in 1980 to 2.35 in 1984 (United Nations 1997).

Understandably, a policy that potentially deprives half the people of the right to continue their family lines would be difficult to enforce, especially in the rural areas. In particular, cadres have lost their power of income redistribution during the economic reform. This weakening of law enforcement strength is striking in contrast to the growing demand for children in the rural areas because of both production and income considerations. From the production standpoint, when households once again became the accounting units of production, peasants considered children as inputs of production, and they were inclined to have more children (Moore 1998). On the demand side, the economic reform substantially raised the income of rural dwellers, and children are presumably normal goods the demand for which, in terms of both quality and quantity, is likely to rise (Becker 1994). This hypothesis is confirmed by Schultz and Zeng (1995). Besides, when many lucrative jobs are available for young people through the economic reform, job security from the government loses its attraction.

Having faced great difficulties in implementing the centrally formulated family planning policy, local cadres modified the policy to suit local needs better. A de facto two child policy has allegedly been implemented in some rural areas (Lee and Feng 1999). This compromise meets the state’s goal of limiting birth on the one hand, and satisfies the local demand for children on the other hand (Greenhalgh 1988). In 1984, the Chinese government issued a document – Document No.7 – that officially recognized the difficulty in enforcing the one child policy and allowed some families to have a second child under certain conditions – i.e., opened a small hole to prevent a

31 Birth control became mandatory in the Marriage Registration Regulations in 1980 (Palmer 1995).
large hole (Zeng 1989). Thus, 1984 to 1988 was a period of lenient policy enforcement. Total fertility rose once again to an alarming level, and rendered reaching the target population a formidable task. Indeed, the target population was revised from 1.2 billion to about 1.2 billion.

Since 1989, the family planning policy has been strengthened, and more resources have been allocated for the personnel and cadres that implement the family planning policy. Instead of relying heavily on the periodic movement campaigns, this policy has been incorporated into the semi-annual health examination of women. Local officials responsible for the family planning policy may be denied promotion, and under the “one vote down” campaign, cadres may be fired if they fail to meet the target for the family planning policy. Totality fertility dropped from 2.35 in 1989 to 2 in 1992 (United Nation 1997).

There is no consensus about the effect of the family planning policy on total fertility. Some suggest that this policy contributed to the reduction of total fertility (Zhang 1994; McElaroy and Yang 2000), and that China provides a good example of the fact that with the right population policy implemented by a strong central government, a poor country can experience a demographic transition (Birdsall and Jamison 1983). On the other hand, economic factors are suggested to be the most important contributing factors in the fertility decline. In particular, female education is important in explaining fertility decline (Moore 1998). Controlling for the effects of education and socioeconomic development, Li and Ballweg (1992) find that there is no difference between fertility in rural and urban areas. In fact, economic development may have an indirect effect on family planning through the fertility planning policy (Poston and Gu 1987).

32 In 1992, a national fertility survey reported that total fertility dropped to 1.65 in 1991 and 1.52 in 1992. Zeng (1996) argues that there is substantial underreporting in the 1992 fertility survey. He suggested that a 25% upward adjustment was appropriate. The number turned to about 2.2, or near the replacement level.
33 It is estimated that from 1980 to 1990, the accumulated number of children born was reduced by 140 millions, about one half of the children born during the period (Pang 1997: 545).
There is a growing concern about the rising of sex ratio in the ascending order of birth, which is an indication of infanticide or sex selective abortion. A rising sex ratio was also observed in other countries with strong son preferences but without involuntary family planning policies during the demographic transition, however. For instance, the sex ratio at birth in South Korea increased from 1.04 in 1980 to 1.13 in 1989. In 1989, this sex ratio increased in the ascending order of birth from 1.05 for the first born child to a strikingly high ratio of 2.17 for the fourth born child (Schultz 1997). Thus, even without the family planning policy, the sex ratio may eventually rise in countries with strong son preferences when fertility declines.

A closer examination of the one child policy reveals striking variations of the policy across both time and space. Figure 3 shows five main events in the family planning policy for our sampled provinces during the past 4 decades. The establishment of the provincial Birth Control Planning Committees was a milestone for implementing birth control. They were established as early as 1957 in Shandong and Hunan, followed by Liaoning and Jiangsu in 1958. Guangxi and Guizhou, on the other hand, did not have Birth Control Planning Committees before the Great Leap Forward. For the “Later, Wider, and Fewer” policy, a four year difference is found between the early movers, Jiangsu and Hubei, and the latecomers, Hunan and Guizhou. This policy was not implemented in Guangxi, a province with nearly 40% of the population composed of minorities.

