Measuring Couples' Fertility Change in Process of the New Transition in Japan; Effects of Marriage Delay, Educational Upgrading, and Couples' Behavioral Changes[1]

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Abstract

A unique feature of the modern decline in Japanese fertility is the fact that it has been accompanied by relatively stable marital fertility rates until around 1990. However, a certain decline in marital fertility has been witnessed during 1990's. This suggests that Japan is entering a new phase in its fertility transition. In this paper, we reconstruct the history of Japanese marital fertility via examining 48 years of the wife's birth cohort grouped by age and birth order, using results from six national representative fertility surveys expanded over 25 years. Decomposition of fertility reduction into effects of exogenous factors such as marriage delay on marital fertility is necessary to estimate reduction from couple's behavioral change. The logistic regression framework is applied for this purpose. Some visual techniques such as the Lexis mapping are employed to understand what is happening in the marital fertility. With the decomposition, they reveal a detailed process of the onset of marital fertility reduction.

Introduction

The (second) fertility transitions marked by a decline in fertility rates below-replacement levels have been universally observed in the developed world during the last quarter of the Twentieth century. Among the developed countries, Japan has one of the lowest fertility rates today. One of the unique features of its fertility decline, however, has been the stability in marital fertility. The entire decline in the fertility rate from the mid 1970's until the late 1980's can be exclusively attributed to the transformation of marriage behavior, notably delays in marrying and an overall decrease in rates of marriage (Kaneko 1999). Thus the Japanese transition has been unique insofar as the as the fertility decline has been caused solely by change in partnership formation without any change in reproductive life after marriage, unlike in Europe and America The Japanese example has served as an important indication of an alternative transition path to decreased fertility. However, since the 1990's a certain decline in marital fertility has finally been witnessed in Japan. This may indicate that Japan is entering the onset of a new phase in the fertility transition. We expect that close scrutiny of this process will be highly informative and

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useful for the study of the fertility transition, since it appears that many other countries (Asian nations in particular) may follow a similar path in the coming decades. In this paper, we reconstruct the history of Japanese marital fertility by measuring the number of children and computing the probability of having a child of each birth order for 48 years of the wife's birth cohort organized by the wife's age. We use data from a series of national representative fertility surveys conducted over 25 years. Fertility changes indexed by a single year of wife's cohort and age are mapped on the Lexis plane, by birth order if necessary, to view what is happening to the marital reproductive behavior. Since the number of dimensions being observed is relatively large, various facets of the phenomena are examined by using other visual arrangements. Furthermore, in order to measure a couples' behavioral changes correctly, the effects of compositional changes in exogenous factors such as the marriage delay and/or educational upgrading are eliminated by applying the logistic regression model to the probability of having a child of each birth order.

Visual representation and the standardized techniques of the logistic regression model both are very effective in helping us to understand what is happening to the Japanese marital fertility. They reveal a detailed process of the onset of marital fertility reduction and allow us to determine who is exhibiting the change in reproductive behavior, when the change is occurring, and what the magnitude of the change is.

Data: National Fertility Surveys

The dataset that we use in this analysis is built from six surveys among the National Fertility Survey (NFS) series, which have been conducted by National Institute of Social Security and Population Research every 5 year (NIPSSR 2003). Birth histories of first-marriage couples for the wife's cohorts born in 1928 through 1975 are employed from The Seventh (1977) through Twelfth (2002) Survey.

Method: The Logistic Regression Model for Removal of Exogenous Effects

The probability of having a child of each birth order and (therefore) the average number of children for couples are expressed in terms of the logistic regression model with exogenous factors. The probability of having an n-th order child by some age of wife (say age 35) for wife i is given by;

$$\ln p_{i,n} /(1-p_{i,n}) = \beta_{n,0} + \sum_{j=1}^{k} \beta_{n,j} X_{i,j} + \sum_{m=1}^{k_m} \gamma_{n,m} a_i^m + \sum_{c=1}^{k_c} \delta_{n,c} Y_{i,c} + e_{i,n}$$

where a_i , $X_{i,j}$, $Y_{i,c}$ are age at marriage, dummy for covariates, and cohort dummy for i, $\beta_{n,j}\ (j=1\cdots k), \gamma_{n,m}\ (m=1\cdots k_m), \delta_{n,c}\ (c=1\cdots k_c)$ are regression coefficients for those regression variables(k, k_{m}, k_c are number of categories of each variable, regression coefficients for reference categories are zero), and $e_{i,n}$ is regression error. Then

