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Household Composition and Female Fertility in Revolutionary China

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Having others, especially close relatives, help rear one's young has been documented across diverse taxa of non-human species, including birds, mammals, and fish (Krebs and Davies 1993; Emlen 1997; Cockburn 1998). It is also a significant characteristic of human reproductive patterns that in many societies members of the familial groups would assist mothers in caring for their children (Turke 1988; Flinn 1989; Low 1991; Skinner 1997; Bereczkei 1998; Hawkes et al 1997; Hermalin et al 1998; Hrdy 1999; Sear et al. 2000; Crognier et al. 2001). The availability of potential helpers in the family can disperse the costs of childbearing, which in turn allows mothers to reproduce at a higher rate than would otherwise be possible (see Turke 1989; Mace 2000). In this paper, I examine how different household composition, as determined by the availability of potential childcare helpers, influenced female fertility during the first 35 years of history of the People's Republic of China.

Human life histories are unusual among primates in a number of ways (see Low 1998; Low 2000; Mace 2000). Human babies are extremely large compared to the mother's size. Although our babies are weaned at a much younger age, they remain helpless and are in need of care and protection for much longer than other primates.

Therefore, raising human children requires a considerable amount of time, energy, and resources. At the same time, humans start reproducing at a much older age than expected for mammals of our size. Human females also have a long postmenopausal life span compared to other mammals. Hence, the relatively long pre- and post-reproductive stages of the human lifetime mean that there is potential for mothers to receive substantial assistance from pre- and post-reproductive relatives (e.g., daughters and grandmothers) in raising offspring (Sear et al. 2003).

The tremendous amount of investment required to successfully rear multiple children at different stages of dependency to maturity makes it a very difficult job for mothers to achieve alone. Nevertheless, mothers are able to co-opt assistance from other family members if they are available and ready to help. The question is: why would helpers help? According to Hamilton's theory of kin selection (1964), helpers who engage in nepotistic investment are able to obtain indirect genetic benefits via enhanced production and survival of non-descendant kin born by relatives. Individuals contribute genetically to future generations both directly, through the production of their own offspring, and indirectly, by assisting relatives with their reproduction. Because of shared genes by virtue of common descent, helping rear the offspring of relatives can be as genetically profitable as producing one's own. The closer the genetic relationship between helpers and the helped, the greater the frequency of shared genes (see Emlen 1995).

Among non-human species engaging in cooperatively breeding, the breeders recruit their "helpers at the nest" primarily from the ranks of the pre-reproductive (Krebs and Davies 1993; Emlen 1997). In humans, though, both pre- and post-reproductive

family members are likely candidates. In many historical, traditional, or pre-industrial societies, the availability of offspring help contributes to parental reproductive success through either increasing the fertility of the mother or improving the survival of later born siblings (Turke 1988; Low 1991; Skinner 1997; Bereczkei 1998; Crognier et al. 2001; Crognier et al. 2002; Sear et al. 2002). First-born or early-born daughters are essential in enhancing mothers' reproductive success. However, in some populations, there are no differentials in contribution between an eldest daughter and an eldest son (e.g., Crognier et al. 2001; Crognier et al. 2002).

The presence of different sets of grandparents, particularly grandmothers, affects mothers' reproductive success in somewhat different ways. Both maternal and paternal grandmothers are found to increase the fertility of their daughters or daughter-in-laws (Skinner 1997; Bereszkei 1998; Sear et al. 2003). In contrast, only the presence of maternal grandmothers has been found to improve the nutritional status or survival of grandchildren in some traditional and historical societies (Hawke et al. 1997; Sear et al. 2000; Sear et al. 2002; Voland and Beise 2002).

China provides an interesting case study of relationships between kinship networks and reproduction, because various social, economic, and political policies during the second half of the twentieth century have, to some extent, transformed kinship structure in China (Stockman 2000). Many of these policies are of the sorts that alter reproductive costs and benefits for individual Chinese women in the long run, particularly those directed at engaging women in public production (i.e., production outside the sphere of the household) and family planning. Thus, we must ask: in the face of these policies, which are unprecedented in the history of China, what are the

associations between kinship network and female reproduction under the regime of the communist state? Does the presence of parents in the household affect the pace of family formation (i.e., the timing of the first birth) for conjugal couples? Do married couples with co-resident parents (i.e., grandparents) in the household have higher fertility than those who do not reside with parents after marriage? Do paternal and maternal grandparents have the same influence on the reproductive outcomes of mothers? How is a mother's fertility affected if her first living child is a daughter?

To answer these questions, I examined how differently configured family systems affect women's reproduction during the first 35 years of the communist China. These differently configured family systems include households in which married couples lived with the husband's parents, married couples lived with the wife's parents, or married couples lived with neither set of parents. I compare the age at first birth and the number of children ever-born among women from these different households in different parts of China (Hebei, Shaanxi, and Shanghai). Hebei, Shaanxi, and Shanghai have different ecological, demographic and economic characteristics. Shanghai includes the biggest city in China and hence is the most developed site. Hebei and Shaanxi are rural, and Shaanxi is the poorest province among the three I examined.

Comparisons for the three provinces as a whole reveal variations in reproductive outcomes among women from households of different composition. However, the differences underlying these provinces mean that within-province comparisons are required to examine in detail how regional variations manifest themselves in the pace of family building and fertility for women with access to different kinds of childcare helpers.

Materials and Methods

Study Areas

Hebei, Shaanxi, and Shanghai have different ecological, demographic, and economic characteristics (Figure 1). Hebei, a coastal province on the North China Plain, has an area of 187,700 km^2. The 1990 estimated population was around 62 million. Various crops, such as wheat, cotton, corn, rice, tobacco, peanuts, and sesame grow on the alluvial plain of eastern Hebei. The rugged Taihang Mountain Area in western Hebei, besides growing cereal crops, also produces walnuts, persimmons, dates, apricots, and a variety of fruits. In addition, Hebei has sizeable reserves of coal, iron, and petroleum. Shijiazhuang, leaning against the Taihang Range and situated in the middle south of the province, is a major city and the capital of Hebei province. It is one of the important railway hubs in China with an estimated population around 8.6 million in the mid 1990s.

