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THE EFFECTS OF INCOME LEVEL, INCOME DISTRIBUTION, EDUCATION AND URBANIZATION ON FERTILITY RATES AMONG 28 ADMINISTRATIVE REGIONS OF CHINA

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This paper analyzes the influence of income distribution on fertility behavior using the Chinese provincial data mainly taken from the 1982 Population Census of China. The existing evidence on this important issue is inconclusive. In particular, our use of cross-province data for a single country improves upon the existing literature which employed either cross-country data or individual household data.

INTRODUCTION

This paper analyzes the influence of income distribution on fertility behavior using the Chinese provincial data mainly taken from the 1982 Population Census of China.

As shown in Section 2, emiprical evidence concerning the influence of income distribution on fertility is conflicting, and the literature on this important issue is controversial and does not provide any conclusive guidance to the policy decision makers. Previous studies used either cross-country data or individual household data. In contrast, this study uses cross-province data of China. The use of cross-country data in previous studies has a serious problem because measurements and qualities of income level and income distribution data vary too widely among different countries to be able to use the conclusion from these analyses as a guidance to policy makings. The use of the cross-province data in this study does not suffer from this problem because the measurement and quality of income level and income distribution data must be much more uniform within one nation than across countries. In spite of the superiority of the cross-regional data over the cross-country data, few studies used cross-province or cross-country data to analyze the influence of income distribution on fertility behaviors with an exception of Birdsall and Jamison (1983).

Furthermore, Chinese interregional income data are particularly interesting because it is widely recognized that the inequality of interregional income distribution is higher in the socialist countries than that of the capitalist countries, whereas the inequality of household income distribution is lower in the former than that in the later (Pannell 1987-88; Debroy 1987). The main reason for the large interregional income differentials is the restriction of free factor movements among regions. In China the labor movements among regions were severely restricted until recently, except for the non-economical, political, and government-forced movements of labor during the Cultural Revolution. The Maoist policy encouraged local and regional self-sufficiency in foodgrains and so discouraged crop specialization according to the principle of comparative advantage. This policy brought stagnation of some regions. The evidence on the relationship between the inequality of interregional income distribution and fertility in China has a very important policy implication.

The discussion of the literature examining the influence of income distribution on fertility in Section 2 is followed by Section 3 which includes discussions on the data and major statistical characteristics of the variables included in the estimations. The major regression results are reported and interpreted in Section 4. The summary and conclusions are presented in Section 5.

THE EFFECT OF INCOME DISTRIBUTION ON FERTILITY

One of the important linkages between socioeconomic variables and fertility is the hypothesis that a more equitable distribution of income contributes to the reduction of fertility, and may even be a precondition for such a reduction. It is argued that, in developing countries, fertility is generally negatively associated with income and that the relation is nonlinear in such a way that a small increase in the income of a poor couple reduces fertility more than does a small increase in the income of a rich couple; thus a redistribution of income from the rich to the poor reduces the average level of fertility. This hypothesis has important policy implications. It implies that countries should consider a redistribution of incomes as a way to reduce fertility (in addition to other effects it might have). Kocher (1984) suggests the following policy guidelines in order to increase the full income accruing to the low income majority; he argues that the overall fertility decline effects from these income redistribution policies will be greater than would occur if these development resources were directed to other areas: (a) major commitment of public resources to basic schooling (especially up to secondary level, and especially for girls), technical training, health care, and family planning services; (b) adoption of development strategies which give strong emphasis to policies and investments which stimulate labor-intensive sectors; and (c) technology development, promotion, and adoption strategies that favor technologies that complement rather than displace labor, in both the urban and rural sectors.

Repetto (1973, 1978, 1979), Kocher (1973), and Rich (1973) performed the empirical testings of these hypothesized linkages between income distribution and fertility and concluded that equalizing the distribution of income reduces fertility. Particularly, Repetto employs a three-equation model of interrelationships among fertility, infant mortality, and income distribution to test the hypothesis using cross-country data; this shows that the coefficient for the Gini Coefficient of income distribution variable in the fertility equation is positive and statistically significant.

Repetto also performed a micro-level analysis using household data from Puerto Rico and Korea. He tested that the relationship between household income and fertility was nonlinear with the expectation of a negative linear term and a positive quadratic term. The principal test consisted of regressions of children-ever-born on an income-per-household member (YPC), income per household member squared (YPC2), age of the wife, wife's education, and other variables expected to influence fertility. He found that in all regressions for both Puerto Rican and Korean data, the coefficient for YPC was negative and the coefficient for YPC2 was positive, and both coefficients were statistically significant. Based on this evidence, he asserts that equalization of income levels among households results in lower aggregate fertility for the entire population. For example, he argues that redistribution of income between households at one-half the average Korean income level and households at five times the average income level would reduce the overall fertility level of Korea by about 12 percent, or approximately half of a birth in terms of mean numbers of children ever born per household (Repetto 1979).