The probability of having the n-th child (observed): $p_n = 1\Big/\left[1+\exp\left\{-(\beta_0+\delta_c)\right\}\right]$

The probability without effect of marriage delay: $p_{n|M^-} = 1 \Big/ \left[1 + \exp\left\{ -(\beta_0 + \delta_{c|M^-}) \right\} \right]$

The probability without effect of educational upgrading: $p_{n|E^-} = 1 \Big/ \left[1 + \exp\left\{ -(\beta_0 + \delta_{c|E^-}) \right\} \right]$

The probability without both effects: $p_{n|EM^-} = 1 \Big/ \left[1 + \exp\left\{ -(\beta_0 + \delta_{c|EM^-}) \right\} \right]$

Total effect of marriage delay: $\nabla \hat{p}_{n|M} = \hat{p}_n - \hat{p}_{n|M^-}$,

Pure effects of marriage delay: $\nabla \hat{p}_{n|M^*} = \hat{p}_{n|E^-} - \hat{p}_{n|EM^-}$,

Total effect of educational upgrading: $\nabla \hat{p}_{n|E} = \hat{p}_n - \hat{p}_{n|E^-}$,

Pure effects of educational upgrading: $\nabla \hat{p}_{n|E^*} = \hat{p}_{n|M^-} - \hat{p}_{n|EM^-}$,

Common effect: $\nabla \hat{p}_{n|EM^*} = \hat{p}_n - \hat{p}_{n|M^-} - \hat{p}_{n|E^-} + \hat{p}_{n|EM^-}$,

Effect of marital behavioral change: $\nabla \hat{p}_{n|B^*} = \hat{p}_{n|EM^-} - \hat{p}_n[0]$,

($\hat{p}_n[0]$ is the probability of reference cohort).

Then, the reduction of the probability of having an n-th child is decomposed as follows,

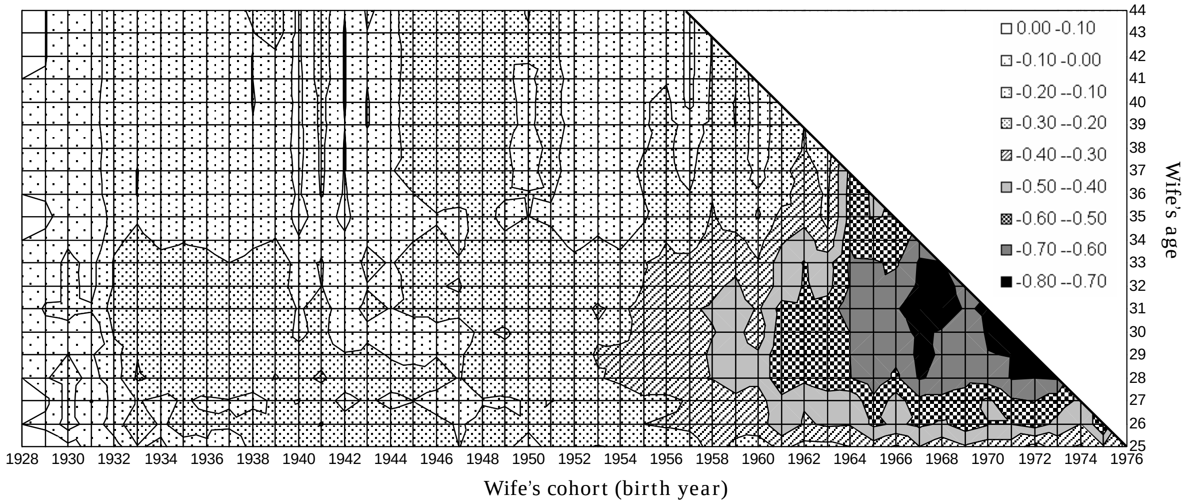
$$\Delta p_n = \nabla p_{n|E^*} + \nabla p_{n|EM^*} + \nabla p_{n|M^*} + \nabla p_{n|B^*}$$

The change in the average number of children is the sum of those effects by birth order.

