# Final Term Paper

What Drives the Relationship between Education and Fertility?

Evidence from China, 1982

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Abstract: The relationship between education and fertility is important both for China's economic development and the educational inequality pattern. Moreover, this relationship has always been the focus of economics of fertility through the discussions on the two classic trade-offs: trade-off between quantity and quality of children and trade-off between women's time allocation on housework and labor force participation. China, as a country having one fifth of the world's total population and severe gender gap of education, provides a crucial context to test the relevant economic theories. Based on the data of IPUMS International China 1982, this article investigates the evolution and causes of the relationship between education and fertility of Chinese women aged 41-64. By empirical examination and theoretical argument, this article draws some interesting conclusions which suggest a negative relationship between education and fertility for both older and younger cohorts. Specifically, for the older cohorts, the negative relationship is getting stronger with an increasing average fertility for all educational levels, while for the younger cohorts, the negative relationship is getting weaker with a decreasing average fertility. Therefore, policy effect is likely to be the driving force of the evolution of the relationship rather than that of the relationship itself. Since female education tends to be positively correlated with the fraction of children surviving as well as female employment rate, the "two trade-offs" is more likely to be the reason for the negative relationship itself.

## INTRODUCTION

Although its large population has provided China with a sufficient labor force, compared to its limited resources, it is widely believed that China's economic development and ability to modernize to a great extent depends on its success in curbing the population (Tsuya & Choe, 1988). Moreover, education has always been a crucial aspect of China's severe gender disparity. On one hand, China's huge population along with its increasing fertility and decreasing mortality could intensely limit China's further development. On the other hand, China's market transition and economic growth dating from the late 1970s along with the increasing population growth may have actually slowed down the progress toward gender equity instead of accelerating it (Hannum, 2005). The slowing progress is caused by the rising cost of education and increasing

population which were resulted from the market transition and economic development. The combination of these factors may result in even more intense competition between boys and girls for parents' investment onto them, which boys are more likely to "win."

Therefore, by investigating the relationship between the educations of women aged 41-64 and their fertility behavior I could possibly answer whether or not China would be left in this "economic growth ⟶ population growth and enlarging educational gender gap ⟶ increasing population growth ⟶ slower economic growth" trap. In this way, the answer may also provide an insight into how the relationship between education and fertility contributes to China's educational gender gap and a possible prediction of China's future development. Furthermore, to investigate the relationship from a cohort perspective could enable us to investigate the dynamics of the relationship, approach the changing historical background of fertility policies in China, and also compensate for the unavailability of data for other than 1982 while helping to forecast what relevant changes may lie in years ahead.

From the perspective of other social context of China, although its large-scale one-child policy did not start until 1979, the *wan-xi-shao* policy dating from 1970 might actually cause the relationship itself as well as its evolution over cohorts.[1] Firstly, the *wan-xi-shao* policy may drive the relationship itself. This is because on one hand, fertility fell dramatically under the policy – the policy is negatively correlated with fertility in this way; on the other hand, in more developed regions and for the majority ethnicity group Han female education tends to be higher and the policy tends to be implemented in a more rigorous and far-reaching way – the policy is positively correlated with female education in this way. Therefore, the policy might be the intermediary

[1] China's national fertility-control policies started with the *wan-xi-shao* (later-longer-fewer) policy, dating from 1970, and continued with the one-child policy starting in 1979. Fertility fell dramatically under the *wan-xi-shao* policy, from a total fertility rate of about 5.78 births per woman in 1970 to 2.6 by 1978 (Hannum, 2005).

part joining female education and fertility together and drive the relationship between them. Secondly, the *wan-xi-shao* policy may also cause the evolution of the relationship. This is because for women aged 41-64 in 1982, the younger of them may have not yet completed their fertility at the time of the policy and thus were more likely to be influenced by the policy, while the older of them may have already completed their fertility at the time of the policy and thus were more likely to be exempted from the policy.[2] The different levels of policy effect may result in different patterns of the relationship across female cohorts of interest.

From the perspective of economic theory, the negative correlation between the quantity and quality of children in a family is one of the central features of economic theories of fertility (Becker & Lewis, 1973). Willis (1973) further extended the theory and argued that because education increased the value of women's time, women with higher education tend to substitute toward quality and away from quantity of children. This suggests a negative correlation between women's education and their fertility levels (Willis, 1973; Lam, 2005). Lam and Duryea (1999) have more explicitly attributed the negative relationship to the results of two trades-offs: trade-offs between quantity and quality of children and trade-offs between women's time allocation between housework and labor force participation. China, a country with more than one fifth of the world's total population and severe gender inequality of education (Hannum, 2005), provides a critical context for testing the theories and investigating how the underlying mechanisms of the relationship operate.

Specifically, this paper will investigate the following questions: How did the education of women in China aged 41-64 in 1982 correlate with their completed fertility? How would the

[2] For example, women aged 41-52 in 1982 were more likely to be influenced by the fertility policy since they were only 29-40 in 1970, while women aged 53-64 in 1982 were more likely to be exempted from the fertility policy since they were already 41-52 in 1970.

relationship change across cohorts? What caused this relationship itself and its change over time? My empirical analysis is based on retrospective fertility histories of 89,594 Chinese women aged 41-64 in 1982. I document the strong negative relationship between education and fertility and summarize trends in education and fertility across cohorts. By relying on both the general trends across cohorts and including cohorts in the regression model, I demonstrate that the relationship for older cohorts is getting stronger and the relationship for younger cohorts is getting weaker. Analyzing the mechanisms through which education affects fertility, I first show that for both younger cohorts who were more likely to be influenced by the fertility policy and older cohorts who were more likely to be exempted from the fertility policy, the relationship between education and fertility remains negative. Combing this pattern with the above results indicating varying strength of the relationship, I conclude that fertility policy is not likely to be the cause of the negative relationship itself but the cause of the evolution of the relationship. Furthermore, by examining the relationship between women's education and their children's survival fraction as well as the relationship between women's education and their labor force participation, I find evident positive relationships in both results. My interpretation of this limited evidence, based on the rich research on the "two trade-offs", is that the "two trade-offs" are likely to be the cause of the negative relationship itself.

## LITERATURE REVIEW

Many studies have focused on the relationship between women's education and fertility in developing countries. Bongaarts' (2003) conclusions were based on the data from Demographic and Health Surveys in 57 less developed countries and he investigated the relationship from the view of fertility transition that these educational differentials in fertility are

slightly larger in the earlier than in the later stages of the transition.[3] He provides the perspective to analyze the relationship in China under such a macro background of fertility transition. Jain's (1981) research was based on the data from the First Country Reports of the World Fertility Surveys for eleven developing countries and reached the conclusion that advancement in female education can be expected to influence fertility behavior even without simultaneous changes in other factors such as increasing opportunity for participation in the paid labor force in the modern sector.[4] Lam and Duryea (1999) also confirmed the negative relationship between women's schooling and fertility in Brazil, a developing country experiencing rapid fertility decline in the absence of a major family planning effort.

Moreover, there are many studies paying attention to the mechanisms beneath the relationship. Graff (1979) concluded that "a more basic, critical, and realistic conceptualization of the role of education is required. Education … should be seen … less directly and less linearly, functioning and mediating through and with other structural and attitude-shaping factors." Weinberger (1987) reached a similar conclusion that education influences fertility through its effects on the intermediate factors, for example, age at marriage, breastfeeding and contraceptive practice. Both of their conclusions stressed the importance of finding out the mechanisms driving the causality from education to fertility and of controlling for other relevant variables. Martin (1995) argued that education enhances women's ability to make reproductive choices which resulted from their intensified bargaining power. This argument was consistent with Lam and Duryea's (1999) conclusion that education would increase women's household productivity.