The analyses and conclusions of Repetto have recently been criticized by various researchers including Birdsall (1977a, 1977b), and Boulier (1982) (see also Repetto (1977, 1982) for his responses to criticisms by Birdsall and Boulier). Birdsall points out that when the Eastern European countries of Bulgaria, Czechoslovakia, Hungary, Poland, and Yugoslavia — all extreme observations with the lowest fertility and the most equitable distribution of income — are excluded from Repetto's 64 nation sample, the coefficient for the income-distribution variable is no longer significant at the conventional 5 percent level. When the regression sample is limited to 41 less developed countries excluding 27 developed countries, the coefficient on the income distribution variable is also not significant. Birdsall argues that since the regression results are so sensitive to the exclusion of different sets of countries, our understanding of the true underlying relationship between income distribution and fertility is far from complete for Repetto's model to be useful in drawing policy conclusions. Birdsall further argues that the Repetto's use of such highly aggregated cross-country results to predict the pattern of a relationship between income distribution and fertility for a nation over time is highly questionable.

Boulier (1982) criticizes the micro-level analysis of Repetto, arguing that by regressing fertility on per capita (household member) income variables rather than per household income variables, Repetto introduces a spurious nonlinearity. This occurs because the per capita income variable is obtained by deflating the total household income by the number of family members which is highly correlated with the dependent variable, children ever born. Because of this statistical problem, Boulier feels that Repetto's regressions relating fertility to the per capita income measures cannot be used to test hypotheses relating fertility change to income distribution.

Both Birdsall and Boulier emphasize that the income distribution data in developing countries are often of poor quality and that measures of income inequality are often not comparable among nations because of differences in the definitions of income and households, and difference in the distributions of individuals among households. They suggest that recognition of the limitations of using faulty measures and poor quality data for income distribution dictates caution in the interpretation of Repetto's quantitative results.

There are recent empirical studies which contradict the conclusions of Repetto (Resenzweig and Evenson 1977; Boulier 1982). In their analysis of the determinants of fertility among Indian rural women, Rosenzweig and Evenson (1977) found that land size, which was assumed to be complementary with child labor, had a positive and statistically significant influence on fertility, and that a measure of land concentration had a negative influence on fertility. Based on the latter evidence, they conclude that a land redistribution program aimed at promoting equality, unaccompanied by other changes, would increase fertility in rural India. This finding contradicts Repetto's contention that the effects of land redistribution on fertility is negative.

Boulier (1982) analyzed the socioeconomic determinants of the number of children-ever-born to Filipino women aged 25 to 50. When he used the per household income variable (YH) and income squared (YH2), rather than the per capita income measures, the coefficient for YH is positive and that for YH2 is negative and both coefficients are statistically significant. The nonlinear relation between income and fertility resembles an inverted U such that a transfer of income from a couple with higher income to a couple with lower income raises fertility. When he adopted the Repetto-like specification which uses the per capita income variables (YPC and YPC2) rather than the per household income variables in the fertility regressions, he obtained very similar results to Repetto's, revealing that the relationship between income and fertility is U-shaped. Boulier concluded that this outcome provided further evidence that Repetto's estimates of the effect of income distribution on fertility were deficient because the latter misspecified his model by using the per capita income measures rather than the per household income variables. From his analysis of Philippine data, Boulier also generated another important finding: the nature of the nonlinear relation between fertility and female education is such that a redistribution of a fixed stock of years of schooling from better-educated women to women with fewer years of schooling increases the average level of fertility. For example, he shows that if a woman with 11 years of schooling had attained only 10 years of schooling and this additional year of schooling were given to a woman with 1 year of schooling, the number of births would increase by .07.

It is generally accepted that the dispersion of adult educational attainment and the concentration of land ownership are the major determinants of income distributions in developing countries (see Repetto 1979). The empirical evidence generated by Rosenzweig and Evenson (1977) and Boulier (1982), indicating that more equal distributions of land holdings and schooling years increase rather than decrease fertility in developing nations, undoubtedly justify many skeptical views of Repetto's works on the income distribution fertility relationship.

DATA

This paper analyzes the effects of income level, income distribution, education, and urbanization on fertility rates among 28 major provinces, municipalities, and autonomous regions of China, circa 1982. The autonomous region of Tibet has been excluded because data for some major variables are not available for this region. These 28 regions are generally referred to as provinces hereafter. The data on fertility and socioeconomic characteristics for each of the 28 provinces are taken mainly from *The 1982 Population Census of China: Results of Computer Tabulation* (1985) and partly from previous studies including Tien (1984), Poston and Gu (1987) and the People's Republic of China Population Data Sheet prepared by Gu, Poston, and Shu (1987).

TABLE 1. MEANS AND STANDARD DEVIATIONS OF VARIABLES USED IN THE REGRESSION[a]

Variable Name	Mean	Standard Deviation
TFR	2.689	0.841
CBIRTHR1	21.903	4.156
RINCREA1	15.368	3.623
GRPOP	0.484	0.173
CEBZ82	2.554	0.340
CEBA82	3.780	0.417
YOUTPC80	0.901	1.117
YOUTP802	2.018	6.217
YOUTPH80	3.732	3.969
YOUTH802	29.151	80.927
AUTORGD	0.172	0.384
URBAN	25.810	15.830
PURB79	17.586	15.637
FLIT	54.269	15.239
FSCHYR	5.319	1.027
FSCHYR2	29.319	11.644
VARFSYR	10.803	1.843
FAJHIGH	0.273	0.118
FASHIGH	0.086	0.056
FASMCOL	0.006	0.008

[a] Definitions of variables are provided in the text.