Shaanxi, an inland province on the middle reaches of the Yellow River, is located in the center of China, covering an area of 206,000 km^2. Its population was estimated at approximately 33 million in 1990. It has three distinctive landforms from north to south. Northern Shaanxi belongs to the Loess Plateau with an elevation of 800 to 1,300 m, and accounts for 45% of the province. Soil erosion in this area over the centuries has created many crisscrossing gullies. Northern Shaanxi is a farming-pastoral area producing corn, sorghum, millet and sheep. The Central Shaanxi Plain (i.e., Guanzhong Plain) has an elevation of 520 m on average and is famous for growing wheat and cotton. Southern Shaanxi covers Qinling and Daba mountainous regions with

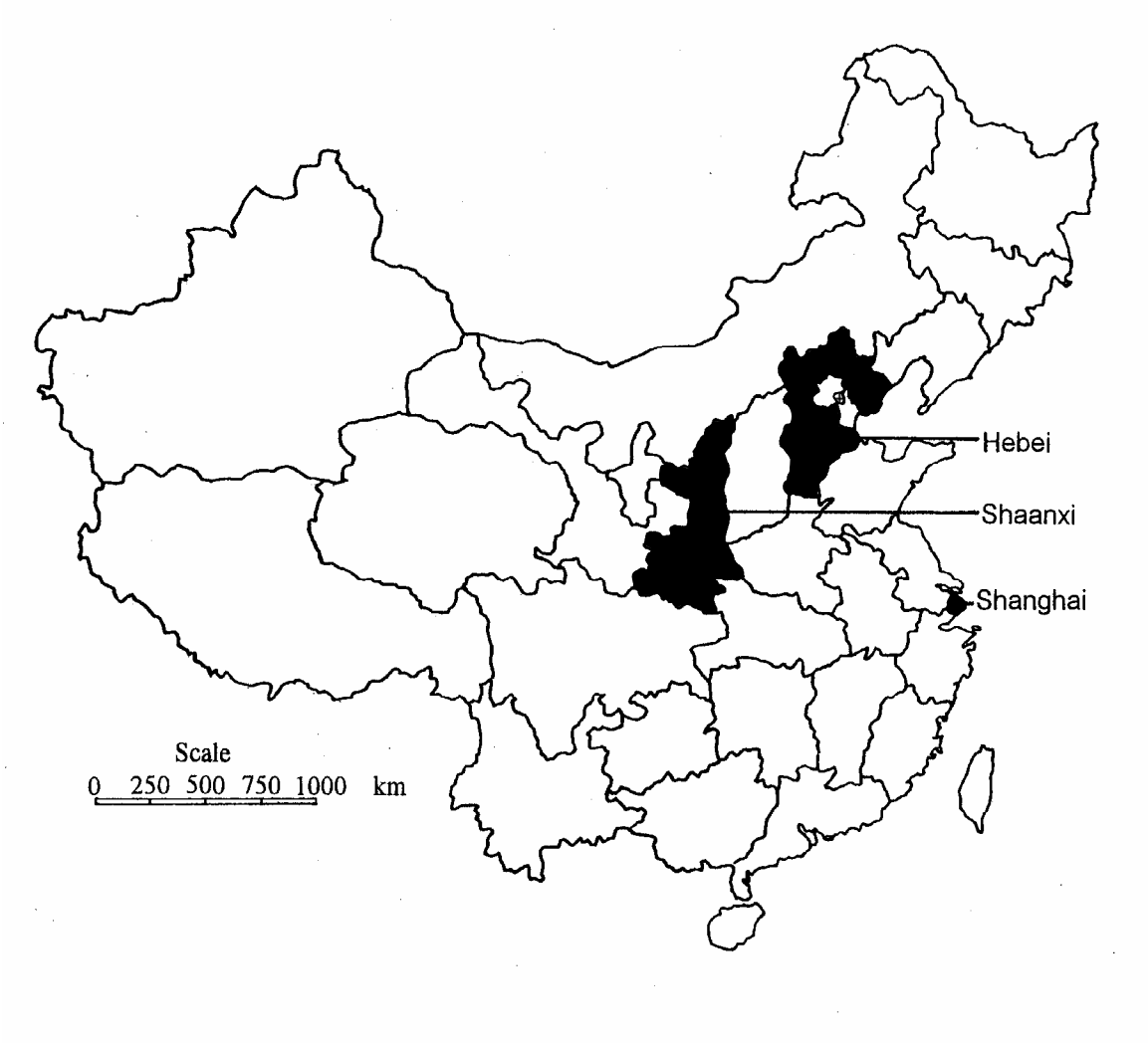

Figure 1. Map of China indicating the geographic locations of Hebei, Shaanxi, and Shanghai.

an elevation between 1000 and 3000 m. This region accounts for 36% of the province. It is a subtropical farming area which grows rice, peas, soybeans, rape, tangerines, tea, sugar cane, lacquer, bamboo, and medicinal herbs. Shaanxi is rich in its mineral deposits, including coal, gold, and molybdenum. The province also has a large reserve of natural gas in the north. Xi'an, located in the Guanzhong Plain, is the largest city and the capital of Shaanxi. Xi'an is a main industrial and tourism center for the province. The population of Xi'an was estimated around 6.6 million in the mid 1990s.

Shanghai, a coastal metropolis in the southeast, covers an area of 6,340 km^2. Situated just south of the Yangtze Estuary, Shanghai is one of the largest ports in China and biggest cities in the world. The estimated population of Shanghai was about 13 million in 1990. Although it is mainly urban, Shanghai still has a sizeable (about 38%) rural population (Dankert and van Ginneken 1991). The fertile Yangtze River Delta, not far from Shanghai, has long been important to China's agriculture.

Shanghai consistently has the highest population density in China, while Shaanxi has the lowest among the three study areas (Wang 2000). Before the famine of 1960, Shanghai had the highest natural growth rate among the three. Since then, its natural growth rate has been the lowest. With regard to total fertility rates, Shanghai has had the lowest rate among the three since the 1960s, while Shaanxi has maintained a higher rate than Hebei most of the time. Shanghai also has the highest per capita GDP. Between the early 1950s and 1970s, Hebei and Shaanxi had comparable per capita GDPs; however, Hebei has exceeded Shaanxi in its per capita GDP since the late 1970s. All these characteristics indicate that Shanghai is the most, and Shaanxi the least, developed region among the three.