In contrast, the time gap in implementing the one child policy in these provinces was small. Hunan implemented this policy in March 1979 and was closely followed by other provinces. By the end of 1980 all sampled provinces had implemented this policy. On the other hand, a sizable time gap was found in the relaxation of this policy. Shandong relaxed this policy in May 1984, followed by Liaoning in September 1984. In contrast, Jiangsu relaxed this policy in

34 A higher sex ratio due to sex selective abortion may be a substitution of pre-natal discrimination for post-natal discrimination (Goodkind 1996; Das Gupta and Mari Bhat 1997).
35 To prevent sex selective abortion, the Korean government has enforced strict measure to prevent identification of the sex of fetuses (Park and Cho 1995).
April 1987. A considerable time gap was also found in incorporating the birth target into the evaluation of the local cadres’ working performance evaluation. While Shandong incorporated this policy into the cadres’ evaluation in 1988, and was closely followed by Liaoning and Henan in 1989, Guizhou did this almost five years later, in 1993.

Supportive evidence for the variation in the family planning rule is also found in the community level data of the CHNS survey. Table 3 summarizes the information. Of the 192 survey sites, we have information about the family policy rule for 181. The most important rule is about whether couples are allowed to have a second child unconditionally or not. Only 22 sites, or 12% of them, approved this rule, and only three of them are located in urban areas. For 159 sites that normally do not allow couples to have a second child, 53 of them allow people to have a second child when the first born child is a girl – i.e., the “first girl second child” rule. Only 2 of these are located in urban areas. This rule is important because it allows about 50% of families to have a second child. There are other unspecified exceptions that allow couples to have a second child, and rural communities have a higher chance of approving these rights.

Local governments rely more on disincentives than incentives to implement the policy. The sample mean of the cash penalty for every child above what is allowed is about 3600 yuan, nearly 60 times the mean subsidy a one child family would obtain. In urban areas, people in 42 out of 59 cities will lose their promotions, bonus payments, access to housing, and even their jobs, if they have more children than they are allowed. In contrast, less than 20% of communities have offered better housing or extra supplies of food to the one child families. For communities requiring cadres to implement the family planning policy, only 17% and 25% of them in urban and rural areas, respectively, did not receive additional economic rewards.

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36 During my field trip in China in the spring of 2000, I noticed that miners who have worked for 5 years are entitled to have a second child. In the Shanxi province, Greenhalgh (1990) have found that when both spouses are returned Overseas Chinese, when only one of several brothers has reproductive capacity, and when a couple has real economic difficulties because its first child is a girl, families are entitled to have a second child.
In summary, it may be said that there are considerable variations in both the content and enforcement of the family policy across time and space. Still, no attempt has been made to analyze formally the determinants of the variations in the local family rules. Will local governments implement stringent policy rules when they believe that such rules are more likely to be enforceable? Are local conditions determining the family rules, including the local labor supply? For instance, will the rule be stringent when the female labor supply is high?

3.4 Son preference in China

Boys are preferred to girls in China for various reasons. Boys play the role of continuing the family line, and they provide income security for their parents (United Nation 1997; Moore 1998). The land adjustment policy in rural China also has a subtle effect on son preference. The entitlement part of the policy is sex neutral, but the land will be taken away from the family when any household member dies, and this will presumably increase the importance of income security provided by other family members, and particularly by the sons (Johnson 1994).

The preference for a son, regardless of the underlining causes, implies that a household without a boy will have a higher propensity to have another child, a hypothesis confirmed by Qian (1992) and Zhang (1994), among others. People with one daughter are less likely to have obtained a one child certificate than people with one son (34% v. 40.3%), or, if they have received a certificate, they are more likely to violate its provisions by having a second child (Fred and Liu 1986). Even in a city with extremely low fertility such as Shanghai, people are more likely to have another child after the death of a son than after the death of a girl (Ahn 1994).

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37 Short (1998) produced the first paper that illustrates the diversity of the family planning rules in different localities. She found that strong policy is correlated with stronger monetary incentives and disincentives.

38 In contrast to the assumption used in many studies, i.e., that parents prefer balance in the sex of their children, we argue that son preference is more appropriate in the context of China. For an international review of preference in sex balance, see Williamson (1976).
Figure 4 plots the sex ratio against total fertility in 30 administrative regions of China in 1989. An inverse relationship between the sex ratio and total fertility supports the occurrence of the son preference. Further support is gained in Figure 5, which plots the sex ratio at different birth orders from 1981 to 1989. The sex ratio for the first born child is basically normal and steady at around 105-108. Even if sex selective abortion may have been taken place in China, a steady and a relatively low sex ratio should convince observers that this maneuver has not been frequently used in the first birth. On other hand, we observed ascending sex ratios observed from the 2nd to the 5th birth, a pattern also recognized by Hull (1990) and Zeng et al (1992). Together with the secular trend of increasing sex ratio that we observed, these provide some evidence of sex selective abortion in the high order of birth.