Table 1 presents the means and standard deviations for the major variables used in the regression analyses. For the dependent variable we utilized six fertility rate measures including TFR, CBIRTHR1, RINCREA1, GRPOP, CEBZ82, and CEBA82. TFR is the total fertility rate in 1981 which was taken from Poston and Gu (1987). The mean value of TFR was 2.69; the smallest value was 1.32 for Shanghai and the largest value 4.36 for Guizhou. Guangxi and Ningxia also had a total fertility rate above 4. The TFRs for Beijing and Tianjin, 1.59 and 1.65, were the second and third lowest fertility rates. The values of TFR clearly show that there are wide variations in fertility among the provinces. According to Poston (1987), the total fertility rate for Shanghai is roughly equivalent to those of West Germany and Denmark, whereas the TFR for Guizhou is close to those of Mexico and Indonesia.

CBIRTHR1 is the crude birth rate in 1981 and had a mean value of 21.9 births per 1000 people. RINCREA1 is the rate of natural increase in 1981 and had a mean value of 15.37 per 1000 people. Both CBIRTHR1 and RINCREA1 were taken from China's Population Data Sheet prepared by Gu, Poston and

Suh (1987). GRPOP is the increase in population between 1964 and 1982 as a fraction of the 1964 population and was taken from the 1982 Census. The mean value of GRPOP was 0.48. The largest values were 84.8 percent increase for Ningxia, 81.6 percent for Qinghai, and 79.9 percent for Xingjian. The smallest growths were observed for three primate cities: 9.6 percent for Shanghai, 21.5 percent for Beijing, and 24.2 percent for Tianjin. This result seems to reflect the outcome of the Chinese government's longstanding policy of discouraging the growth of the east coastal area major cities and encouraging the growth of the western inland areas. Because of this influence of the government's population redistribution policies, GRPOP may not accurately measure the fertility rate of a province. Since it is true that the mortality rates vary substantially among the regions of China, RINCREA1, which is the difference between the crude birth and death rates, is also deficient as a measure of the fertility rate.

Two additional fertility measures were created utilizing 1982 Census data. These two variables are the weighted average of children ever born to a woman and computed as follows:

$$\begin{aligned} \text{CEBZ82} = {} & 1\cdot(\text{fraction of women with 1 birth}) \\ & + 2\cdot(\text{fraction of women with 2 births}) \\ & \cdots + 6\cdot(\text{fraction of women with 6 births}) \\ & + 7{\cdot}5\cdot(\text{fraction of women with 7 or more births}) \end{aligned}$$

$$\text{CEBA82} = \text{CEBZ82}/(1 - \text{fraction of women with zero live birth})$$

CEBZ82 is the average children ever born to an eligible woman who is at least 15 years old whereas CEBA82 is the average children ever born to a woman who had at least one live birth and is at least 15 years old. The mean value of CEBZ82 was 2.55 and the lowest values were 1.82 for Shanghai, 1.84 for Beijing and 1.95 for Tianjin. The highest values were 3.16 for Guizhou, 3.02 for Yunnan and 3.0 for Ningxia. The mean value of CEBA82 was 3.78; the lowest value 2.89 was for Shanghai and the highest value 4.57 was for Guizhou.

The independent variables include four categories of variables: income, education, urbanization, and the extent of family planning programs. As income variables, YOUTPC80, YOUTP802, YOUTPH80, and YOUTH802 were used. YOUTPC80 is the output per capita in 1,000 yuan (1 yuan = $.6 in 1979-80) in 1980 and was taken from Tien (1984). The mean value was 901 yuan, or $546. The largest value 5,715 yuan for Shanghai is more than twice that of the second highest values, 2,824 and 2,801 yuan for Beijing and Tianjin, respectively, and is equal to or slightly less than 20 times the values for the poorest provinces, 266, 324, and 328 yuan for Guizhou, Yunnan and Tibet, respectively. These data clearly indicate the large inequality of regional income distribution. YOUTP802 is the square of YOUTPC80. As discussed in Section 2, Boulier (1982) argued that the use of the per capita income variable and its squared value variable in the fertility regression introduces a spurious nonlinearity. Following Boulier's suggestion, household income variables, YOUTPH80 and YOUTH802, appear in the regression equations. YOUTPH80 is obtained by multiplying YOUTPC80 by the average family size in each province which was obtained from the 1982 Census. YOUTH802 is the squared value of YOUTPH80. The mean value of YOUTPH80 was 3,732 yuan, the largest value 20,574 yuan for Shanghai, and the smallest value 1,303 yuan for Guizhou. YOUTPH80 is highly correlated with YOUTPC80 with the correlation coefficient of 0.999.

The urbanization variable is PURB79, which is the share of urban population in 1979 but excludes urban residents who are involved in farming and was taken from Tien (1984). The mean value of PURB79 was 17.59 percent; the largest value was 65.6 for Tianjin, and the smallest value was 5.7 for Guangxi. The values for Shanghai and Beijing were 52.2 and 58.5, respectively.