Data

I use data from the 1985 China In-depth Fertility Survey (IDFS), Phase I, carried out by the Department of Population Statistics of the State Statistical Bureau (SSB) of the PRC, in cooperation with the International Statistical Institute, Voorburg, Netherlands. The IDFS was largely inspired by the example of the World Fertility Survey carried out between 1973 and 1985. Details of survey methodology and main findings were published in the Principle Report (SSB 1986).

The IDFS, Phase I, covered Hebei, Shaanxi, and Shanghai. For each region, the IDFS was conducted using a stratified, multistage sampling design to cover the whole area in the hope that information collected from the survey would represent the general situation in the area. The IDFS questionnaire consisted of three parts: a community questionnaire, a household questionnaire to determine eligible respondents (women ever-married and aged 15-49 years), and an individual questionnaire to interview each eligible woman. The individual questionnaire included eight major sections, including interview characteristics, respondent's and relatives' background, respondent's marital history, respondent's fertility history, knowledge and use of contraception, respondent's fertility preferences, fertility summary, birth history, and pregnancy history. A total of 13,307 married women of childbearing age were interviewed, of whom 5,080 were from Hebei, 4,084 from Shaanxi, and 4,143 from Shanghai (SSB 1986; see also Dankert and van Ginneken 1991).

Although the survey covered women aged 15-49 years, in this study I consider only those who were aged 20-49. To control for as much heterogeneity as possible in this

group of women, I further constrain the sample to those who were in their first marriage, had been married for at least two years, and had a minimum of two years of co-residence with either their husband's or their own parents (except for those who lived with neither parents after marriage). The final sample also excluded those who had non-marital first births or had not had first births at the time of survey. In total, 9,332 women were included in the resulting sample; among them, 3,588 women were from Hebei, 2,887 from Shaanxi, and 2,857 from Shanghai.

Analysis

Age at first birth. I used multiple regression analysis to examine how different household compositions affected women's age at first birth. To control for background factors that could influence women's age at first birth, I included variables such as their age at first marriage, residence, age cohort, and level of education in the analyses. Residence was coded as either urban or rural. Women's age cohort was composed of six five-year groups. Level of education included five categories: no schooling, primary school, secondary school, senior high school, and university or more. The variable of interest was household composition (i.e., living with parents or not), including three categories: with neither, with the husband's parents, and with the wife's parents. Dummy coding was applied to each categorical variable. Covariates were then entered in a single block before the variable of interest for each analysis using SPSS. I conducted one analysis for all women from three provinces as well as separate analyses for women from each province.

Fertility. Fertility was measured as the number of children ever-born. I used multiple regression analysis to examine how different household compositions affected women's fertility. To control for background factors that would influence women's fertility, I included variables such as years since marriage, residence, age cohort, and level of education in the analyses. Here the variables of interest were "living with parents or not" and "the sex of first living child." The same dummy coding scheme as in the previous section also applied here. Covariates were first entered into the model before any of the independent variables. I conducted one analysis for all women from three provinces and separate analyses for women from each province. Each analysis contains two models: Model 1 tests the effect of parents on fertility, and Model 2 examines the effects from both parents and first child.

Results

Age at First Birth

In Hebei, 71 percent of the couples lived with the husband's parents and only 3 percent lived with the wife's parents for at least 2 years. The corresponding figures are 77 and 5 percent in Shaanxi; 49 and 12 percent in Shanghai. Thus, patrilocal co-residence was very common in all three provinces, though more so for Hebei and Shaanxi than Shanghai (see also Lavely and Ren 1992). On the other hand, Shanghai has the highest percentage of couples living with the wife's parents among the three provinces.

Although other factors also affect age at first birth, the household composition remains an important factor (Table 1; see Appendix 1 for descriptive statistics). Among all women, those living with in-laws had older first births than those living without parents or living with their own parents. In particular, women who lived with their in-laws after marriage gave first births on average 4.3 months later than those living with their own parents ($t = 5.563$, $df = 6758$, $P < 0.0005$). No difference was found between those living with their own parents and those without co-resident parents after marriage.

The within-province patterns varied across all three provinces (Table 2). In Hebei, all else being equal, women who lived with in-laws gave first births later than other women. Compared to women living with their own parents, women with co-resident in-laws on average had older first births by 5.8 months ($t = 3.021$, $df = 2652$, $P = 0.003$). Although women living with their own parents gave first births earlier than those living without parents, the difference was not statistically significant.

Among Shaanxi women, those with co-resident in-laws had marginally significant later first births than those living without parents (Table 2). In contrast, women living with their own parents had marginally significant younger first birth than those living without parents. Women with co-resident in-laws, on average, had older first births by 5.3 months than women living with their own parents ($t = 3.253$, $df = 2362$, $P = 0.001$). In Shanghai, however, no differences were found in age at first birth among women from different types of households in Shanghai (Table 2).

Table 1. Multiple regression analysis (including all provinces) on wife's age at first birth according to different types of living arrangement with parents[a].

	Coefficients	Std. Error	
Intercept	4.277	0.120	****
Age at first marriage	0.903	0.005	****
Residence			
Urban (reference)	—	—	
Rural	0.063	0.038	+
Age cohort			
45-49 (reference)	—	—	
40-44	-0.192	0.055	***
35-39	-0.441	0.053	****
30-34	-0.533	0.052	****
25-29	-0.715	0.055	****
20-24	-1.104	0.081	****
Level of education			
No schooling (reference)	—	—	
Primary	-0.206	0.037	****
Secondary	-0.162	0.047	***
Senior high	-0.060	0.061	
University+	0.044	0.128	
Lived with parents			
With neither (reference)	—	—	
With husband's	0.140	0.034	****
With wife's	-0.056	0.065	

[a] N = 9332, F (13, 9318) = 3205.899, $P < 0.0005$, $R^2 = 0.817$

\+ $P < 0.1$

*** $P < 0.005$

**** $P < 0.0005$

Table 2. Multiple regression analysis on wife's age at first birth according to different types of living arrangement with parents by province.