[3] During Demographic and Health Surveys, Asian countries only include Bangladesh, Cambodia, India, Indonesia, Nepal, Philippines, Thailand, and Vietnam, without China.

[4] Countries included in the World Fertility Surveys are: Costa Rica, Colombia, Dominican Republic, Panama, Fiji, Korea, Malaysia, Pakistan, Sri Lanka, Thailand and Indonesia.

Martin (1995) also concluded that in some of the least-developed countries, education might have a positive impact on fertility at the lower end of the educational range, which was different from Lam and Duryea's (1999) finding that low levels of schooling are associated with large declines in fertility. Both of the above similarity and discrepancy raised the necessity to empirically investigate the evolution of the relationship and to test the mechanism beneath the relationship. Some articles especially emphasized the importance of controlling for other relevant variables. Freedman (1979) suggested controlling for changes in life conditions and changing perceptions, while Bongaarts (1978) preferred controlling for intermediate fertility variables (exposure factor, deliberate marital fertility control factors and natural marital fertility factors). Instead, Lam and Duryea (1999) controlled for socioeconomic factors including husband's schooling, region, race, marriage age and husband's income.

This paper will provide a complementary perspective compared to the above literatures by examining whether the policy effect is the driving force of both the relationship between education and fertility as well as its evolution. Furthermore, although all of the above studies were on developing countries, none of them were on China, for which my investigation might be a necessary complement and improvement.

Moreover, all of Jain (1981), Freedman (1979), Bongaarts (2003) and Lam and Duryea's (1999) articles emphasize the importance of controlling for other relevant variables. However, both Freedman (1979) and Bongaarts (2003) ignored the socioeconomic factors which are more fundamental since they actually determine life condition, perceptions and fertility variables in the first place. Therefore, I will turn to Lam and Duryea (1999) for reference on which socio-economic variables should be controlled for.

RESEARCH STRTEGY

Table 1 presents the summary statistics of key variables of interest in the study. The dataset I will use is the IPUMS International China 1982. The sample will be restricted to Chinese women aged 41-64. By this restriction, women who are too young or too old for a research on completed fertility can be excluded. For those too young, their fertility or even education pattern may still be changing frequently and intensely; for those too old, their relevant patterns would already be very fixed, thus, including them may contribute little to the general analysis. The average age for women of interest is around 51.27. Therefore, their fertility behaviors can hardly be influenced by the large-scale on-child policy starting from 1978 since it is highly likely their childbearing age had already ended at the time. However, as discussed in the previous sections, the *wan-xi-shao* policy dating from 1970 might dissimilarly influence the fertility behaviors of the women of different cohorts. To capture the policy effect and the general evolution of the relationship between education and fertility, women aged "41-52" and those aged "53-64" will be analyzed separately through regressions. 41.86% of the women are aged 53-64, which generally guarantees the representativeness of both age groups. Furthermore, relationship changes across female birth cohorts will be investigated as a more detailed examination of the policy effect and relationship evolution.

Within the women of interest, 79.27% of them were illiterate or semi-illiterate, 15.05% of them had primary schooling, 3.56% of them had junior middle schooling, 1.57% of them had senior middle schooling, and only 0.56% of them had undergraduate schooling or higher. For their employment status, 53.44% of them were employed, 0.009% of them were unemployed and 46.55% were inactive. This under-representativeness of higher educational groups and unemployed groups may make the conclusions shaky. The women had a mean family size of

5.18 and had born 5.31 children on average of which 4.24 had survived. Therefore the average fraction of children surviving is as high as 83.25%.

Moreover, since most minority ethnicity groups were exempted from the fertility control policy, the patterns of the relationship between education and fertility for majority and minority ethnicity groups are also good indication of the policy effect. In the sample, as high as 93.91% of the women belong to the majority ethnicity group - Han. This under-representativeness of the minority ethnicity groups may influence the reliability of the conclusions.

Specifically, to investigate the first research question that how did the education of women in China aged 41-64 in 1982 correlate with their completed fertility, firstly, descriptive statistics of the education level and number of children ever born to women aged 41-64 will be used to demonstrate the general trends and relationship between education and fertility of women of interest. Then a regression of the number of children ever born to women aged 41-64 on their educational levels will be done in order to achieve the partial and incremental correlation of each educational level on the number of children ever born. Both of the above descriptive and regression analyses can be done using the 1982 IPUMS International data for China, and the variables used are educational level and number of children ever born. Since the universe of educational level is all persons aged 6+, the universe of number of children ever born is females aged 15 to 64, and the dataset is based on the China census in 1982, there should not be serious self-selection problem. The variable indicating educational level will be treated as five dummy variables and their partial correlations with number of children ever born as well as their incremental correlations beyond the lower one will be shown.

To address the second research question that how would the relationship evolve across cohorts, firstly, descriptive statistics of the educational levels and fertility levels of female

cohorts will be plotted to demonstrate the general evolution of the relationship between women's education and fertility across time. Next, two regressions of number of children ever born on educational levels will be done respectively for age group 41-52 and 53-64. In this way, general changes of the relationship across time can be achieved. Then two more inferential analyses will be done by regressing the number of children ever born to women aged 41-64 on the educational level and female cohorts respectively with and without interactions of each cohort with educational level, in order to demonstrate how the relationship between education and fertility changes across different cohorts. An F-test will be done between the above two regressions so as to examine whether the changing relationship between education and fertility across cohorts are statistically significant. Both of the above descriptive and regression analyses can be done using the 1982 IPUMS International data for China, and the variables will be used are educational level, number of children ever born and female birth cohorts. The eight 3-year female cohorts will be treated as seven dummy variables. Note that educational level will be treated as a categorical variable here for the convenience of interpretation.

The third research question that what caused the relationship and its evolution is highly important in that it investigates the underlying mechanisms driving the relationship between education and fertility. To examine whether the relationship itself is the result of the policy effect, the analyses for the second research question could be applied to demonstrate whether the directions of the relationship are different from younger to older women in 1982. Furthermore, since most Chinese minority groups were exempted from the *wan-xi-shao* policy (Tsuya and Choe, 1988), two regressions of number of children ever born on educational level, ethnicity with and without interaction of ethnicity with educational levels may also be instructive to test

the possible causality carried out by the policy change. Ethnicity group will be treated as one dummy variable with minority ethnicity groups as the reference level.

The two trade-offs have provided insightful explanations for the negative relationship across many literatures. By attributing the declined fertility to the increased productivity of women in household and labor market as a result of the generally improved educational status of women, the rationales behind the negative relationship emerge in a clear and reasonable way.

To examine the trade-off between children quantity and quality, I will use both descriptive statistics of education, children quantity and children quality, in which children quantity is indicated by the number of children ever born, and children quality is indicated by number of children ever born now living and fraction of children alive. The analysis can be done using the 1982 IPUMS International data for China.