Table 4 presents the sex ratio of the first four children born and the sex ratio of the last child born in our sample. Consistent with the national trend, there are more boys than girls in our sample. If boys are preferred to girls, the family will continue to have more children until it has a boy, and we expect to have more high order girls than boys (Coale and Banister 1994). In other words, boys are more likely to be the last born child in many families. We present the sex ratio of the last born child in each family and the sex ratio of families with different numbers of children in the lower panel of Table 4. Evidently, the sex ratio of the last born child is higher than the sex ratio of the first born child, and the sex ratio decreases with the total number of children in the families. This suggests that the boy-stopping rule may have been used in our sampled households.

We argue that sex selective abortion is seldom in the first order of birth, and the sex of the first born child is a purely random event. In Lee (1998b), the hypothesis that families in rural China spend an equal amount of resources on boys and girls is tested and I cannot reject this hypothesis. In Lee (1998a), the hypothesis that women allocate equal amounts of time for a boy

39 Only 1% of the households in our sample have five or more children.
and a girl is tested, and I cannot reject this hypothesis either. These results may suggest that, in the context of rural China the child-rearing cost and the preference effect may not differ systematically between boys and girls, and that the criticism of Rosenweig and Wolpin (2000) may not be applicable.
4. Regression Analysis

4.1 The OLS of labor supply and fertility

We examined the relationship between female labor supply and fertility by the OLS. 

\[ Y = \alpha_0 + \alpha_1 \text{more1} + \alpha_2 \text{d_ethnic} + \alpha_3 \text{cmwage} + \alpha_4 \text{r_girl} + \alpha_5 \text{r_one} + \alpha_6 \text{r_job} + \alpha_7 \text{fboyr_g} + \alpha_8 \text{fboyr_o} + \alpha_9 \text{fboyr_j} + \alpha_{10} \text{womenage} + \alpha_{11} \text{age_2} + \alpha_{12} \text{agefirst} + \alpha_{13} \text{educat} + \alpha_{14} \text{fc10} + \alpha_{15} \text{fb_p_r} + \alpha_{16} \text{lpen} + \alpha_{17} \text{pro1} + \ldots \alpha_{23} \text{pro7} + \alpha_{24} \text{yrbf62} + \alpha_{25} \text{yr6266} + \alpha_{26} \text{yr6773} + \alpha_{27} \text{yr7478} + \alpha_{28} \text{yr8487} + \alpha_{29} \text{yr8893} + \varepsilon \] (26)

\( Y \) is a set of variables measuring different aspects of labor market behavior, including whether the woman have wage employment or not (work), the number of weeks they worked (week), and the average hours per week they worked (hr_week). Women who have more children may prefer part-time jobs or seasonal jobs, and they may adjust their labor supply at the extensive margin (participate or not), but not at the intensive margin (hours of participation) (Heckman 1993). Finally, we measure the outcome of the wage employment by the annual income they received from the wage employment (tincome).

We included the following covariates in the regression. They include a dummy variable, which is equal to 1 if the woman has more than 1 child, and 0 if the woman has one child only (more1), and a dummy for ethnicity (d_ethnic), which is equal to 1 if the woman is an ethnic Han, and 0 otherwise. The mean wage for a male worker in the community (cmwage) is included to control for the difference in labor demand. Since variations in the family planning rules might be correlated with local female labor supply, we control them by using a set of dummies for the rule, including whether a community allows a woman to have a second child or not when: (i) the first born child is a girl (r_girl), (ii) she is in a couple whose members both came from a one child family (r_one), and (iii) couples with specialized jobs (r_job). We also interact the sex of the first born child with the three family rules stated above (fboyr_g, fboyr_o and fboyr_j) to examine the

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40 We find a high correlation between the community level wage wage and the female wage.
interactive effect between rules and the sex of the first born child. We include the age of the mother (womenage) and its square (age_2) to examine the life cycle effect on female labor supply. We include the age of the female when she had her first child (agefirst), and her educational attainment (educat), to control for individual characteristics and productivity differences. To examine the effect of a young child on female labor supply, we include a dummy that is equal to 1 if the first born child is 10 years old or above, and 0 otherwise (fc10). We also include the logarithm of the cash penalty (lpen), and a triple interactive term among the sex of the first born child, the cash penalty, and whether a community approves the “second child first girl rule” or not (fb_p_r). On the basis of the result of a one way anova test that indicates substantial difference in the level of the cash penalty among provinces,\(^{41}\) we replace the missing values for 25 communities that do not report the cash penalty\(^{42}\) by the median of the provincial cash penalty. Finally, a set of provincial dummies (pro1, \(\ldots\), pro7) is included to capture spatial heterogeneity, and a set of cohort dummies (yrb62, yr6266, yr6773 yr7478 yr8487, and yr8893) is included to capture any cohort effect, such as the effect of different family planning policies. Table 5 presents the summary statistics of the variables used in the regression.