	Hebei[a]		Shaanxi[b]		Shanghai[c]	
	Coeff.	SE	Coeff.	SE	Coeff.	SE
Intercept	4.480	0.203 ****	5.282	0.254 ****	2.943	0.198 ****
Age at first marriage	0.901	0.009 ****	0.850	0.012 ****	0.957	0.009 ****
Residence						
Urban (reference)	—	—	—	—	—	—
Rural	0.072	0.067	0.068	0.078	0.029	0.060
Age cohort						
45-49 (reference)	—	—	—	—	—	—
40-44	-0.306	0.096 ***	-0.163	0.105	-0.131	0.083
35-39	-0.416	0.090 ****	-0.667	0.104 ****	-0.362	0.081 ****
30-34	-0.633	0.087 ****	-0.615	0.102 ****	-0.424	0.084 ****
25-29	-0.855	0.093 ****	-0.727	0.108 ****	-0.496	0.088 ****
20-24	-1.268	0.133 ****	-1.238	0.139 ****	-0.552	0.171 ***
Level of education						
No schooling (reference)	—	—	—	—	—	—
Primary	-0.212	0.056 ****	-0.024	0.067	-0.326	0.082 ****
Secondary	-0.198	0.079 *	0.044	0.093	-0.274	0.095 ***
Senior high	-0.141	0.111	0.205	0.126	-0.157	0.106
University+	-0.243	0.562	-0.154	0.433	-0.028	0.141
Lived with parents						
With neither (reference)	—	—	—	—	—	—
With husband's	0.113	0.057 *	0.131	0.077 +	0.067	0.048
With wife's	-0.198	0.160	-0.244	0.143 +	0.108	0.072

[a] N = 3588, F(13, 3574) = 868.960, $P < 0.0005$, $R^2 = 0.760$
[b] N = 2887, F(13, 2873) = 534.804, $P < 0.0005$, $R^2 = 0.708$
[c] N = 2857, F(13, 2843) = 1567.895, $P < 0.0005$, $R^2 = 0.878$
\+ $P < 0.1$
* $P < 0.05$
*** $P < 0.005$
**** $P < 0.0005$

Fertility

In all women, both household composition and the sex of first living child have significant effects on women's fertility, even though other background factors also influence fertility (Table 3; see Appendices 2 and 3 for descriptive statistics). In Model 1 (which did not include the factor of the sex of first living child), when background characteristics were controlled for, women with in-laws in the household had the highest fertility. No difference was found between women with their own parents in the households and those without parents in the households. Model 2 reveals that women whose first living child is a daughter had higher fertility than those with a son, with both background factors and the type of household controlled for.

Within-province comparisons show that women from Hebei and Shaanxi shared similar patterns regarding the effects of household types and the sex of first living child on their fertility (Tables 4-1 and 4-2). In Hebei and Shaanxi, Model 1 shows that women living with their in-laws had the highest fertility, and there was no difference between women with their own parents in the households and those living without parents. When household type was controlled for in Model 2, women with daughters as the first living child had higher fertility than those with sons.

Although "living with in-laws or not" has an impact on women's fertility in Hebei and Shaanxi, it is not a significant factor for women from Shanghai (Table 4-3). That is, no differences were found in fertility among women living with in-laws, with their own parents, and with neither set of parents in the household (Model 1). However,

Table 3. Multiple regression analysis (including all provinces) on the number of children ever-born according to different types of living arrangement with parents and the sex of first living child. (Note: Model 1 did not test the effect of the sex of first child on fertility, but Model 2 did.)

	Model 1[a]		Model 2[b]	
	Coeff.	SE	Coeff.	SE
Intercept	-0.223	0.094 *	-0.315	0.094 ***
Years since marriage	0.153	0.003 ****	0.153	0.003 ****
Residence				
Urban (reference)	—	—	—	—
Rural	0.315	0.025 ****	0.316	0.025 ****
Age cohort				
45-49 (reference)	—	—	—	—
40-44	0.345	0.041 ****	0.348	0.040 ****
35-39	0.476	0.051 ****	0.478	0.050 ****
30-34	0.667	0.065 ****	0.672	0.065 ****
25-29	0.882	0.078 ****	0.886	0.077 ****
20-24	0.813	0.093 ****	0.817	0.092 ****
Level of education				
No schooling (reference)	—	—	—	—
Primary	-0.238	0.025 ****	-0.236	0.024 ****
Secondary	-0.383	0.031 ****	-0.376	0.031 ****
Senior high	-0.481	0.041 ****	-0.475	0.041 ****
University+	-0.777	0.085 ****	-0.770	0.085 ****
Lived with parents				
With neither (reference)	—	—	—	—
With husband's	0.192	0.023 ****	0.194	0.023 ****
With wife's	-0.049	0.043	-0.048	0.043
Sex of first living child	—	—		
Male (reference)			—	—
Female			0.169	0.019 ****

[a] N = 9332, F(13, 9318) = 1164.645, $P < 0.0005$, $R^2 = 0.619$
[b] N = 9332, F(14, 9317) = 1095.612, $P < 0.0005$, $R^2 = 0.622$
* $P < 0.05$ **** $P < 0.0005$
*** $P < 0.005$

Table 4-1. Multiple regression analysis on the number of children ever-born according to different types of living arrangement with parents and the sex of first living child: Hebei province. (Note: Model 1 did not test the effect of the sex of first child on fertility, but Model 2 did.)

	Model 1[a]		Model 2[b]	
	Coeff.	SE	Coeff.	SE
Intercept	0.202	0.145	0.095	0.145
Years since marriage	0.150	0.005 ****	0.150	0.005 ****
Residence				
Urban (reference)	—	—	—	—
Rural	0.262	0.041 ****	0.259	0.040 ****
Age cohort				
45-49 (reference)	—	—	—	—
40-44	0.237	0.063 ****	0.238	0.063 ****
35-39	0.193	0.077 *	0.194	0.077 *
30-34	0.352	0.098 ****	0.355	0.098 ****
25-29	0.447	0.119 ****	0.454	0.118 ****
20-24	0.373	0.140 **	0.368	0.139 **
Level of education				
No schooling (reference)	—	—	—	—
Primary	-0.125	0.034 ****	-0.120	0.034 ****
Secondary	-0.243	0.048 ****	-0.239	0.048 ****
Senior high	-0.282	0.068 ****	-0.284	0.067 ****
University+	-0.563	0.341 +	-0.491	0.339
Lived with parents				
With neither (reference)	—	—	—	—
With husband's	0.112	0.034 ***	0.117	0.034 ***
With wife's	0.098	0.097	0.094	0.096
Sex of first living child	—	—		
Male (reference)			—	—
Female			0.212	0.030 ****

[a] N = 3588, F(13, 3574) = 473.379, $P < 0.0005$, $R^2 = 0.633$
[b] N = 3588, F(14, 3573) = 449.418, $P < 0.0005$, $R^2 = 0.638$
+ $P < 0.1$ ** $P < 0.01$ **** $P < 0.0005$
* $P < 0.05$ *** $P < 0.005$

Table 4-2. Multiple regression analysis on the number of children ever-born according to different types of living arrangement with parents and the sex of first living child: Shaanxi province. (Note: Model 1 did not test the effect of the sex of first child on fertility, but Model 2 did.)