To investigate the trade-off between women's time allocation between housework and labor force participation, I will use descriptive statistics to show the general relationship between women's education, wage and labor force participation. With the increase of wage, if women's labor force participation does not change much, the research focus should be turned to the first trade-off that women, with even more improved market productivity, may tend to stay in housework and try to invest more on children quality. The opposite causality might also be achieved through empirical test. However, data needed for this analysis are not entirely available in IPUMS 1982. I can only use women's employment status and education to examine with higher education, whether or not women are more likely to participate in the labor market. To determine the pattern of the relationship between women's education and income, conclusions from Xie and Hannum (1996) will be referred to. However, since Xie and Hannum's paper was based on the 1988 Chinese Household Income Project (CHIP), the conclusions may not be quite

comparable in this article due to the fact that China has experienced fast economic transition between 1982 and 1988. Moreover, CHIP and IPUMS data are based on different universe and survey design. As a result, reliance on their conclusions is quite limited.

RESULTS:

*Fertility and Education in China*

Figure 1 shows the number of children ever born and the number of children ever born now living at the time of the survey, classified by different educational levels, for all Chinese women aged 41-64. The figure demonstrates the large differences in fertility across different educational levels. Illiterate or semi-illiterate women (about 79 percent of the women aged 41-64) report an average 5.8 live births. This falls rapidly with the educational levels from illiterate to undergraduate, at which mean number of children born alive was 2.5. Figure 1 also shows the large differences in child survival across educational levels. Illiterate women lost an average of 1.2 children, a survival rate of 78 percent. Women with graduate education report an average of only 0.07 children death, for survival rates over 97 percent. This leads to the issue of child health and child survival which indicates implicitly the interaction between education, fertility and investment in child quality. Therefore, it is a good starting point for my later investigation into the causes beneath the relationship between education and fertility. However, from undergraduate to graduate schooling, the declining trend of mean number of children ever born starts to be weaker, which is corresponded to by the following regression analysis.

Although family size does not entirely correspond to fertility levels, it does reflect the fertility and labor participation decisions made by women. Figure 2 shows the number of persons

in the household at the time of the survey, classified by different educational levels, for all Chinese women aged 41-64. The figure demonstrates the large differences in family size across different educational levels. Illiterate or semi-illiterate women report an average family size of 5.2. This falls relatively fast with the educational levels from primary school to senior high school, while declining gradually in both educational levels of illiterate to primary school and senior high school to graduate schools.

To investigate the relationship between education and completed fertility, it is necessary to determine firstly whether education had shown a certain trend during the period of interest. As discussed by Lam and Duryea (1999), educational inequality is associated with the low mean and high variance of mean educational levels. Table 2 shows the trends in educational levels for female cohorts born between 1918-1941, based on the cross-sectional relationship between educational levels and age in the 1982 IPUMS International China. Mean educational levels for women has increased tremendously across cohorts by eight times over the years shown. The most rapid increase in the mean occurred for the cohorts born from 1930 to 1941. The role of these cohorts in the fertility decline as well as the evolution of the relationship between education and fertility will be investigated in the next section. However, Table 2 also demonstrates the enlarging educational inequality with the increase of standard deviations. Moreover, as seen in Table 2, the coefficient of variation declined steadily during the cohorts shown, which indicates that the educational distribution has a general tendency toward equality relative to their mean levels.

Table 3 represents the estimated correlations of educational levels on the number of children ever born to Chinese women aged 41-64. It is clear that both for the age group 41-64 in general, and for the separate age groups 41-52 and 53-64, a significant negative relationship

exists between women's educational levels and their fertility level, that is, the higher educational levels women have, the lower their fertility levels are. Moreover, for the age group 41-52, the negative relationship does seem stronger than both the age group 41-64 in total and the age group 53-64 since for all of the educational levels, the absolute values of the coefficients are larger. This to some extent indicates that the *wan-xi-shao* policy did influence the fertility behavior of those women who were still in their active childbearing age at the time when the policy were implemented despite their respective educational levels. Therefore, it might be meaningful to treat different cohorts as dummy variables to be regressed on along with educational levels by fertility levels, in order to test whether or not the policy effect are significant.

Furthermore, although the negative relationship between educational and fertility levels is estimated to significantly exist, the marginal differences of the estimated coefficients[5] of educational levels on fertility levels are actually diminishing, that is, for women aged 41-64, when the educational level turns from illiterate or semi-illiterate to primary school, the number of children ever born is estimated to reduce by 0.925, however when the educational level turns from primary school to junior middle school, the marginal correlation is only -0.905; from junior middle school to senior middle school, the marginal correlation is -0.622; from senior middle school to college undergraduate, the marginal correlation is -0.662 and from college undergraduate to graduate, the marginal correlation is only -0.001. The diminishing trend is the same for women aged 41-52, though with a larger marginal correlation from college undergraduate to college graduate. The trend is even more evident for women aged 53-64 for whom the marginal correlation from college undergraduate to college graduate gets a quite large positive value 0.445, which indicates that for this group of women, the higher education, instead

[5] The coefficient of a higher educational level minus that of the educational level one level lower.

of leading to lower fertility level, is actually resulting in higher fertility level. However, different from two other age groups, there is a rebound of marginal correlation from senior middle school to college undergraduate.[6] Lam and Duryea (1999) attributed this diminishing trend of marginal educational correlations to the increased household productivity of women whose fertility decisions were mainly based on the trade-off between "quantity" and "quality" of children. Therefore, those results indicate the importance to investigate the driving forces of the relationship between education and fertility. However, these diminishing marginal correlations may also be due to the under-representativeness of women with higher education.

*Relationship between Education and Fertility across Cohorts*

Figure 3 shows the fertility and education trend across female birth cohorts. As can be seen, there are changing relationships between educational and fertility levels longitudinally. It is clear that from the cohort 1927-1929, evident negative relationship between the average educational and fertility levels started and with an increasing speed. Before cohort 1927-1929, this trend of changing relationships was rather weak and gradual, and the relationship between education and fertility almost kept positive. However, both trends before and after 1927-1929 do not indicate the causality between the educational and fertility levels and also does not show whether the observed negative relationship was getting stronger or weaker across different female birth cohorts. To address this problem, regression analysis of fertility levels on educational levels and different female birth cohorts might be helpful.

Model 1 in Table 4 shows the regression results of number of children ever born on education which is treated as a categorical variable for convenience of interpretation, and cohort

[6] From -0.292 to -1.312.

dummy variables which treat cohort 1918-1920 as the reference level. Interaction terms between education and cohorts are included in Model 2. As can be seen in Model 1, the negative relationship between education and fertility still holds. Moreover, along with the cohort evolving from 1921-1932, the average differences in number of children ever born across educational levels with the reference level of cohort 1918-1920 have been increasing. However, from 1930 to 1941, the differences in average fertility level between the cohort of interest and cohort 1918-1920 starts to decrease with an increasing speed. Especially, the difference falls below zero for cohort 1939-1941. In general, Model 1 shows the changing pattern of the average fertility level that although from cohort 1918-1932 the average fertility level keeps increasing, it increases at a decreased speed. For Model 2, the negative relationship between education and fertility also holds. This also shows that for those illiterate or semi-illiterate women, the average fertility level keeps rising from cohort 1918-1932 and then starts to decline. However, the changes of the negative coefficients on the interaction terms indicates that along with the cohort evolution, the negative correlation between education and fertility is getting stronger from cohort 1921-1932 and then begins weakening with the absolute values of the negative coefficients getting smaller. An F-test between Model 1 and Model 2 is done with an F-value of 6.96, which indicates the changing strengths of the negative relationship across cohorts are statistically significant.