The variables reflecting the educational level of each province include FLIT, FSCHYR, FSCHYR2, VARFSYR, FAJHIGH, FASHIGH, and FASMCOL. FLIT is the percent female population 12 years or older which is literate and was taken from the 1982 Census. The mean value was 54.27; the largest value was 77.76 for Beijing, and the lowest value was 15.66 for Tibet. The provinces which had more than 70 percent of female literate population include Liaoning (76.59), Shanghai (74.12), Tianjin (73.88), and Jilin (71.04) in addition to Beijing. The provinces which had less than 40 percent of female literate population include Guizhou (32.60), Gangsu (35.44), Yunnan (35.86), Anhui (35.95), and Qinghai (36.84) in addition to Tibet.

All the educational variables except FLIT were created utilizing 1982 Census data. The Census provides information on total numbers of females 6 years or older for each province who completed elementary school, junior high school, senior high school, incompleted college education, or who graduated from college. From these data FAJHIGH, FASHIGH, and FASMCOL were calculated. (FAJHIGH is the fraction of female population 12 years or older who have at least completed junior high school; FASHIGH is the corresponding population who have at least completed senior high school; and FASMCOL is for those who had at least some college education.) The mean values reveal that 27.3 percent of the female population completed junior high school or higher levels of schooling, 8.6 percent completed senior high or higher schooling, and only 0.6 percent had some level of college education. In Beijing 57.0, 25.9, and 4.2 percent of female residents had completed at least junior high, senior high, and some college education, respectively. The corresponding percentages for Shanghai were 52.7, 24.4, and 2.3, respectively. On the other hand, in Tibet only 5.1, 1.6 and 0.3 percent of female population had completed at least junior high, senior high and some college education. In 7 of 29 provinces less than 20 percent of female population had an education level of junior high or above. In both Guizhou and Yunnan only 14 percent of female population had an educational level of junior high or above.

FSCHYR is the weighted average years of women's education and is computed as follows:

FSCHYR = 2·(fraction of female illiterate population 12 years or older)
+ 6·(fraction of female population 12 years or older who had elementary education only)
+ 9·(fraction of women with junior high schooling only)
+ 12·(fraction of women with senior high schooling only)
+ 14·(fraction of women who are currently in colleges or had dropped from college)
+ 16·(fraction of women who graduated from college)

FSCHYR2 is the squared value of FSCHYR and VARFSYR is the variance of FSCHYR for each province.

The mean value of FSCHYR was 5.32 years; the largest values were 7.74 for Beijing and 7.36 for Shanghai; and the lowest values were 3.83 for Guizhou and 3.95 for Yunnan. The mean value of VARFSYR was 10.80; the largest values were 14.94 for Beijing and 14.86 for Shanghai; and the smallest value was 5.92 for Tibet.

REGRESSION RESULTS

Table 2 shows the ordinary least square regression results regressing six different measures of fertility rates on the independent variables including YOUTPC80, KYOUTP802, FLIT, PURB79, and AUTORGD. We expect the coefficient for the income variable, YOUTPC80, to be negative mainly because when per capita income is high, the couple substitutes the quality of child services for the quantity of children. The demand for financial support

TABLE 2. THE EFFECTS OF INCOME LEVEL, INCOME DISTRIBUTION, WOMEN'S SCHOOLING, AND URBANIZATION ON FERTILITY RATES FOR 28 CHINESE PROVINCES USING THE PER CAPITA INCOME VARIABLES[a]

Independent Variables	Dependent Variables					
	TFR	CBIRTHR1	RINCREA1	GRPOP	CEBZ82	CEBA82
Constant	4.557	27.568	18.611	.740	3.405	4.818
	(10.43)	(14.0)	(10.29)	(8.93)	(26.55)	(29.78)
YOUTPC80	−1.853	−7.422	−5.961	−.524	−.927	−1.198
	(−2.57)	(−2.10)	(−1.83)	(−3.52)	(−4.38)	(−4.48)
YOUTP802	.224	.866	.641	.058	.110	.141
	(2.31)	(1.82)	(1.46)	(2.88)	(3.87)	(3.92)
PURB79	.038	.186	.148	.012	.015	.023
	(2.10)	(2.04)	(1.78)	(3.06)	(2.92)	(3.42)
AUTORGD	.792	5.444	5.085	.084	.061	.136
	(2.67)	(4.07)	(4.14)	(1.50)	(.70)	(1.23)
FLIT	−.025	−.091	−.049	−.002	−.009	−.012
	(−2.66)	(−2.24)	(−1.31)	(−1.29)	(−3.26)	(−3.32)
R^2	.7296	.7106	.6787	.7066	.8576	.8492

[a] The numbers in the parentheses below the coefficient estimates are the usual t-values.

from children during the parents' old age diminishes, thus the demand for children is reduced. If we believe that more equitable income distribution contributes to the reduction of the fertility rate, then we would anticipate a positive coefficient for the square term of the per capita income variable, YOUTP802. On the other hand, if we feel that the equality of income distribution does not matter to the fertility rate, then the coefficient for YOUTP802 will be negative. We anticipate the coefficient of the women's literacy rate variable, FLIT, to be negative because more educated women are more efficient in fertility control techniques, incur higher time costs in bearing and raising children, and have higher aspiration for their children's educational levels. We expect a positive coefficient for the autonomous region dummy variable, AUTORGD, because the Chinese government does not strictly enforce its family planning programs in the autonomous regions which have large populations of ethnic minorities. We anticipate a negative coefficient for the urbanization variable, PURB79, because relative prices and incomes of urban areas discourage large family size.