The regression results of female labor participation are presented in Table 7. The first column of Table 7 presents the OLS results of labor market participation. Fertility has a significant negative effect on women’s labor supply. Women who have more than one child are 23% less likely to have wage employment. There is no difference in labor supply among people with different ethnicity. A strong negative relationship is found between female labor participation and the “first girl second child” rule. We are cautious about this result, for this may indicate that the family rule is endogenous to female labor participation. Other rules and their interaction with the sex of the first born child have no effect on female labor supply. The age and

\(^{41}\) The F-statistic for the one way anova is 5.81. The R\(^2\) of the OLS of the cash penalty by the provincial dummies is .30.

\(^{42}\) Of the 25 communities that do not report the cash penalty, 6 are in Liaoning, 10 in Jiangsu, 6 in Shandong, 2 in Hunan, and 1 in Guizhou.
the square of the age of the woman, and the age of the woman when she had her first child are not significant. Education is significant in explaining female labor participation. One year more education increases the likelihood of working by 2.7%. Since the return on wage employment is considerably higher than the return on farming, consistent with the findings of Kung and Lee (2000) and Benjamin et al (2000), education improves the level of family income. Whether the first born child is over 10 or not is not significant to labor participation. It is interesting that, controlling for the above factors, women in Jiangsu and Henan are less likely to have wage employment, and women in Hubei are more likely to have wage employment, compared to women in Guizhou. There seems to be no cohort effect on labor supply.

The results of other dependent variables, namely the number of weeks worked, the hours worked per week, and annual wage income are basically the same as the result obtained in female labor participation. Instead of presenting the results of the whole regression, we present the coefficients of the fertility effect (More1) on labor supply in Table 8. The results are that those who have two or more children on average worked 11 weeks less, worked 10 hour less per week, and received 400 yuans less in a year. The OLS results clearly support the general observation that women with more children work less. The results, however, may have suffered from the simultaneity bias. The instrumental variable method, estimated by two stage least squares, is used in the following to examine the simultaneity problem.

4.2 Two Stage Least Squares

4.2.1 The First Stage Regression

\[ \text{More1} = \alpha_0 + \alpha_1 f_{\text{boy}} + \alpha_2 d_{\text{ethnic}} + \alpha_3 c_{\text{m wage}} + \alpha_4 r_{\text{_girl}} + \alpha_5 r_{\text{_one}} + \alpha_6 r_{\text{_job}} + \alpha_7 f_{\text{boyr}}_g + \alpha_8 f_{\text{boyr}}_o + \alpha_9 f_{\text{boyr}}_j + \alpha_{10} w_{\text{omen age}} + \alpha_{11} a_{\text{ge2}} + \alpha_{12} a_{\text{ge first}} + \alpha_{13} e_{\text{duc}} + \alpha_{14} f_{\text{c10}} + \alpha_{15} f_{\text{b _p _r}} + \alpha_{16} l_{\text{pen}} + \alpha_{17} p_{\text{ro1}} + \ldots + \alpha_{23} p_{\text{ro7}} + \alpha_{24} y_{\text{r bearing }} + \alpha_{25} y_{\text{r6266}} + \alpha_{26} y_{\text{r6773}} + \alpha_{27} y_{\text{r7478}} + \alpha_{28} y_{\text{r8487}} + \alpha_{29} y_{\text{r8893}} + \varepsilon \] (27)
In the first stage, we regress the fertility variable More1 by the same set of independent variables used in the OLS estimation plus the sex of the first born child fboy. The result of the first stage regression is presented in Table 6. Fboy is a good predictor of fertility. The suggestion is that the family policy rule is a binding constraint that limits the family from having the optimal number of children. Other variables have the expected signs. Older women are more likely to have more than one child. Fertility is negatively related to the age of the mother when she has her first child. A year delay in having the first child reduces the probability of having more than one child by 4.4%. Fertility is negatively correlated with female education. One year more education reduces the probability of having more than one child by about 1%. Highly educated women may have higher aspirations for their children, and they trade off the quality of their children against the quantity of children (Becker 1960). It may also be that the opportunity cost of time rises with the educational level. The ethnic dummy is not important. We also observe huge provincial differences in fertility. Compared to women in Guizhou, women in Liaoning, Jiangsu, and Shandong are less likely to have more than one child. We also observe the women married from 1988 to 1993 are less likely to have more than one child than women who married in the period 1979 to 1983.