	Model 1[a]		Model 2[b]	
	Coeff.	SE	Coeff.	SE
Intercept	0.317	0.219	0.200	0.220
Years since marriage	0.152	0.007 ****	0.153	0.007 ****
Residence				
Urban (reference)	—	—	—	—
Rural	0.320	0.055 ****	0.322	0.054 ****
Age cohort				
45-49 (reference)	—	—	—	—
40-44	0.227	0.083 **	0.232	0.083 ***
35-39	0.282	0.107 **	0.289	0.107 **
30-34	0.145	0.141	0.158	0.141
25-29	0.377	0.176 *	0.384	0.175 *
20-24	0.240	0.205	0.265	0.204
Level of education				
No schooling (reference)	—	—	—	—
Primary	-0.130	0.047 **	-0.129	0.047 **
Secondary	-0.260	0.065 ****	-0.247	0.064 ****
Senior high	-0.363	0.088 ****	-0.358	0.088 ****
University+	-0.774	0.303 *	-0.786	0.302 **
Lived with parents				
With neither (reference)	—	—	—	—
With husband's	0.154	0.054 **	0.146	0.054 **
With wife's	0.071	0.100	0.079	0.100
Sex of first living child	—	—		
Male (reference)			—	—
Female			0.202	0.040 ****

[a] N = 2887, F(13, 2873) = 349.079, $P < 0.0005$, $R^2 = 0.612$
[b] N = 2887, F(14, 2872) = 328.823, $P < 0.0005$, $R^2 = 0.616$
* $P < 0.05$ *** $P < 0.005$
** $P < 0.01$ **** $P < 0.0005$

Table 4-3. Multiple regression analysis on the number of children ever-born according to different types of living arrangement with parents and the sex of first living child: Shanghai municipality. (Note: Model 1 did not test the effect of the sex of first child on fertility, but Model 2 did.)

	Model 1[a]		Model 2[b]	
	Coeff.	SE	Coeff.	SE
Intercept	0.818	0.101 ****	0.766	0.101 ****
Years since marriage	0.084	0.003 ****	0.084	0.003 ****
Residence				
Urban (reference)	—	—	—	—
Rural	0.093	0.027 ****	0.096	0.027 ****
Age cohort				
45-49 (reference)	—	—	—	—
40-44	0.099	0.041 *	0.101	0.041 *
35-39	0.064	0.054	0.065	0.054
30-34	0.148	0.071 *	0.151	0.071 *
25-29	0.254	0.081 ***	0.256	0.081 ***
20-24	0.278	0.108 **	0.273	0.107 *
Level of education				
No schooling (reference)	—	—	—	—
Primary	-0.178	0.037 ****	-0.176	0.037 ****
Secondary	-0.380	0.043 ****	-0.373	0.043 ****
Senior high	-0.495	0.048 ****	-0.487	0.048 ****
University+	-0.583	0.063 ****	-0.576	0.063 ****
Lived with parents				
With neither (reference)	—	—	—	—
With husband's	0.004	0.021	0.007	0.021
With wife's	-0.029	0.032	-0.028	0.032
Sex of first living child	—	—		
Male (reference)			—	—
Female			0.084	0.020 ****

[a] N = 2857, F(13, 2843) = 436.259, $P < 0.0005$, $R^2 = 0.666$
[b] N = 2857, F(14, 2842) = 408.846, $P < 0.0005$, $R^2 = 0.668$
* $P < 0.05$ *** $P < 0.005$
** $P < 0.01$ **** $P < 0.0005$

whether the first living child is a daughter or not has a significant effect on women's fertility in Shanghai. In particular, women whose first living child was a daughter had higher fertility than those with a son (Model 2).

Discussion

This study indicates that, at least for this sample, the husband's and the wife's parents have different influences on the pace of family building and fertility for married couples. However, the significance of co-residential arrangements exhibits regional variations (possible reasons for such variations are discussed below). In contrast, though, the positive effects on mothers' fertility of first living daughters are universal across regions.

For most of human history, social and economic success has heavily depended on the social organization of extended kinship networks. Kinship networks are instrumental in traditional economic pursuits, such as hunting, gathering, and farming, where close cooperation by kin is required for subsistence (Turke 1989). Historically, economic production, such as farming or family-owned business, in China was also centered around the household composed of extended kinship, especially patrilineal kin. The typical division of labor placed women within the domain of the household, while men could make extensive forays into the world outside the household. However, the Communists transformed this traditional mode of household production and labor division in two regards. First, production was moved out of the household into the public sphere (i.e., collectivized). Second, for the first time in Chinese history, adult females were expected to participate full-time in *public* production outside the household (Harrell 2000).

However, this change in the structure of household economy was accomplished somewhat differently in urban and rural areas, which in turn transformed urban and rural patrilineal kinship organization to different degrees (Harrell 2000; Stockman 2000). In urban China, household ceased to be the unit of production; as members of a state or collective work unit, everyone became a wage earner. Various welfare services were also made available by the work units. This altered material and structural basis contributed to the attenuation of extended patrilineal kinship. Instead, an emphasis on bilineal kinship emerged in which daughters became increasingly equally valued as sons (Davis-Friedmann 1983; Wolf 1985). Married daughters continued to maintain close relations with their parental homes; patrilocal marriage did not separate young women from their natal families (Stockman 2000).