As can be seen more clearly in Figure 8 and Figure 9, although the average fertility level is estimated to increase before cohort 1930-1932, it is with a stronger negative correlation between education and fertility; however, although from cohort 1930-1932 the average fertility level is estimated to decrease, it declines with a weaker negative correlation between education and fertility.

*What Drives the Relationship Itself and Its Evolution?*

Fertility Control Policy

*Wan-xi-shao* policy started from 1970. Therefore, those younger women of cohorts 1930-1941 were most at their 30s at the time of *wan-xi-shao* policy, and it is highly likely that their fertility behaviors were influenced by the fertility policy; however, those older cohorts from 1918-1932 were more likely to be exempted from the policy effect. As can be seen from Model 1 and Model 2 in Table 4, for both older and younger cohorts the relationship between education and fertility remains negative. Moreover, since most minority groups were exempt from the fertility control policy, analysis including ethnicity may also be helpful to determine whether it is the policy effect that drives the negative relationship itself. Figure 4 shows that the average family sizes of Han women across all educational levels tend to be lower than those of minority women. Furthermore, Figure 5 presents that for lower educational level, the average fertility of Han is lower; however, for higher educational level, the average levels of fertility for Han and minority groups are rather similar, which might be due to the fact that with higher education, minority women tend to be more accessible and confirmative to fertility control policy. As can be seen in Table 5, Model 3 shows the regression results of number of children ever born on education which is treated as a categorical variable for convenience of interpretation, and ethnicity dummy variable which treat minority groups as the reference level. Interaction term between education and Han is included in Model 4. Both models demonstrate that the average fertility level for Han is lower than that of minority groups; however, for both Han and minority groups, the negative relationship holds. Although Han is estimated to have a stronger negative relationship than minority groups, this difference is not statistically significant. All of the above results indicate that policy effect is not likely to be the driving force of the relationship itself.

Model 1 and Model 2 also show that before cohort 1930-1932, the negative relationship is getting stronger with an increasing average fertility for all educational levels; however, from cohort 1930-1932, the negative relationship is getting weaker with a decreasing average fertility. Especially, both in Model 1 and Model 2, from cohort 1930-1932, the coefficients of cohort dummy variables decreased fast and eventually turn negative for the cohort 1939-1941. These results demonstrate that fertility policy might be the reason for the evolution of the relationship.

Two Trade-offs

I. Children Quantity vs. Children Quality

Figure 1 and Figure 6 show that with higher education, the number of children ever born tends to be lower and the average fraction of children ever born now living tends to be higher. This generally indicates women with higher education do substitute toward quality and away from quantity of children. The first trade-off is likely to drive the relationship itself.

II. Women's Time Allocation

Figure 7 respectively shows that women's labor force participation tends to increase with higher education. Moreover, Xie and Hannum (1996) concluded that education is estimated to be positively correlated with earnings in China during 1988. If the conclusion is used here, it indicates that women with higher education actually reacted actively to the higher income by participating more in the labor force. Therefore, the second trade-off might also be the key driving force of the negative relationship.

## CONCLUSIONS

Based on the above descriptive statistics and linear regressions of fertility on educational levels with controlling for other key relevant variables, it can be concluded that the higher the educational levels of the women, the lower the fertility levels. This negative relationship holds true for both older and younger cohorts. More specifically, for older cohorts, the negative relationship is stronger but with an increasing average fertility for all educational levels; while for the younger cohorts, the negative relationship is weaker but with a decreasing average fertility for all educational levels. Moreover, the average fertility level for Han is estimated to be lower with a stronger negative relationship than that of minority groups, although the difference of the slopes is not statistically significant and the negative relationship remains for both majority and minority ethnicity groups. Furthermore, both the number of children ever born now living and labor force participation of women tend to increase with higher education, which generally follows the rationales of the two trades-offs.

Based on the above empirical results, the following conclusions can be drawn:

1) There is a negative relationship between education and completed fertility for Chinese women aged 41-64 in 1982.
2) The negative relationship evolved across different cohorts. Specifically, before cohort 1930-1932, the average fertility level increased across cohorts and started to decrease from then. Moreover, before cohort 1930-1932, the relationship between education and fertility was getting stronger across cohorts and started to be weaker from then.
3) Therefore, policy effect is likely to be the reason for the evolution of the relationship, rather than the reason for the relationship itself.

4) Instead, based on the given limited empirical evidence however rich literature on the "two trade-offs", the "two trade-offs" are likely to be the driving force of the relationship between education and fertility.

From the above conclusions, some implications about China's social reality can be reached. In the first place, decreasing China's gender gap of education and improving women's education tends to be an effective way to curb China's population and mitigate the intense competition for resources among its people. However, in terms of China's already limited resources and increased gender inequality resulted from the economic transition, this is a quite long and hard way to go. Relatively, implementing fertility control policy is effective not only in restricting China's population but also in weakening the reliance of fertility on women's education. Moreover, since it is implemented imperatively by the government, it is also more efficient in the short term. However, to improve women's education, in the long run, is more significant since this can fundamentally pull the relationship between education and fertility out of the vicious circle from large gender gap of education to increased fertility.

However, the above conclusions and implications should be taken cautiously due to the following reasons. Firstly, the regression of fertility on education has not been done repetitively by treating each educational level as the reference level in order to statistically test whether their respective correlations with fertility are significantly different from one another. Secondly, women with higher education and unemployment, as well as minority ethnicity groups are under-representative in the used sample, which may affect the reliability of the conclusions. Thirdly, to investigate the two trades-offs, descriptive statistics and regressions to examine the relationship between women's education, wage, labor force participation and their children's education should be achieved aside from the reference to other literature's conclusions. These analyses will

be done for future study and will be based on a combined dataset of China Study (1964) and Chinese Household Income Project (1988, 1995). However, the three datasets are different in their specific universes and survey designs; moreover, although the time periods of the dataset covered 1982, in terms of China's intense transitions during 1980s, the possible results achieved from the above dataset may be unrepresentative and inconsistent with the situation in 1982, and thus lack the convincing power. Fourthly, except for cohorts and ethnicity, more variables should be controlled for in the model to secure the estimates to be unbiased while making the conclusions more reasonable and convincing. Last but not least, the conclusions should be related more deeply with China's social context in order to provide more insights and implications for gender gap of education and sustainable economic development of China.

## Appendix

## Table 1

*Descriptive Statistics of Variables Used, Women Aged 41-64, China 1982*

| Variables | Sample Size | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| **Year** | 89,594 | 1982 | 0 | 1982 | 1982 |
| **Sex** | 89,594 | 2 | 0 | 2 | 2 |
| **Age** | 89,594 | 51.27426 | 6.71366 | 41 | 64 |
| **Educational Level** | 89,594 | 0.29610 | 0.69359 | 0 | 5 |
| **Primary School** | 89,594 | 0.15048 | 0.35754 | 0 | 1 |
| **Junior Middle School** | 89,594 | 0.03561 | 0.18530 | 0 | 1 |
| **Senior Middle School** | 89,594 | 0.01568 | 0.12424 | 0 | 1 |
| **College Undergraduate** | 89,594 | 0.00054 | 0.02314 | 0 | 1 |
| **College Graduate** | 89,594 | 0.00505 | 0.07085 | 0 | 1 |
| **Numbers of Children Ever Born** | 89,594 | 5.31230 | 2.47584 | 0 | 20 |
| **Numbers of Children Ever Born Now Living** | 89,594 | 4.23924 | 1.91032 | 0 | 20 |
| **Children Survival Rate** | 86,977 | 0.83245 | 0.21367 | 0 | 1 |
| **Family Size** | 89,594 | 5.17527 | 2.10812 | 1 | 24 |
| **Employed** | 89,594 | 0.53439 | 0.49882 | 0 | 1 |
| **Unemployed** | 89,594 | 0.00009 | 0.00945 | 0 | 1 |
| **Inactive** | 89,594 | 0.46552 | 0.49881 | 0 | 1 |
| **Year of Birth** | 89,594 | 1930.72600 | 6.71366 | 1918 | 1941 |
| **Age Group** | 89,594 | 0.41859 | 0.49333 | 0 | 1 |
| **Cohort** | 89,594 | 1929.71500 | 6.67078 | 1918 | 1939 |
| **Ethnicity** | 89,594 | 0.93906 | 0.23922 | 0 | 1 |