4.2.2 The Second Stage Regression

\[ Y = \alpha_0 + \alpha_1 \text{more1} + \alpha_2 d_{\text{ethnic}} + \alpha_3 \text{cmwage} + \alpha_4 \text{[r\_girl]} + \alpha_5 \text{[one]} + \alpha_6 \text{[job]} + \alpha_7 f\text{boyr\_g} + \alpha_8 f\text{boyr\_o} + \alpha_9 f\text{boyr\_j} + \alpha_{10} w\text{omenage} + \alpha_{11} \text{age\_2} + \alpha_{12} \text{age\_first} + \alpha_{13} \text{educat} + \alpha_{14} f\text{c10} + \alpha_{15} f\text{b\_p\_r} + \alpha_{16} \text{[pen]} + \alpha_{17} \text{[pro1]} + \ldots + \alpha_{23} \text{[pro7]} + \alpha_{24} \text{yr\_bf62} + \alpha_{25} \text{yr\_6266} + \alpha_{26} \text{yr\_6773} + \alpha_{27} \text{yr\_7478} + \alpha_{28} \text{yr\_8487} + \alpha_{29} \text{yr\_8893} + \varepsilon \] (28)

4.2.2.1 Using the gender of the first born child as an instrument

Different variables are used as instruments here. Depending on the instrument used, the second stage equations will be slightly different. We bracket the variable r\_girl and f\text{boyr\_g} to
show that they may be used as instruments, instead of as independent variables, in the second stage regression.

The result of 2SLS when fboy is used as an instrument is presented in the second column in Table 7. This result strikingly contrasts with the OLS results. Once instrumented by fboy, more1 is not statistically different from 0 in all equations. On the basis of the arguments that son preferences are strong in China, and that fboy is a valid instrument for more1, the results here point to the inevitable conclusion that change in fertility has no effect on female labor supply.

In fact, when we run an OLS for labor supply and fboy directly, controlling for the same set of explanatory variables, we find no statistical effect from fboy to labor supply. In terms of the diagram, we find that the slope of the PPF is relatively flat. This result, however, is not uncommon. For instance, Cramer (1980) finds that the impact of fertility on labor supply is highly sensitive to the exogeneity assumption of fertility. The fertility effect on labor supply is found to fall with the age of women when fertility is considered exogenous, but to rise when fertility is instrumented (Schultz 1978). In other cases when fertility is found to cause a reduction in labor supply, it may explain only a small part of the variation. Fertility explained 6% of the total increase in labor force participation in the U.S. during the period 1970-80 (Jacobsen et al 1999), and less than 10% of the increase in female participation in the U.S. during the period 1970-90 (Angrist and Evans 1998).

4.2.2.2 2SLS using other instruments

We use the following different combination of the “first girl second child” rule and the sex of the first born child as instruments: r_girl, fboy + fboyr_g, and r_girl + fboy + fboyr_g and present the respective results in the third, fourth, and fifth columns of Table 7. More1 turns out to be significant when instrumented by r_girl, turns out to be insignificant when instrumented by fboy + fboyr_g, and More1 turns out to be significant when instrumented by r_girl + fboy + fboyr_g. In summary, fertility has no effect on the female labor supply if instrumented by fboy,
but has a significant effect on the female labor supply when instrumented by \textit{r\_girl}. That these two sets of instruments give entirely opposite results is puzzling. On the basis of the exogenous nature of the sex instrument, we suspect that the family planning policy may be endogenous to local labor market conditions. One way to test for this endogenous problem of the instrument when we have more than one instrument is the over identifying test, which is a test to examine if the residual from the 2SLS is correlated with the independent variables\footnote{This statistic has a chi-squared distribution with 2 degrees of freedom. The critical value at .05 significance level is 5.99.}. The results are presented in the last row of Table 7. They support the premise that the residuals are correlated with the instruments and reject the null hypothesis of the exogeneity of the instruments.

Comparing the coefficients of \textit{More1} when instrumented separately by \textit{r\_girl} and \textit{fboy}, a downward bias is induced when \textit{r\_girl} is used as an instrument. As discussed above, this indicates a negative relationship between the approval of the rule and the local female labor supply, which can be explained by the three possible reasons, namely, that the stringent rule is used in areas where such a rule is more likely to be enforceable, that cadres may increase labor supply by setting a stringent rule, and that the rule might have been used to generate tax revenue for local government.

The 2SLS results of other dependent variables are presented in Table 8. The results are highly consistent with the result of labor participation, i.e., that fertility has a negative impact on these measure of labor supply and income received when \textit{r\_girl} or \textit{fboy + fboyr + r\_girl} is used as instruments, but is not significant when \textit{fboy} is used as an instrumented. The result of the over identifying tests also support the premise that \textit{r\_girl} is not exogenous to local female labor supply.