The coefficients for YOUTPC80 in Table 2 are consistently negative and statistically significant. The coefficients for YOUTP802 are consistently positive and statistically significant in most regressions. These results strongly support the argument by Repetto (1979) that the redistribution of income from high income provinces to low income provinces would reduce national fertility rates. Birdsall and Jamison (1983) regressed a measure of inequality on fertility using the Chinese provincial data and obtained a statistically significant positive coefficient. Their inequality measure reflects the extent to which a greater proportion of the population is living at low levels of consumption than would be expected given average provincial income. Their approach is similar to the macro-level analyses of Repetto (1979), and the approach used in this study is similar to the micro-level analysis of Repetto. Both theirs and this study support the contention by Repetto for Chinese data.

The coefficients for FLIT in Table 2 are consistently negative and statistically significant in most regressions. It is clear that the increase in women's education reduces fertility rates. The coefficients for AUTORGD are consistently positive and statistically significant except for two regressions: CEBZ82 and CEBA82. The relaxation of family planning program enforcements appears to make a significant difference in fertility rates. The correlation coefficients of CEBZ82 and CEBA82 with AUTORGD are 0.28 and 0.33 and are significantly lower than those of TFR (0.49), CBIRTHR1 (0.69), RINCREA1 (0.70) and GRPOP (0.47) with AUTORGD. The active governmental family planning programs started in 1971. It is reasonable to expect that 1970's family planning programs had stronger effects on the fertility variables reflecting the current year fertility rates, such as TFR, CBIRTHR1 and RINCREA1, than on the children ever born variables, such as CEBZ82 and CEBA82, for which a large portion of births might have occurred before the beginning of governmental family planning programs.

The coefficients for PURB79 in Table 2 are all positive and statistically significant. These results are contrary to our expectation. Birdsall and Jamison (1983) had similar results and explained as follows:

> The overall weakness of the urban variables in the province-level regressions could be real, that is, because lower fertility in more highly urbanized provinces is entirely due to higher income (so that there is no urban effect per se once income is controlled for). It is plausible that the urban populations in other countries enjoy many amenities-particularly access to educational, health, and family planning services-that are not available to those in rural areas, and that are not well reflected in urban-rural income differences. In contrast, China is notable for the extent to which birth planning and health services have reached rural areas. The alternative explanation is that there are real differences in fertility, even controlling for income, but that underregistration of births in rural areas is greater than in urban areas, and the dependent variable is therefore artificially low for rural areas.

The urbanization coefficients are further evaluated later in this section. Overall, most of these results support the explanations given above by Birdsall and

TABLE 3. THE EFFECTS OF INCOME LEVEL, INCOME DISTRIBUTION, WOMEN'S SCHOOLING, AND URBANIZATION ON FERTILITY RATES FOR 28 CHINESE PROVINCES USING THE PER HOUSEHOLD INCOME VARIABLES[a]

Independent Variable	Dependent Variables					
	TFR	CBIRTHR1	RINCREA1	GRPOP	CEBZ82	CEBA82
Constant	4.816	28.357	18.963	.782	3.542	4.984
	(10.04)	(12.70)	(9.15)	(7.68)	(24.19)	(27.07)
YOUTPH80	−.440	−1.703	−1.088	−.107	−.230	−.281
	(−2.13)	(−1.67)	(−1.15)	(−2.30)	(−3.64)	(−3.41)
YOUTH802	.014	.052	.028	.003	.007	.009
	(1.87)	(1.39)	(.79)	(1.71)	(3.14)	(2.89)
PURB79	.033	.160	.107	.009	.014	.019
	(1.75)	(1.69)	(1.21)	(2.06)	(2.39)	(2.58)
AUTORGD	.862	5.663	5.396	.106	.090	1.83
	(2.84)	(4.13)	(4.24)	(1.69)	(.98)	(1.51)
FLIT	−.029	−.099	−.058	−.003	−.011	−.014
	(−2.95)	(−2.42)	(−1.51)	(−1.55)	(−3.59)	(−3.58)
R^2	.7090	.6929	.6516	.6339	.8342	.8115

[a] The numbers in the parentheses below the coefficient estimates are the usual t-values.

Jamison.