Note: Estimated from 1982 IPUMS International China. The sample is restricted to women aged 41-64. The variable "educational level" has 6 values "0, 1, 2, 3, 4, 5" to indicate educational levels from lower to higher. The five dummy variables "primary school", "junior middle school", "senior middle school", "college undergraduate" and "college graduate" are a set variables indicating educational levels with "illiterate or semi-illiterate" as the reference level. "Children Survival Rate" is the results of number of children ever born now living divided by number of children ever born. The three dummy variables "employed", "unemployed" and "inactive" are a set of variables indicating employment status each with "otherwise" as the reference level. "Year of birth" is the census year minus women's ages. "Age group" has two values "0, 1" to indicate women aged "41-52" and "53-64". "Cohort" has eight values "1918, 1921, 1924, 1927, 1930, 1933, 1936, 1939" to indicate eight 3-year cohorts "1918-1920, 1921-1923, 1924-1926, 1927-1929, 1930-1932, 1933-1935, 1936-1938, 1939-1941". "Ethnicity" is a dummy variable treating majority ethnicity group – Han as one and all the other minority ethnicity groups as zero.

**Table 2**

*Distribution of Educational Levels for Cohorts Born 1918-1941, Three Year Female Birth Cohorts, China 1982.*

| Age Group | Birth Cohort | Sample Size | Mean Education | Standard Deviation | Coefficient of Variation |
|---|---|---|---|---|---|
| 62-64 | 1918-1920 | 7765 | 0.08 | 0.37 | 4.44 |
| 59-61 | 1921-1923 | 8993 | 0.11 | 0.42 | 3.90 |
| 56-58 | 1924-1926 | 10129 | 0.14 | 0.50 | 3.52 |
| 53-55 | 1927-1929 | 10616 | 0.18 | 0.53 | 3.02 |
| 50-52 | 1930-1932 | 11852 | 0.22 | 0.60 | 2.74 |
| 47-49 | 1933-1935 | 13429 | 0.30 | 0.69 | 2.31 |
| 44-46 | 1936-1938 | 13448 | 0.47 | 0.83 | 1.78 |
| 41-43 | 1939-1941 | 13362 | 0.65 | 0.94 | 1.43 |

Note: Estimated from 1982 IPUMS China. The sample is restricted to women aged 41-64.

**Table 3**

*OLS Regressions, Number of Children Ever Born, Education, Chinese Women Aged 41-64, 41-52 and 53-64, 1982 IPUMS International China*

| | Women 41-64 | Women 41-52 | Women 53-64 |
|---|---|---|---|
| COEFFICIENT | Dependent Variable: Number of Children Ever Born | | |
| Primary School | -0.925*** | -0.982*** | -0.734*** |
| | [0.023] | [0.023] | [0.054] |
| Junior Middle School | -1.830*** | -1.904*** | -1.459*** |
| | [0.044] | [0.042] | [0.13] |
| Senior Middle School | -2.452*** | -2.592*** | -1.751*** |
| | [0.065] | [0.062] | [0.19] |
| Undergraduate | -3.114*** | -3.140*** | -3.063*** |
| | [0.35] | [0.36] | [0.74] |
| Graduate | -3.115*** | -3.217*** | -2.618*** |
| | [0.11] | [0.11] | [0.32] |
| Constant (Illiterate) | 5.572*** | 5.581*** | 5.563*** |
| | [0.0090] | [0.011] | [0.015] |
| Observations | 89594 | 52091 | 37503 |
| R-squared | 0.05 | 0.1 | 0.01 |
| Effect of change from: | | | |
| Illiterate-Primary | -0.925 | -0.982 | -0.734 |
| Primary-Junior | -0.905 | -0.922 | -0.725 |
| Junior-Senior | -0.622 | -0.688 | -0.292 |
| Senior-Undergraduate | -0.662 | -0.548 | -1.312 |
| Undergraduate-Graduate | -0.001 | -0.077 | 0.445 |
| Standard errors in brackets | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | |

Note: Estimated from 1982 IPUMS China. The sample is restricted to women aged 41-64. The coefficients and other statistics are obtained by regressing number of children ever born on the five dummy variables of educational levels respectively within the age group "41-64", "41-52" and "53-64". The effects of change are obtained by the coefficients minus the coefficient of the lower educational level.

**Table 4**

*OLS Regressions, Number of Children Ever Born, Education, Chinese Women 3-Year Cohorts from 1918-1941, 1982 IPUMS International China*

| | Model 1 | Model 2 | | Model 1 | Model 2 |
|---|---|---|---|---|---|
| COEFFICIENT | Number of Children Ever Born | | COEFFICIENT | Number of Children Ever Born | |
| Education | -0.763*** | -0.619*** | Education*Cohort | | 0.0383 |
| | [0.012] | [0.073] | 1921-23 | | [0.095] |
| Cohort 1921-23 | 0.145*** | 0.137*** | Education*Cohort | | -0.0193 |
| | [0.037] | [0.038] | 1924-26 | | [0.087] |
| Cohort 1924-26 | 0.370*** | 0.365*** | Education*Cohort | | -0.180** |
| | [0.036] | [0.037] | 1927-29 | | [0.085] |
| Cohort 1927-29 | 0.521*** | 0.540*** | Education*Cohort | | -0.263*** |
| | [0.036] | [0.037] | 1930-32 | | [0.082] |
| Cohort 1930-32 | 0.536*** | 0.574*** | Education*Cohort | | -0.230*** |
| | [0.035] | [0.036] | 1933-35 | | [0.079] |
| Cohort 1933-35 | 0.396*** | 0.434*** | Education*Cohort | | -0.176** |
| | [0.034] | [0.036] | 1936-38 | | [0.077] |
| Cohort 1936-38 | 0.156*** | 0.183*** | Education*Cohort | | -0.0822 |
| | [0.034] | [0.037] | 1939-41 | | [0.076] |
| Cohort 1939-41 | -0.154*** | -0.182*** | Constant | 5.289*** | 5.277*** |
| | [0.035] | [0.038] | | [0.027] | [0.028] |
| Observations | 89594 | 89594 | | | |
| R-squared | 0.06 | 0.06 | | | |
| Standard errors in brackets | | | | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | | | | |

Note: Estimated from 1982 IPUMS China. The sample is restricted to women aged 41-64. The coefficients and other statistics of Model 1 are obtained by regressing number of children ever born on categorical variable of education and 7 dummy variables indicating cohorts from 1918-1941. Cohort 1918-1920 is the reference level. The coefficients and other statistics of Model 2 are obtained by regressing number of children ever born on categorical variable of education, 7 dummy variables indicating cohorts from 1918-1941 and their interaction terms with education.