4.2.3 The Problem of the Local Treatment Effect

One potential problem of our results is that we pool all families with more than one child into one group and examine the difference between the labor supply of this group of people and
the labor supply of other families with one child only. If the effect of fertility on labor supply is concentrated in those families with 3 or more children, our instrument may not be able to identify this phenomenon. To check whether this is a problem or not, we performed the same analysis for women who married after 1978 and have one or two children. This reduces our sample to 634. The results are presented in Table 9. These results are highly consistent with the results of the full sample. Thus, we do not have a problem with the local treatment effect.
5. Concluding Remarks

In this paper, we proposed to use the sex of the first born child as instrument to examine the relationship between fertility and labor supply. Our conclusion, i.e., that fertility has no effect on women’s labor supply contrasts greatly with that of Rosenzweig and Wolpin (1980b), that the endogeneity problem of fertility will lead to an underestimation of the effect of fertility on female labor supply. Fleisher and Rhodes (1979) also found that controlling for the endogeneity problem, fertility has no effect on labor supply, though they argue that fertility may have an indirect wage effect on labor supply. Other studies have found that some activities that seemingly have a negative effect on labor supply, such as breast feeding (Roe et al 1999) and child care costs (Ribar 1995), turn out to have no effect. The question is why a sorting story is a good description of labor supply and fertility in China. In other words, why do people inclined to have more children not supply less labor? We argue that the level of social security and the development of the labor market may be the reasons.

The labor market in rural China is far from fully developed. A person willing to supply his labor at the going market wage may not be able to find a job. Given the level of development in China and the lack of a general social security system, only a few people are able to support their living from income other than the return on their labor. Thus, few people would reduce their labor supply because they have more children. A woman may need a part-time job instead of a full-time job when she has more children, but, given the level of economic development, part-time jobs are still not readily available in rural China.

The finding that local family planning policy is endogenous to female labor supply has important implications both for policy and empirical analysis. In a large developing country such as China, where endowments and preferences tend to vary substantially from one place to

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44 Fleisher and Rhodes (1979) also consider that the result may be due to weak instrument. However, there is no R-squared presented in Ronsenzweig and Wolpin (1980) for a comparison.
another, chances are small that a uniform (or “single cut”) policy – whether it is for birth planning or land tenure – will be equally received everywhere. While test trials may often prove successful, it is perhaps more important to inquire into the choice of these trials in the first place, if one is to avoid the potential problem of a selection bias. A recent study of an experiment in land tenure policy has inspiringly demonstrated this proposition.45

As an extension of this paper, we will analyze the determinants of family planning rules and the level of the cash penalty. We will explore the panel nature of the CHNS data set to examine the dynamics of change in family planning rules. Besides economic factors, we anticipate that this analysis will involve many political economy considerations.

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45 Resource endowment was arguably a principal factor in choosing Meitan County in Guizhou Province to be the site for conducting the experiment of halting land reallocation as a way of invigorating tenure security. Meitan has a hilly topographical terrain and a rich variety of both arable and nonarable resources, which inherently make land reallocation a costly process. A recent study has indeed shown that villagers in Meitan had already halted land reallocations long before the official policy, implemented in 1987, was enunciated (Kung, 2000).
Appendix 1 The Labor Supply Model

In this appendix, we show how changing the exogenous assumption of the instrument will affect our result.

The Simultaneity Bias of the Labor Supply and Fertility Equations

The problem of the simultaneous bias is obvious in estimating the relationship between fertility and labor supply. For simplicity, assume that other variables are exogenous. Consider the following two equation model: Labor Supply (measure in deviation from mean)

\[ L = \alpha C + \epsilon_1 \]
\[ C = \beta L + \epsilon_2 \]

Rearranging terms will give

\[ C = \beta \epsilon_1 + \epsilon_2 \]
\[ \frac{1-\alpha \beta}{\text{cov} (C, \epsilon_1)} = \beta \text{Var}(\epsilon_1) \neq 0 \]

This violates one assumption in the OLS estimation and the OLS estimator will be bias.

Case 1: When the Instrument Z is independent of the error term in the labor supply equation.

One way to resolve this simultaneity bias is to find a variable that correlates with C, but is independent of L. It will give a consistent estimator of \( \alpha \).

\[ L = \alpha C + \epsilon_1 \]
\[ C = \beta Z + \epsilon_2 \]

Assume that \( \text{cov} (Z, \epsilon_1) = 0 \), and using the sample estimate of \( \text{cov} (Z, \epsilon_1) = 1/n \Sigma (L - \alpha C) = 0 \)

\[ \alpha_{IV} = \Sigma ZL / \Sigma ZC \]
\[ \alpha_{IV} = \Sigma Z (\alpha C + \epsilon_1) / \Sigma ZC \]
\[ \alpha_{IV} = \alpha + \Sigma Z \& \epsilon_1 / \Sigma ZC \]
\[ \text{plim } \alpha_{IV} = \alpha \]

as \( \Sigma Z \epsilon_1 / \Sigma ZC = 1/n(\Sigma Z \epsilon_1) / 1/n(\Sigma ZC), \)

\[ \text{plim } 1/n(\Sigma Z \epsilon_1) = \text{cov}(Z, \epsilon_1) = 0 \text{ and } \text{plim } 1/n(\Sigma Z \epsilon_1) = \text{cov}(Z, C) \neq 0. \]