Table 3 shows results similar to Table 2 except that YOUTPC80 and YOUTP802 are replaced by YOUTPH80 and YOUTH802. As discussed in Section 2, Boulier (1982) criticized the regression results obtained by Repetto (1979) with regard to the influence of income distribution on the fertility because Repetto obtained a significant negative coefficient for the income variable and a significantly positive coefficient for the squared value of the income variable by using the per capita income variable instead of the per household income variable. Boulier argues that the per household income variable is more appropriate because the fertility decision by the couple is based on the total household income rather than on the per family member income. In order to overcome this criticism, the regressions were rerun using the per household income variables instead of the per capita income variables. Table 3 shows that the replacement of the income variables by the per household income variables does not make any significant difference. Therefore, one cannot criticize the results of this study as the outcome of a spurious nonlinearity due to the misspecification of the model. Hereafter, YOUTPH80 and YOUTH802 are used in all the regressions.

Table 4 shows different specifications for the education variables in the regressions of CEBZ82. CEBZ82 is preferred over TFR because CEBZ82 was

TABLE 4. THE EFFECTS OF INCOME LEVEL, INCOME DISTRIBUTION, WOMEN'S SCHOOLING AND URBANIZATION ON FERTILITY RATES FOR 28 CHINESE PROVINCES USING DIFFERENT SPECIFICATIONS FOR THE SCHOOLING VARIABLES[a]

Independent Variables	Dependent Variable = CEBZ82						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	3.140	3.542	3.384	3.218	3.137	4.533	4.088
	(27.01)	(24.19)	(30.15)	(29.55)	(25.51)	(4.20)	(13.57)
YOUTPH80	−.287	−.230	−.192	−.233	−.286	−.210	−.195
	(−3.82)	(−3.64)	(−2.98)	(−3.29)	(−3.66)	(−3.33)	(−3.01)
YOUTH802	.009	.007	.006	.008	.009	.007	.006
	(3.39)	(3.14)	(2.65)	(3.22)	(3.26)	(2.89)	(2.73)
PURB79	.012	.014	.017	.018	.013	.014	.015
	(1.77)	(2.39)	(3.04)	(2.66)	(1.66)	(2.02)	(2.72)
AUTORGD	.025	.090	.132	.078	.025	.124	.138
	(.22)	(.98)	(1.42)	(.76)	(.22)	(1.31)	(1.44)
FLIT		−.011					
		(−3.59)					
FAJHIGH			−2.191				
			(−3.81)				
FASHIGH				−3.912			
				(−2.54)			
FASMCOL					−.987		
					(−.11)		
FSCHYR						−.441	−.176
						(−1.07)	(−3.24)
FSCHYR2						.024	
						(.60)	
VARFSYR							−.030
							(−.90)
R^2	.7371	.8342	.8417	.7968	.7372	.8479	.8510

[a] The numbers in the parentheses below the coefficient estimates are the usual t-values.

constructed from the data of the 1982 Census, as were most of the independent variables, whereas TFR was estimated from the 1982 One-Per-Thousand-Population Fertility Sample Survey. Furthermore, CEBZ82 is more equivalent to the dependent variable of children ever born to a woman which is used in most studies of household data fertility regression analyses.

Column 1 of Table 4 shows the regression results for the equation without any education variable and column 2 is reproduced from Column 5 of Table 3 for the purpose of comparison. The drop of the FLIT variable reduces the value of R^2 from 0.8342 to 0.7371. (The adjusted R^2 declined from 0.7965 to 0.6914.) This implies clearly that the literacy level of women is an important determinant of fertility differentials among the 28 provinces.

Columns 3, 4, and 5 of Table 4 show the regression results with FAJHIGH, FASHIGH, and FASMCOL, respectively. When we compare the values of R^2 among Columns 2-5, it is clear that the fraction of female population with at least junior high school education explains the largest variation of fertility differentials among the provinces ($R^2 = 0.8417$). The fraction of literate female population explains the second largest variation of fertility differentials ($R^2 = 0.8342$). The fraction of female population with at least senior high school education has a significant negative coefficient, but it explains the smaller variation of fertility differentials ($R^2 = 0.7968$) than the two lower level schooling variables. The fraction of women with some college education does not reveal a significantly negative coefficient. The female population of college education might be still too small to show any significant influence on the average fertility rate of the province. At the present situation China could be advised that for the purpose of reducing fertility rate, educational resources should be diverted from college or senior high school levels to the widened opportunities of most women to achieve at least junior high school education level.

Column 6 of Table 4 shows that the coefficient of the weighted average female schooling years variable, FSCHYR, is negative but is not significant, and the coefficient for the square of mean female schooling years variable, FSCHYR2, is positive but also not significant. However, Column 7 indicates that when the variance of the mean female schooling years variable, VARFSYR, is included instead of FSCHYR2, the coefficient for the FSCHYR becomes significantly negative. This implies that when the variance of schooling levels is controlled for, the female mean schooling years becomes a significant determinant of fertility differentials among the provinces.