**Table 5**

*OLS Regressions, Number of Children Ever Born, Education, Majority Ethnicity Group - Han, 1982 IPUMS International China*

| | Model 3 | Model 4 |
|---|---|---|
| COEFFICIENT | Dependent Variable: Number of Children Ever Born | |
| education | -0.815*** | -0.737*** |
| | [0.012] | [0.057] |
| Han-Majority | -0.211*** | -0.194*** |
| | [0.034] | [0.036] |
| education*Han-Majority | | -0.0804 |
| | | [0.059] |
| Constant | 5.751*** | 5.736*** |
| | [0.033] | [0.035] |
| Observations | 89594 | 89594 |
| R-squared | 0.05 | 0.05 |
| Standard errors in brackets | | |
| *** p<0.01, ** p<0.05, * p<0.1 | | |

Note: Estimated from 1982 IPUMS China. The sample is restricted to women aged 41-64. The coefficients and other statistics of Model 3 are obtained by regressing number of children ever born on categorical variable of education and 1 dummy variable indicating majority ethnicity group-Han. Chinese minority ethnicity group is the reference level. The coefficients and other statistics of Model 4 are obtained by regressing number of children ever born on categorical variable of education, 1 dummy variables indicating majority ethnicity group-Han and its interaction term with education.

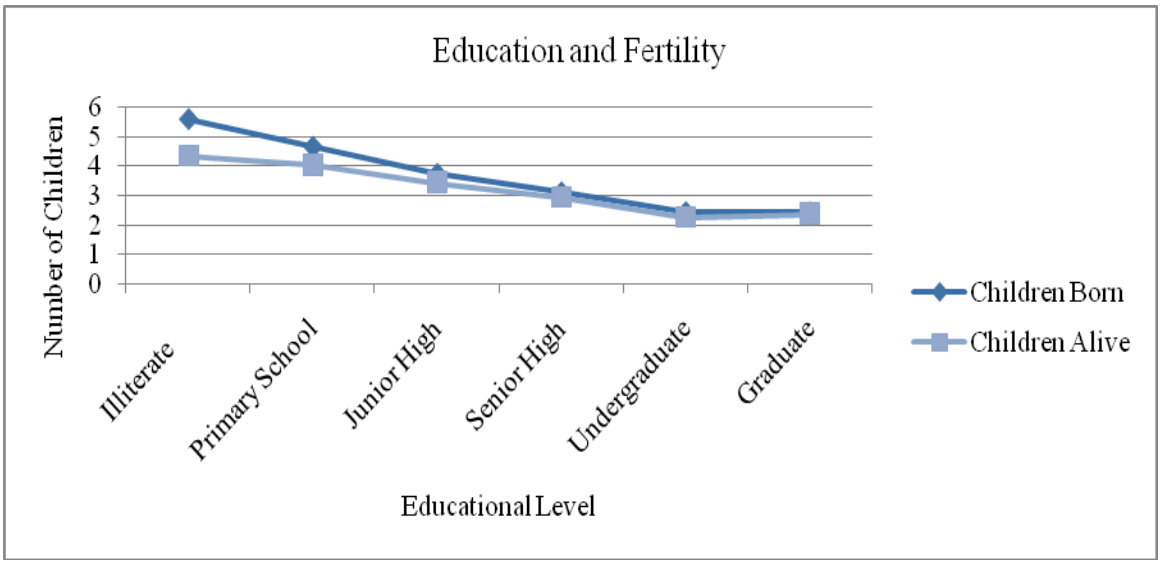


**Figure 1**

*Numbers of Children Ever Born and Number of Children Still Alive at Time of Survey By Educational Levels, Chinese Women Aged 41-64, 1982 IPUMS International China.*

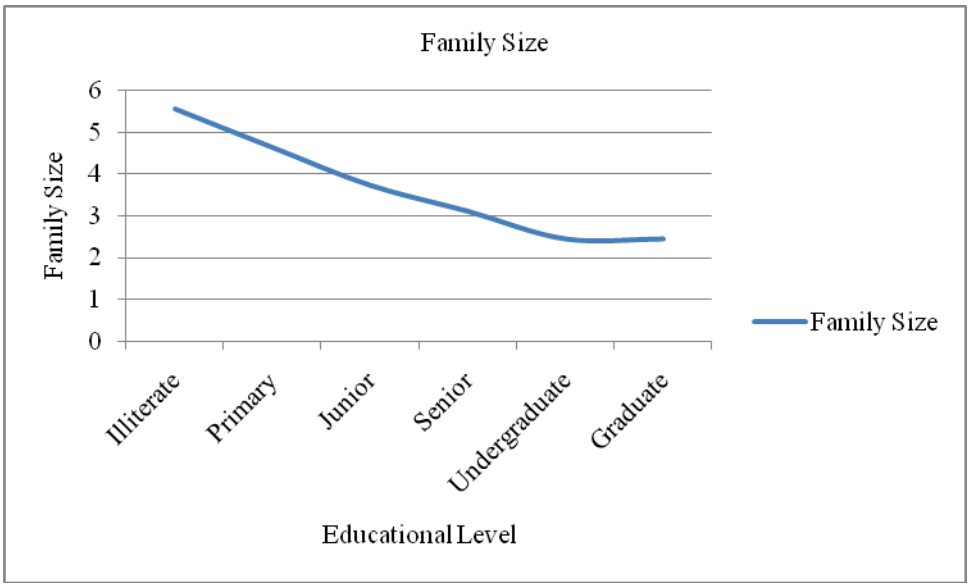


**Figure 2**

*Number of persons in the household at Time of Survey by Educational Levels, Chinese Women Aged 41-64, 1982 IPUMS International China.*

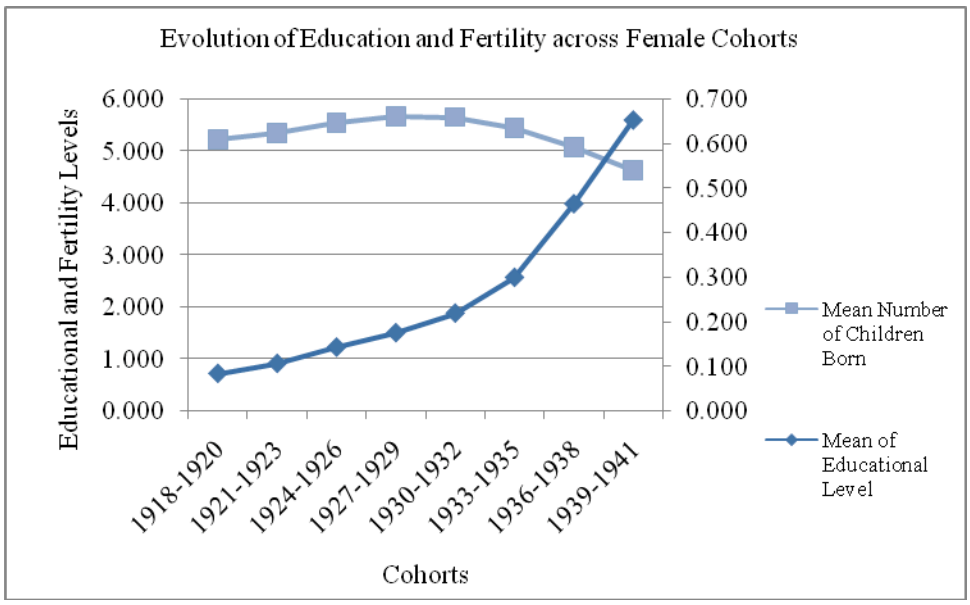


**Figure 3**

*Numbers of Children Ever Born and Educational Levels for Female Birth Cohorts, Chinese Women, 1918-1941; Fertility (smoothed as 3-year moving averages) and Educational Level (smoothed as 3-year moving averages by treating each educational level as the numbers they are coded) for each cohort.1982 IPUMS International China.*