Case 2: When the Instrument Z is correlated with labor supply

In the case when the instrument is correlated with labor supply, the IV estimator will be biased.

\[
\begin{align*}
L &= \alpha C + \epsilon_1 \\
C &= \beta Z + \epsilon_2 \\
Z &= \gamma L + \epsilon_3
\end{align*}
\]

L: Female labor supply
C: Number of Child a woman has
Z: Instrument (in here the family rule. 1 approve, 0 otherwise)

\[ \alpha_{IV} = \Sigma ZL / \Sigma ZC \]

\[ \alpha_{IV} = \alpha + \alpha \gamma \Sigma C \epsilon_1 + \gamma \Sigma \epsilon_1^2 + \Sigma \epsilon_1 \epsilon_3 \]

\[ \alpha_{IV} = \alpha + \frac{(\alpha \gamma \beta + \gamma) \text{Var}(\epsilon_1)}{[\gamma^2 \beta \text{Var}(\epsilon_1) + \beta \text{Var}(\epsilon_3) + (\alpha \gamma \text{Var}(\epsilon_2))]}
\]

We expect that \( \alpha < 0. \) If the instrument is the “first girl second child” rule, we expect that \( \beta > 0. \) The IV estimator will underestimate the relationship between fertility and labor supply if \( \gamma < 0, \) i.e. when the “first girl second child” rule is less likely to be approved in areas where the female labor supply is high.
Appendix II Accounting for the number of households that might have violate the family planning rules

In the absence of any explicit information about whether a family has paid the cash penalty or not in the data set, we perform the following exercise to show the extent to which the family rules have been violated in the data. We examine households that have children during the period from 1989 to 1993 and present the findings in Table A1. There are 152 families that do not have children before 1989. Only 18 families progressed to having a second child; 6 of them have a boy as their first born, and 12 of them have a girl as their first born. Of those who have a first born boy, only 3 are clearly have more children than allowed without any kind of exception to the rule. Of those who have a first born girl, only 5 are clearly have more children than allowed. Only 8 women, or 5% of the sample women may have been induced to work to pay for the fine. In fact, only 1 out of 18 women who had a second child during the period worked, and her first child was a boy.

There are 174 families that had children before 1989 and continued to have more children from 1989 to 1993. About 35% of the families were having their third or fourth child from 1989 to 1993, a somewhat higher proportion than families with three or more children in our sample. Obviously, many of these high order births would have been violating the local family rules. Only 4 of these women, less than 3% of them, have wage employment, however. Thus, the penalty induced working effect is small, and is not likely to bias the use of the sex of the first born child as an instrument.
Reference