The situation in rural China was a different story. The rural economy was still partly household-based (Harrell 2000). Although the means of agricultural production were collectively owned, farming was not a wage job and the harvests were distributed on a household basis. The household registration system also forced rural men to remain in the village in which they were born, hence cementing the patrilineal networks among them. As a result, patrilineal kinship networks still played a central role in the new collectivized institutions, such as mutual aid teams, agricultural co-operatives, and eventually production teams within communes (Stockman 2000). The tradition of the exogamous patrilocal marriage system continued, and it separated young women from their parental homes (Johnson 1983; Lavely 1991). Even if married daughters hoped to maintain frequent contact with their natal families, poor rural transport inevitably made frequent travel difficult (Chen et al. 2000).

Researchers have reported a close association between psychosocial stress and infertility both within and between women (Saunders and Bruce 1997; Matsubayashi et al. 2001). It is suggested that high levels of anxiety lead to the reduction of conception rates. Therefore, different degrees of emphasis on patrilineal lineage and closeness to the natal families faced by rural and urban women who were patrilocally married could have different effects on their timing of first births due to different levels of emotional distress they might experience when first married.

For example, in Hebei and Shaanxi, the presence of the husband's parents in the household delayed the pace of family building (i.e., later first births) for the married couples. In other words, both uxorilocally married women and neolocally married women (who, along with their husband, establish their own independent family upon marriage) gave first births sooner than patrilocally married women. The exogamous patrilocal marriage brought the bride to an unfamiliar family and community. Thus, the anxieties associated with having to shift residence and adapt to a family of strangers, especially in-laws, might have contributed to delayed first births for patrilocally married women in rural China. No significant difference was found in age at marriage between patrilocally and uxorilocally married women; therefore, the difference in their intervals between marriage and first birth was not due to the difference in their age at first marriage.

On the other hand, as one might expect, household composition had no significant influences on age at first birth for women from Shanghai. Compared to their counterparts in Hebei and Shaanxi, patrilocally married women in Shanghai could find fall-back support from their natal family when problems arose in their new family.

Consequently, they may have had an easier time at adapting to the new life with in-laws in the household, without compromising their conception rates.

During the Great Leap Forward, in order to achieve economies of scale and to liberate women's labor for production, many family functions were turned over to the communes, such as child-raising, cooking, laundry, and even residential arrangements (i.e., dormitories). Such an experiment was quickly ended. But the legacy of engaging women, married or unmarried, to work full-time in state or collective work-units or farm fields lived on (Stockman 2000; Harrell 2000).

For Chinese mothers, work activities differ in their compatibility with child care; formal wage work is least compatible, followed by agricultural field work which, though, is more physically demanding (Chen et al 2000; Entwisle and Chen 2002). Women with assigned wage jobs do not have the options to exit and enter the labor force freely or to shift from full- to part-time work even after they give birth (Entwisle and Chen 2002). Therefore, with such high labor force participation rates, Chinese women faced acute conflicts between the role of mother and the role of worker. The presence of childcare helpers in the household becomes ever more important in helping alleviate mother's burden and thus enhance mother's fertility.

Many studies report that grandparents (especially grandmothers) are instrumental in assisting with childcare and domestic chores for mothers in China (Wolf 1972, 1985; Parish and Whyte 1978; Johnsons 1983; Huang et al. 1996; Skinners 1997; Chen et al. 2000; Bossen 2002). Nevertheless, in rural China, such as Hebei and Shaanxi, where patrilineal kinship was still very strong, social pressures might be a more important reason why patrilocally married women had higher fertility than either uxorilocally

married or neolocally married women (see also Freedman et al. 1982; Weinstein et al. 1990). The fact that women with co-resident in-laws had later first births but still ended up with higher fertility illustrates the significance of pressures for more children from the husband's parents. Moreover, the fact that no difference in fertility was found between women with matrilocal co-residence arrangement and women with neolocal co-residence arrangement further attests to the social pressures exerted on women by their co-resident in-laws.

As Sear et al. (2003) point out, a woman's parents might be more concerned about her well being than the husband's parents who might be keen to see their daughter-in-law bear more children even at the expense of her health. In fact, Chen et al. (2002) report that a mother's childcare load is reduced if either set of grandparents lives in the household, but the presence of maternal grandparents reduces a mother's load even more. Nevertheless, the importance of paternal grandparents as childcare helpers should not be dismissed.

In contrast to the situations in Hebei and Shaanxi, co-residence patterns have had no effect on women's fertility in Shanghai. At least three aspects of urban life might be responsible for this observed regional variation. First, according to Chen et al. (2000), the effect of proximity of grandparents on childcare varies substantially in rural and urban China. That is, in rural areas where transportation systems are less well developed than urban areas, it is difficult for mothers to rely on grandparents who do not live in the same household or close by for childcare needs. On the other hand, urban mothers are much less constrained by the transportation problem than rural mothers. As a result, in urban areas, non-coresident kin can be just as helpful as co-resident kin in reducing

mothers' involvement in childcare. Urban co-residence with either the husband's parents or the wife's parents does not translate into higher fertility anymore.

Second, more childcare services are available in urban areas than in rural areas (Chen et al 2000). Although these services are often inadequate or fall short of demands (Logan et al. 1998), urban mothers still have an advantage over rural mothers regarding childcare facilities. Third, the success of family planning policy effectively lowers women's fertility in urban areas. In particular, fertility transition in Shanghai began early in the 1960s and proceeded very rapidly compared to other places in China (Guo 1996). The total fertility rates in Shanghai have been below the replacement level since the early 1970s (Guo 1996). Although co-resident grandparents are still important sources of help in childcare for mothers in Shanghai, the strong family planning policy undermines their capacity to influence mothers' fertility (see Voland and Beise 2002 for a discussion regarding a historical German population with contraceptive motivations).

Besides grandparents, older daughters are also very important in helping mothers with childcare and domestic chores (Wolf 1972, 1985; Parish and Whyte 1978; Johnsons 1983; Skinners 1997; Hershatter 2000; Bossen 2002). Interestingly, although we see the regional variations in the effects of co-residence of grandparents on mothers' fertility, the positive effect of the presence of first living daughter on mothers' fertility turns out to be universal across the regions, even after controlling for the presence of grandparents. Zhao (1997), approaching fertility from a different perspective, reports complementary findings for a selected sample of women born between 1914 and 1930. That is, among women with both surviving sons and daughters, those having their first surviving son at younger ages stopped childbearing earlier, while those having their first surviving son at

older ages stopped later. Such a phenomenon can be attributed to a pronounced preference of parents to have male children (Arnold and Liu 1986).