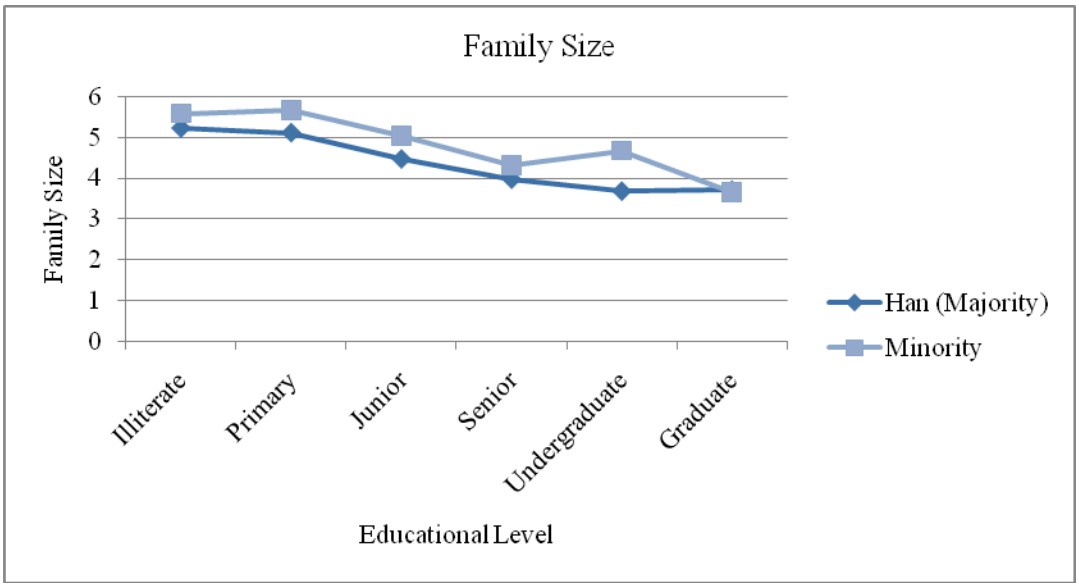


**Figure 4**

*Number of persons in the household at Time of Survey by Educational Levels, Chinese Han and Minority Women Aged 41-64, 1982 IPUMS International China.*

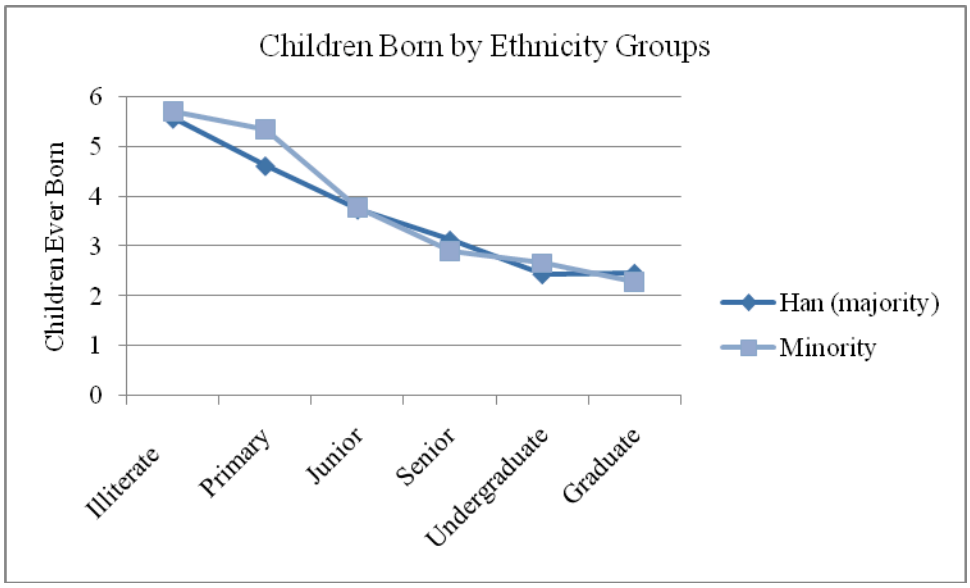


**Figure 5**

*Number of Children Ever Born at Time of Survey by Educational Levels, Han and Minority Women Aged 41-64, 1982 IPUMS International China.*

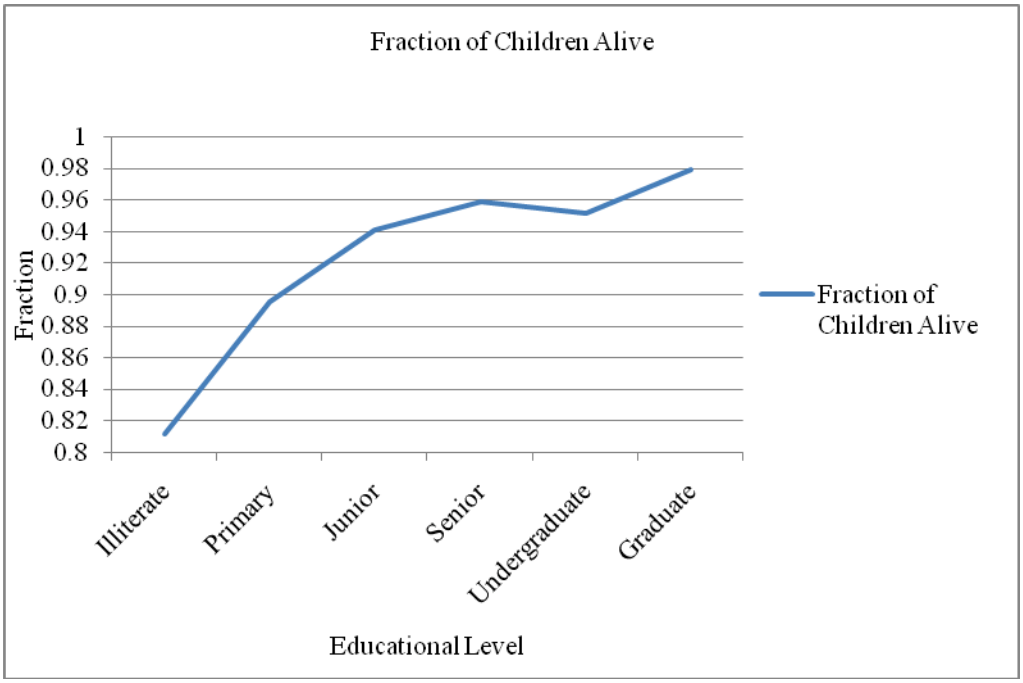


**Figure 6**

*Mean Fraction of Children Ever Born Alive at Time of Survey by Educational Levels, Chinese Women Aged 41-64, 1982 IPUMS International China.*