Table 3 Summary of the family planning rule in the sample counties

<table>
<thead>
<tr>
<th></th>
<th>1993</th>
<th></th>
<th>City</th>
<th></th>
<th>Rural</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowed to have two children?</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>159</td>
<td>3</td>
<td>56</td>
<td>19</td>
<td>103</td>
</tr>
<tr>
<td>First child is a girl?</td>
<td>53</td>
<td>106</td>
<td>2</td>
<td>54</td>
<td>51</td>
<td>52</td>
</tr>
<tr>
<td>First child is handicapped?</td>
<td>152</td>
<td>7</td>
<td>50</td>
<td>6</td>
<td>102</td>
<td>1</td>
</tr>
<tr>
<td>If each parent is an only child?</td>
<td>76</td>
<td>83</td>
<td>27</td>
<td>29</td>
<td>49</td>
<td>54</td>
</tr>
<tr>
<td>If both parents have certain special occupations?</td>
<td>48</td>
<td>110</td>
<td>15</td>
<td>41</td>
<td>33</td>
<td>69</td>
</tr>
<tr>
<td>For Han, any other exceptions?</td>
<td>71</td>
<td>84</td>
<td>26</td>
<td>28</td>
<td>45</td>
<td>56</td>
</tr>
<tr>
<td>Same for minorities as Han?</td>
<td>80</td>
<td>71</td>
<td>25</td>
<td>25</td>
<td>55</td>
<td>46</td>
</tr>
<tr>
<td>Minority allowed to have two children?</td>
<td>56</td>
<td>100</td>
<td>18</td>
<td>34</td>
<td>38</td>
<td>66</td>
</tr>
<tr>
<td>Minority allowed to have three children?</td>
<td>6</td>
<td>149</td>
<td>1</td>
<td>51</td>
<td>5</td>
<td>98</td>
</tr>
<tr>
<td>If have more children than allowed, do they have to pay a fine?</td>
<td>175</td>
<td>4</td>
<td>57</td>
<td>2</td>
<td>118</td>
<td>2</td>
</tr>
<tr>
<td>Mean and median of the fine (yuan)</td>
<td>3643</td>
<td>3000</td>
<td>3811</td>
<td>3000</td>
<td>3527</td>
<td>2800</td>
</tr>
<tr>
<td>What are the terms of payment for this fine?</td>
<td>All in one yr</td>
<td>114</td>
<td>36</td>
<td>78</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>A % each yr</td>
<td>36</td>
<td>12</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>23</td>
<td>8</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If a couple has only one child do you provide a subsidy to them?</td>
<td>103</td>
<td>77</td>
<td>39</td>
<td>20</td>
<td>64</td>
<td>57</td>
</tr>
<tr>
<td>During the past 12 month, cash subsidy to a one-child family (yuan) mean and median</td>
<td>59.5</td>
<td>60</td>
<td>59</td>
<td>60</td>
<td>59.8</td>
<td>50</td>
</tr>
<tr>
<td>Can children who are born out of the plan be registered promptly?</td>
<td>54</td>
<td>120</td>
<td>16</td>
<td>42</td>
<td>38</td>
<td>78</td>
</tr>
<tr>
<td>Before the children are registered, can they have various ration subsidies</td>
<td>5</td>
<td>111</td>
<td>2</td>
<td>36</td>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>Have the local cadres implemented the FPRS?</td>
<td>Yes</td>
<td>135</td>
<td>47</td>
<td>84</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes, but no economic reward</td>
<td>38</td>
<td>10</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If a couple has more children, do you cease to provide them with rationed grains?</td>
<td>17</td>
<td>57</td>
<td>9</td>
<td>38</td>
<td>8</td>
<td>19</td>
</tr>
<tr>
<td>If a couple has more children, do you cease to provide them with ration coupons for cooking oil?</td>
<td>18</td>
<td>53</td>
<td>9</td>
<td>38</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>If a couple has more children, do you cease to provide them with ration coupons for other things?</td>
<td>13</td>
<td>60</td>
<td>7</td>
<td>42</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Do they lose their work?</td>
<td>65</td>
<td>13</td>
<td>42</td>
<td>7</td>
<td>23</td>
<td>6</td>
</tr>
<tr>
<td>Do they lose work unit promotions?</td>
<td>66</td>
<td>14</td>
<td>45</td>
<td>6</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>Do they lose access to housing?</td>
<td>63</td>
<td>17</td>
<td>42</td>
<td>9</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>Do they lose work unit bonuses?</td>
<td>66</td>
<td>14</td>
<td>43</td>
<td>8</td>
<td>23</td>
<td>6</td>
</tr>
<tr>
<td>Do one-child families receive extra ration supplies of food?</td>
<td>7</td>
<td>157</td>
<td>2</td>
<td>55</td>
<td>5</td>
<td>102</td>
</tr>
<tr>
<td>Better housing?</td>
<td>26</td>
<td>138</td>
<td>17</td>
<td>40</td>
<td>9</td>
<td>98</td>
</tr>
<tr>
<td>Child health care subsidies</td>
<td>50</td>
<td>115</td>
<td>31</td>
<td>27</td>
<td>19</td>
<td>88</td>
</tr>
<tr>
<td>Other subsidies?</td>
<td>28</td>
<td>137</td>
<td>13</td>
<td>45</td>
<td>15</td>
<td>92</td>
</tr>
</tbody>
</table>
### Fig. 3 The timing of 5 main events of the family policy in the past 4 decades of sampled provinces

<table>
<thead>
<tr>
<th>Province</th>
<th>57</th>
<th>65</th>
<th>71</th>
<th>76</th>
<th>79</th>
<th>81</th>
<th>84</th>
<th>87</th>
<th>88</th>
<th>93</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liaoning</td>
<td></td>
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<td>Jingsu</td>
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<td>Shandong</td>
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<td>Henan</td>
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<td>Hubei</td>
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<td>Hunan</td>
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<td>Guangxi</td>
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<tr>
<td>Guizhou</td>
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<td></td>
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</tr>
</tbody>
</table>

- : Establishment of Provincial Family Planning Commission
- : The “Later Marriage, Wider spacing, and Fewer Birth” Policy
- : One-child Policy
- : Relaxation of the One-child Policy
- Incorporate target fertility into Cadres’ Performance Evaluation
Fig. 5  Sex ratio at birth: 1981-1989, China