Table 5 investigates the influence of the per household income variables on the coefficients for other independent variables such as urbanization, autonomous regions, and education. Column 1 of Table 5 is identical to column 2 of Table 4 and was reproduced for the purpose of a comparison. Columns 2-7 of Table 5 are similar to columns 2-7 of Table 4 except that in the columns of Table 5, the per household income variables, YOUTPH80 and YOUTH802, were excluded from the independent variables. The comparison between columns 1 and 2 reveals a striking result. The exclusion of the income variables made the coefficient for PURB79 change from a significant positive coefficient to a significant negative coefficient. This result clearly supports the explanation given by Birdsall and Jamison (1983) about the weakness of the urban variables in the province-level regression. As discussed earlier, they felt that the fertility depressing effect of the urban residence is entirely due to the

TABLE 5. THE INFLUENCES OF THE INCOME VARIABLES ON THE COEFFICIENTS FOR OTHER INDEPENDENT VARIABLES IN THE FERTILITY REGRESSIONS[a]

Independent Variables	Dependent Variable = CEBZ82							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	3.542	3.389	3.274	2.965	2.778	4.196	4.304	3.140
	(24.19)	(19.41)	(28.73)	(37.69)	(36.74)	(3.25)	(13.05)	(27.01)
YOUTPH80	−.230							−.287
	(−3.64)							(−3.82)
YOUTH802	.007							.009
	(3.14)							(3.39)
PURB79	.014	−.007	.004	.002	−.011	−.003	.001	.012
	(2.39)	(−2.38)	(.82)	(.40)	(−1.89)	(−.45)	(.24)	(1.77)
AUTORGD	.090	.245	.270	.220	.200	.262	.289	.025
	(.98)	(2.30)	(2.83)	(2.04)	(1.53)	(2.51)	(3.01)	(.22)
FLIT	−.011	−.013						
	(−3.59)	(−3.64)						
FAJHIGH			−2.924					
			(−4.78)					
FASHIGH				−5.370				
				(−3.46)				
FASMCOL					−8.499			
					(−.77)			
FSCHYR						−.366	−.200	
						(−.74)	(−3.25)	
FSCHYR2						.011		
						(.23)		
VARFSYR							−.067	
							(−1.83)	
R^2	.8342	.7071	.7672	.6967	.5564	.7492	.7807	.7371

[a] The numbers in the parentheses below the coefficient estimates are the usual t-values.

higher income of the urban areas and that there is no urban effect per se once income is controlled. The results of this study even suggest that once income is controlled, the urban effect on the fertility is positive rather than negative. This result is contrary to the findings in other developing countries. For example, previous studies by the current author analyzing Korean and Mexican data showed that the urban residence by itself depresses the fertility rates of the urban natives and the rural-urban migrants (Lee and Farber 1984, 1985; Lee and Pol 1985).

The significant positive coefficient of the urbanization variable after income is controlled can be explained by the findings of Yeh and Xu (1984). They point out that since 1949 the Chinese government adopted a spatial industrial policy to decentralize industries from the coastal industrial core provinces to the interior provinces. This policy encouraged urbanization and industrialization in the less densely populated North and Northwest provinces and controlled the growth of urban population in the densely populated East and Central South provinces. As the North and Northwest provinces, which were the major recipients of new industrial developments, are generally large in area and do not have a large rural population, the increase in urban population concomitant with industrial development in these regions made them relatively high urbanized provinces. Because of this unusual situation, most of the highly urbanized provinces are located in the western and northern part of China, such as Xinjiang, Qinghai, Nei Menggu, Heilongjiang, Jilin, and Liaoning which contain proportionally a very small number of cities and urban population. On the other hand, although the East and Central South provinces have the largest proportion of cities and urban population, their level of urbanization is not relatively high. This is because these provinces are also agricultural provinces and the urban population is offset by the large rural population. Yeh and Xu (1984) found that the two important determinants of the provincial variation of urbanization level were industrialization and population density in their regression analysis. Highly urbanized provinces were associated with high per capita economic output, high industrialization level, low population density, and large area. This was generally the case for Nei Menggu, Heilongjiang, Liaoning, Jilin and Qinghai. Provinces with a low urbanization level were associated with low per capita economic output, high population density, and small areas. Examples of this case were Henan, Shangdong, Guangxi, Hubei, and Yunnan. These results imply that in China, once the per capita income is controlled for, highly urbanized provinces are the provinces with the low population density. The national policy of controlling the growth of large cities and the family planning programs were less strictly enforced in the West and Northwest provinces where the urbanization rates were high but population pressure was not severe, due to low population density, than in the more populated and dense East and Central South provinces where the urbanization rates were low but population pressure was severe. Therefore, it is not unreasonable to anticipate the positive coefficient for the urbanization variable, PURB79, in those regressions which control for the per household income level.

Column 7 of Table 5 shows that the drop of the income variables, YOUTPH80 and YOUTH802, made the coefficient for the variance of the female schooling years variable to become significantly negative at the 10 percent level of significance. This result implies that the variance of schooling years variable captures the inequality of income distribution in a province. This is anticipated because Chiswick (1974) showed that one of the major determinants of the regional income inequality is the variance of the years of schooling.

Column 8 of Table 5 shows that the drop of the education variable did not change the coefficient of the urbanization variable as long as the income variables are retained. This result appears to imply that unlike other developing countries, the Chinese urban effect on fertility is not mainly due to the higher education level of the urban areas. China seems to be successful in the extent to which elementary and junior high education, which was shown above to be most effective in reducing fertility, has reached rural areas.