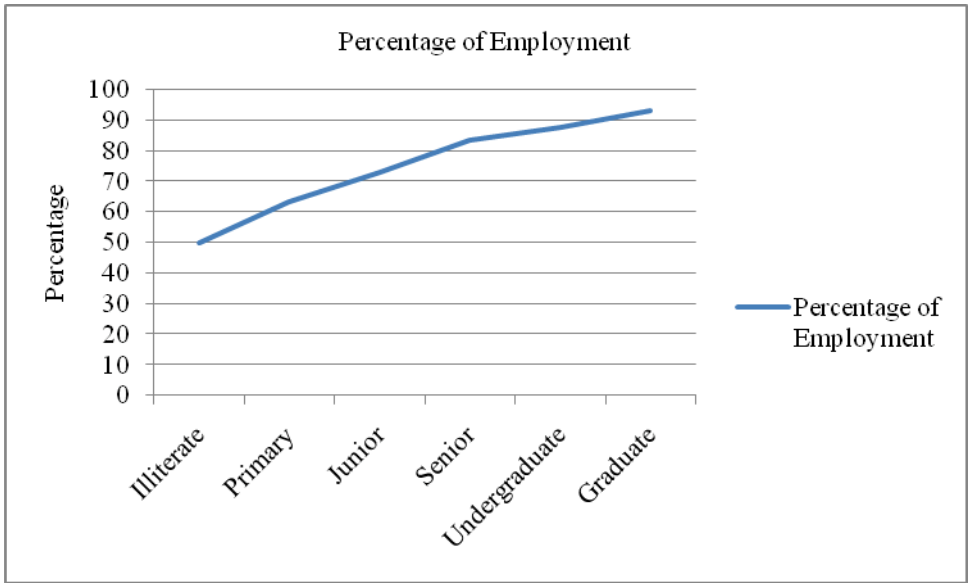


**Figure 7**

*Percentage of Employment at Time of Survey by Educational Levels, Chinese Women Aged 41-64, 1982 IPUMS International China.*

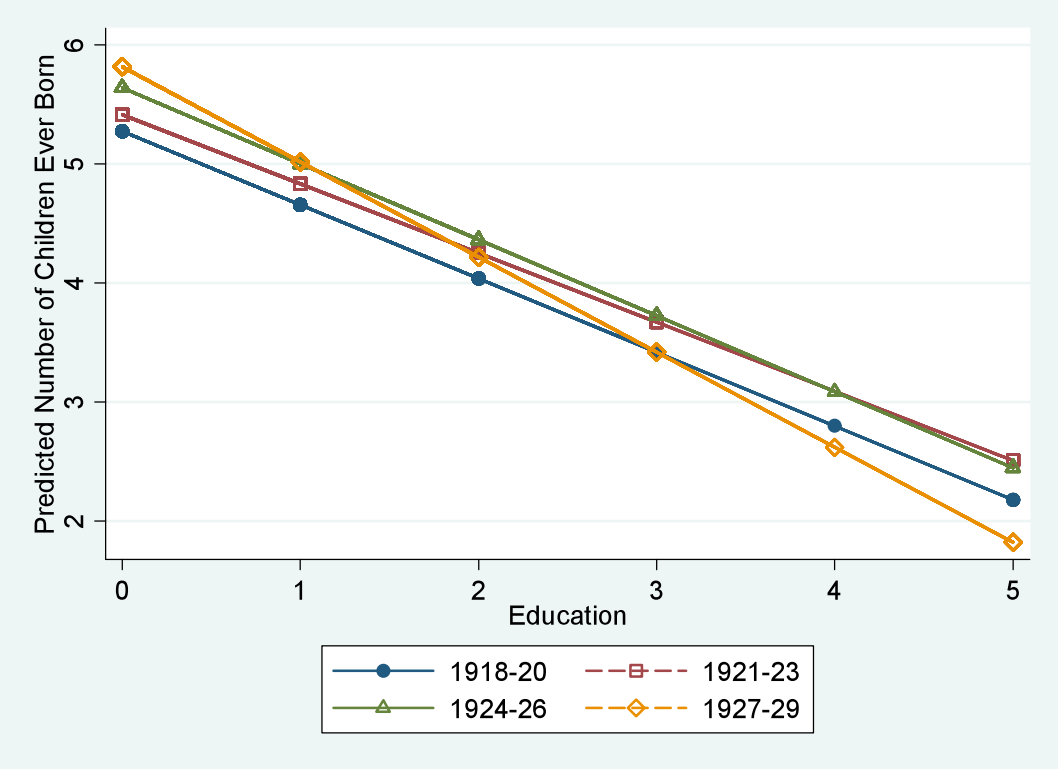


**Figure 8**

*Predicted Number of Children Ever Born on Educational Levels across Older Female Birth Cohorts 1918-1929, 1982 IPUMS International China.*

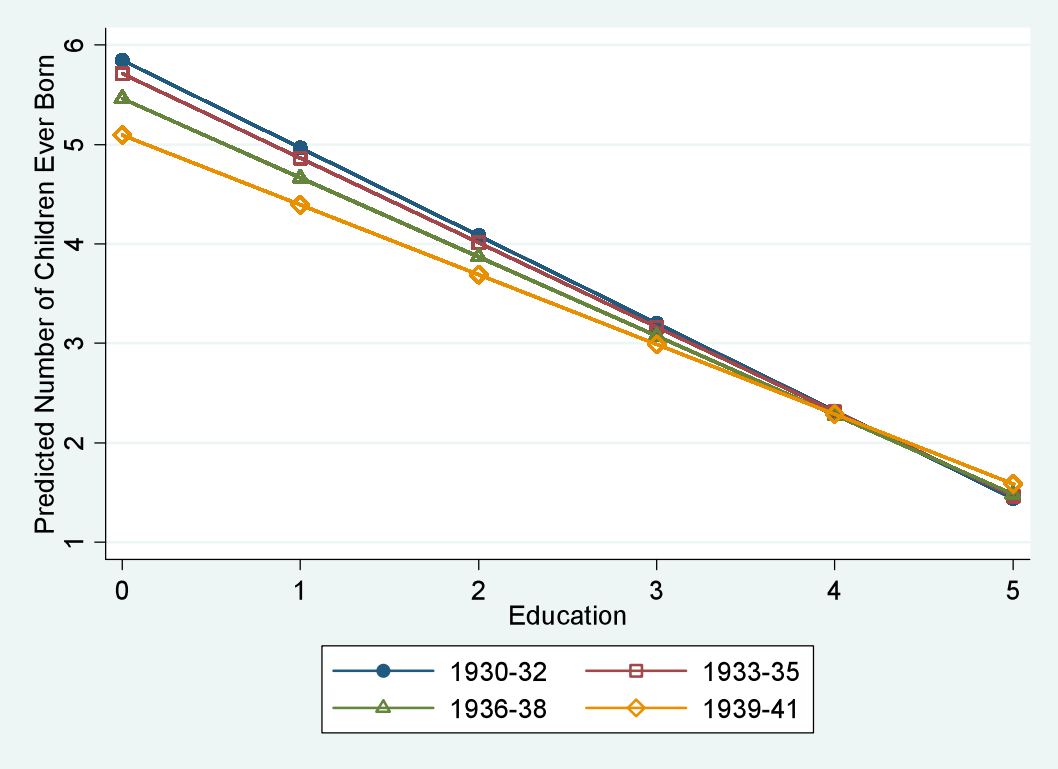


**Figure 9**

*Predicted Number of Children Ever Born on Educational Levels across Younger Female Birth Cohorts 1930-1941, 1982 IPUMS International China.*

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