However, it is hard to separate cause and effect here. Because of son preference, having first living daughters might lead to higher fertility for mothers due to their quest for male children. On other hand, by alleviating mothers' load in childcare and household chores, daughters might reduce mothers' energetic burden, thereby increasing their fertility via decreasing birth intervals. However, the fact that the presence of grandparents in the household did not affect mothers' fertility in Shanghai but first living daughter did points to the influence of son preference. In any case, the contribution of older daughters to childcare is tremendous, even when they are still kids themselves. For example, according to Wolf's ethnographic study on Chinese family (1972), it was common to see a little girl with a baby sibling tied on her back with a long strip of cloth; it was also not unusual for a four-year old girl to be in charge of her two-year-old brother. Hershatter (2000) also gives an account on a daughter who already started cooking by the age of nine on behalf of her busy-working mother in rural Shaanxi.

This study investigates the effects of co-resident grandparents (both paternal and maternal) and first living daughter on mother's fertility. I did not examine their effects on child mortality. However, recent studies (Strassmann and Gillespie 2002; Sear et al. 2003) suggest that variation in child mortality may be more important than variation in fertility in determining reproductive success in natural fertility societies. In particular, studies by Sear et al. (2000, 2002, 2003) on female reproductive success in rural Gambia demonstrate that the effect of maternal grandmother on child mortality was more influential than the effect of paternal grandmother on fertility. Voland and Beise (2002)

also report that in a historical German population, the presence of grandmothers had larger effects on child mortality than on fertility. Infant and child mortality has improved tremendously since the mid 1950s in China (Hao 2000). In this case, I suspect fertility may be more important than child mortality in influencing reproductive success. Nevertheless, the effects of kin on child mortality in revolutionary China still need to be investigated.

References

Arnold, F. and Z. Liu. 1986. Sex preference, fertility, and family planning in China. Population and Development Review 12: 221-246.

Bereczkeit, T. 1998. Kinship network, direct childcare, and fertility among Hungarians and gypsies. Evolution and Human Behavior 19: 283-298.

Bossen, L. 2002. Chinese women and rural development. Rowman & Littlefield Publishers, Lanham, MD.

Chen, F., S. E. Short, and B. Entwisle. 2000. The impact of grandparental proximity on maternal childcare in China. Population Research and Policy Review 19: 571-590.

Cockburn, A. 1998. Evolution of helping behavior in cooperatively breeding birds. Annual Review of Ecology and Systematics 29: 141-177.

Crognier, E., A. Baali, and M-K. Hilali. 2001. Do "helpers at the nest" increase their parents' reproductive success? American Journal of Human Biology 13: 365-373.

Crognier, E., M. Villena, and E. Vargas. 2002. Helping patterns and reproductive success in Aymara communities. American Journal of Human Biology 14: 372-379.

Dankert, G. and J. van Ginneken. 1991. Birth weight and other determinants of infant and child mortality in three provinces of China. Journal of Biosocial Science 23: 477-489.

Davis-Friedmann, D. 1983. Long lives: Chinese elderly and the Chinese revolution. Harvard Univ. Press.

Emlen, S. T. 1995. An evolutionary theory of the family. Proceedings of the National Academy of Sciences 92: 8092-8099.

Emlen, S. T. 1997. Predicting family dynamics in social vertebrates. In J. R. Krebs and N. B. Davis (eds.), *Behavioural Ecology: An Evolutionary Approach.* 4th ed. pp. 228-253. Blackwell, London.

Entwisle, B. and F. Chen. 2002. Work patterns following a birth in urban and rural China: A longitudinal study. European Journal of population 18: 99-119.

Flinn, M. V. 1989. Household composition and female reproductive strategy in a Trinidadian village. In A. E. Rasa, C. Vogel, and E. Voland (eds.), *The Sociobiology of Sexual and Reproductive Strategies.* pp. 206-233. Chapman & Hall, London.

Freedman, R. M-C. Chang, and T-H. Sun. 1982. Household composition, extended kinship and reproduction in Taiwan: 1973-1980. Population Studies 36: 395-411.

Guo, S. 1995. Determinants of fertility decline in Shanghai: Development or policy. In A. Goldstein and F. Wang (eds.), *China: The Many Facets of Demographic Change.* pp. 81-96. Westview Press, Boulder, CO.

Hao, H. 2000. Trends and geographic differentials in mortality. In X. Peng and Z. Guo (eds.), *The Changing Population of China.* pp. 34-50. Blackwell, Oxford.

Johnson, K. A. 1983. Women, the family and peasant revolution in China. University of Chicago Press.

Hamilton, W. D. 1964. The genetic evolution of social behavior. Journal of Theoretical Biology 7: 1-52.

Hawkes, K., J. F. O'Connell, and N. G. Blurton Jones. 1997. Hadza women's time allocation, offspring provisioning and the evolution of long postmenopausal life spans. Current Anthropology 38: 551-578.

Harrell, S. 2000. The changing meanings of work in China. In B. Entwisle and G. E. Henderson (eds.), *Re-drawing Boundaries: Work, Households, and Gender in China.* pp. 67-76. University of California Press.

Hermalin, A. I., C. Roan, and A. Perez. 1998. The emerging role of grandparents in Asia. Population Studies Center, University of Michigan, Elderly in Asia Research Report Series No. 98-52.

Hershatter, G. 2000. Local meanings of gender and work in rural Shaanxi in the 1950s. In B. Entwisle and G. E. Henderson (eds.), *Re-drawing Boundaries: Work, Households, and Gender in China.* pp. 79-96. University of California Press.

Hrdy, S. B. 1999. Mother Nature: A History of Mothers, Infants, and Natural Selection. Pantheon, New York.

Krebs, J. R. and N. B. Davis. 1993. An introduction to behavioral ecology. 3rd ed. Blackwell, Oxford.

Lavely, W. 1991. Marriage and mobility under rural collectivism. In R. S. Watson and P. Ebrey (eds.), *Marriage and Inequality in Chinese Society.* pp. 286-312. University of California Press.