Columns 2-7 of Table 5 show that the exclusion of the income variables made the coefficients for the autonomous region dummy variable, AUTORGD, to become significantly positive. This appears to imply that the large part of the fertility rate differentials between the ethnic minorities and the Han, the majority population, are due to income differentials between the majority and minority groups rather than due to the differential treatment in the enforcement of the family planning programs for the minority groups by the Chinese government. This result is consistent with the findings by Poston and Shu (1987), indicating that the minority groups whose socioeconomic characteristics such as education, occupation, and industry are less differentiated from those of the Han are also less differentiated demographically from the Han.

SUMMARY AND CONCLUSIONS

This paper analyzed the effects of income level, income distribution, women's education, and urbanization on fertility rates among 28 major provinces, municipalities, and autonomous regions of China, circa 1982.

First of all, the evidence from this study should be a valuable addition to the controversial literature concerning the influence of income distribution on fertility rates. The use of cross-country data in previous studies presents serious problems because measurements and qualities of income level and income distribution data vary too widely among different countries. The use of the cross-province data in this study does not suffer from this problem because the measurement and quality of income level and income distribution data are much more uniform within one nation than across countries. The coefficients for the per capita income variable are consistently negative and statistically significant. The coefficients for the squared value of the per capita income variable are consistently positive and statistically significant in most regressions. These results strongly support the argument by Repetto (1979) that the redistribution of income from high income provinces to low income provinces would reduce the national fertility rates.

Boulier (1982) criticized the regression results of Repetto (1979) because Repetto obtained the significant negative coefficient for the income variable and a significant positive coefficient for the squared value of the income variable by using the per capita income variables instead of the per household income variables. In the present analysis, the replacement of income variables by the per household income variables did not make any significant difference. Therefore, one cannot criticize the results of this study as the outcome of a spurious nonlinearity due to the misspecification of the model.

On the other hand, one should be cautious not to generalize the results concerning the income distribution-fertility relationship from Chinese data to the debate concerning Repetto's empirical studies using cross-country data or household data of Puerto Rico and Korea. There are some reasons to suspect that in nonmarket economies, such as China, a small increase in the income of a poor couple reduces fertility more than does a small increase in the income of a rich couple. Until recently, the market incentive system was lacking in China. Therefore, a higher income level beyond a certain threshold level may not have generated greater aspiration for consumption or higher education for their children in China because of very limited availability of consumption goods and career opportunities for highly educated youths. If this is the case, the fertility-depressing effect of the equal income distribution is real, but valid in the nonmarket economies such as China only. There is a possibility that this fertility-depressing effect may not be valid even in China and that the results obtained here, showing this effect, may have arisen because of the measurement problem of the income data. The income variable used in the regressions is actually the per capita economic output in yuan. In the market economy the per capita output must be very close to the per capita income. But in the nonmarket economy it is understandable that the per capita output is quite different from the per capita income because of massive redistribution of income. The reason why the very high per capita output provinces did not have a very low fertility rate may not be because a rich couple did not reduce their fertility rate, but because their actual income level was not very high. In spite of these limitations, it cannot be overemphasized that the use of the cross-province data within a nation provides a valuable insight to the issue on the influence of income distribution on fertility.

Secondly, the regression results for the women's education variables are very similar to those for other developing countries. The coefficient estimates for most women's education variables were significantly negative in the fertility regressions. The fraction of women population with at least junior high school education explained the largest variation of fertility differentials among the 28 provinces. The fraction of literate female population explained the second largest variation of fertility differentials. The fraction of female population with at least senior high school education had a significant negative coefficient, but it explained the smaller variation of fertility differentials than the two lower level schooling variables. The fraction of women with at least some college education did not reveal a significantly negative coefficient. At the present level of development, China might be wise, as far as the purpose of reducing fertility rates is concerned, to divert its educational resources from college or senior high school levels to the widened opportunities of most women to achieve at least junior high school education level.

Finally, the coefficient estimates of the urbanization variable for Chinese data were quite different from those for other developing countries. The coefficients for the urbanization variable in the fertility regressions where the income variables were controlled for were significantly positive. This seems to imply that in China the fertility depressing effect of the urban residence is entirely due to the higher income of the urban areas and there is no urban effect per se, once income is controlled for. Birdsall and Jamison (1983) explain that the urban populations in other countries enjoy many amenities, such as access to educational, health, and family planning services that are not available to the rural residents and that are not well reflected in the urban-rural income differences. In contrast, these amenities are equally available to the rural areas of China. Furthermore, the reason why the urbanization variable reveals a significant positive coefficient may be due to the Chinese governmental spatial industrial policy since 1949. This policy encouraged urbanization and industrialization in the less densely populated North and Northwest provinces and controlled the growth of urban population in the densely populated East and Central South provinces. Due to this policy, once the per capita income level is controlled for, the highly urbanized provinces are the provinces with the low population density. In these low population density provinces, family planning programs were less strictly enforced because scarcity of available land was emphasized as the main reason for the birth control campaign. Therefore, it is not unreasonable to anticipate the positive coefficient for the urbanization variable in the regressions which control the income level. When we consider the special circumstances in the past which caused the weak or positive effect of the urbanization on fertility, one might surmise that the urbanization accompanied by the recent modernization programs will in the long run reduce Chinese fertility rates.

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