Lavely, W. and X. Ren. 1992. Patrilocality and early marital co-residence in rural China, 1955-85. China Quarterly 130: 378-391.

Logan, J. R., F. Bian, and Y. Bian. 1998. Tradition and change in the urban Chinese family: The case of living arrangement. Social Forces 76: 851-882.

Low, B. S. 1991. Reproductive life in nineteen century Sweden: An evolutionary perspective on demographic phenomena. Ethology and Sociobiology 12: 411-448.

Low, B. S. 1998. The evolution of human life histories. In C. Crawford and D. L. Krebs (eds.), *Handbook of Evolutionary Psychology: Ideas, Issues, and Applications.* pp. 131-161. Lawrence Erlbaum, Mahwah, NJ.

Low, B. S. 2000. Why sex matters. Princeton Univ. Press.

Mace, R. 2000. Evolutionary ecology of human life history. Animal Behavior 59: 1-10.

Matsubayashi, H., T. Hosaka, S. Izumi, T. Suzuki, and T. Makino. 2001. Emotional distress of infertile women in Japan. Human Reproduction 16: 966-969.

Parish, W. L. and M. K. Whyte. 1978. Village and family life in contemporary China. University of Chicago Press.

Huang, S-M., K. C. Falk, and S-M. Chen. 1996. Nutritional well-being of preschool children in a north China village. Modern China 22: 355-381.

Saunders, K. A. and N. W. Bruce. 1997. A prospective study of psychosocial stress and fertility in women. Human Reproduction 12: 2324-2329.

Sear, R., R. Mace, and I. A. McGregor. 2000. Maternal grandmothers improve the nutritional status and survival of children in rural Gambia. Proceedings of the Royal Society of London. Series B, Biological Sciences 267: 1641-1647.

Sear, R., F. Steele, I. A. McGregor, and R. Mace. 2002. The effects of kin on child mortality in rural Gambia. Demography 39: 43-63.

Sear, R., R. Mace, and I. A. McGregor. 2003. The effects of kin on female fertility in rural Gambia. Evolution and Human Behavior 24: 25-42.

Skinner, G. W. 1997. Family systems and demographic processes. In D. Kertzer and T. Fricke (eds.), *Anthropological Demography.* pp. 53-95. University of Chicago Press.

State Statistical Bureau. 1986. China In-Depth fertility Survey. Principal Report, Vols 1 & 2. Department of Population Statistics of the State Statistical Bureau, Beijing.

Stockman, N. 2000. Understanding Chinese society. Polity Press, Oxford.

Strassmann, B. I. And B. Gillespie. 2002. life-history theory, fertility and reproductive success in humans. Proceedings of the Royal Society of London. Series B, Biological Sciences 269: 553-562.

Turke, P. W. 1988. Helpers at the nest: Childcare network in Ifaluk. In L. L. Betzig, M. Borgerhoff Mulder, and P. W. Turke (eds.), *Human Reproductive Behaviour: A Darwinian Perspective*. pp. 173-188. Cambridge Univ. Press.

Turke, P. W. 1989. Evolution and the demand for children. Population and Development Review 15: 61-89.

Voland, E. and J. Beise. 2002. Opposite effects of maternal and paternal grandmothers on infant survival in historical Krummhörn. Behavioral Ecology and Sociobiology 52: 435.443.

Wang, G. 2000. The distribution of China's population and its changes. In X. Peng and Z. Guo (eds.), *The Changing Population of China.* pp.11-19. Blackwell.

Weinstein, M., T-H. Sun, M-C. Chang, and R. Freedman. 1990. Household composition, extended kinship, and reproduction in Taiwan: 1965-1985. Population Studies 44: 217-239.

Wolf, M. 1972. Women and the family in rural Taiwan. Stanford Univ. Press.

Wolf, M. 1985. Revolution postponed: Women in contemporary China. Stanford Univ. Press.

Zhao, Z. 1997. Deliberate birth control under a high-fertility regime: Reproductive behavior in China before 1970. Population and Development Review 23: 729-767.

Appendix 1. Descriptive statistics for age at first birth according to different types of living arrangement with parents.

Variable	N	Minimum	Maximum	Mean	S.D.
Hebei					
With neither	934	15	39	22.85	3.00
With husband's parents	2561	14	39	22.62	2.96
With wife's parents	93	16	35	22.71	3.41
Shaanxi					
With neither	523	16	34	22.15	3.11
With husband's parents	2216	13	34	21.31	2.66
With wife's parents	148	16	39	20.69	3.23
Shanghai					
With neither	1115	16	36	24.71	3.36
With husband's parents	1398	15	38	24.34	3.16
With wife's parents	344	16	38	24.81	3.91
Total					
With neither	2572	15	39	23.51	3.36
With husband's parents	6175	13	39	22.50	3.13
With wife's parents	585	16	39	23.43	4.07

Appendix 2. Descriptive statistics for the number of children ever-born according to different types of living arrangement with parents.

Variable	N	Minimum	Maximum	Mean	S.D.
Hebei					
With neither	934	1	8	2.61	1.50
With husband's parents	2561	1	9	2.80	1.45
With wife's parents	93	1	7	2.60	1.43
Shaanxi					
With neither	523	1	10	2.76	1.68
With husband's parents	2216	1	12	3.20	1.71
With wife's parents	148	1	8	2.99	1.61
Shanghai					
With neither	1115	1	6	1.70	0.91
With husband's parents	1398	1	6	1.68	0.91
With wife's parents	344	1	5	1.70	0.87
Total					
With neither	2572	1	10	2.24	1.41
With husband's parents	6175	1	12	2.69	1.56
With wife's parents	585	1	8	2.17	1.33

Appendix 3. Means and standard deviations for the number of children ever-born according to the sex of first living child.

Variable		N	Minimum	Maximum	Mean	S.D.
Hebei						
	Boy	1914	1	9	2.64	1.44
	Girl	1674	1	8	2.86	1.48
Shaanxi						
	Boy	1497	1	10	3.03	1.69
	Girl	1390	1	12	3.19	1.72
Shanghai						
	Boy	1498	1	6	1.65	0.88
	Girl	1359	1	6	1.74	0.93
Total						
	Boy	4909	1	10	2.46	1.49
	Girl	4423	1	12	2.62	1.55