Results

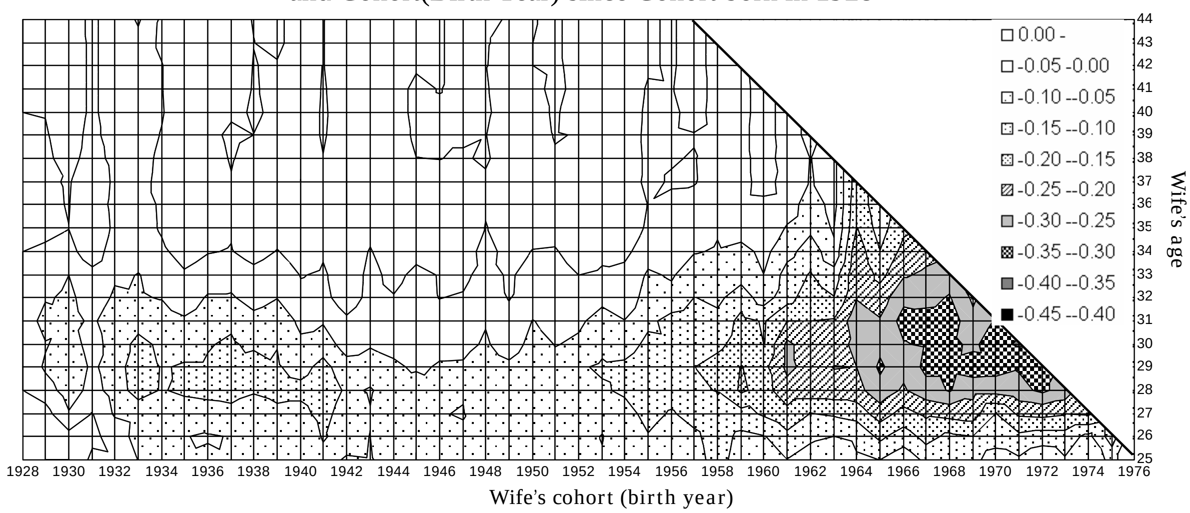
The reduction in the average number of children ever born to the first-married couples at each wife's age (ranged 25 to 44) relative to that of the cohort born in 1928 is mapped on the age-cohort coordinate plane in Figure 1. The larger the reduction turn out to be, the darker the paint pattern appears. Only the visual representations of the results are presented below in this section. The analysis of the data is presented and discussed collectively in the summary and conclusion section to follow.

Figure 1 Reduction in the Average Number of Children Ever Born by Wife's Age and Cohort(Birth Year) since Cohort born in 1928



Note: The reduction in the average number of children ever born among the first-married couples at each wife's age (ranged 25 to 44) relative to that of the cohort born in 1928 is mapped on the age-cohort coordinate plane. The larger the reduction turn out to be, the darker the paint pattern appears. There is white area in the plane for cohort born after 1957, since they have an unreached age range at the time of the latest survey.

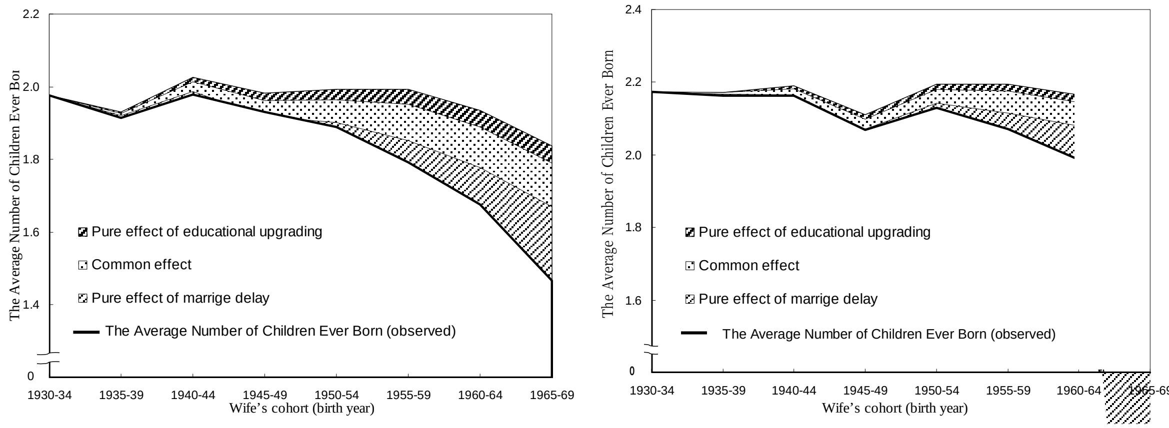
Figure 2 Reduction in the Probability having Second Child by Wife's Age and Cohort(Birth Year) since Cohort born in 1928



Note: The education in the probability of having a second child among the first-married couples at each wife's age (ranged 25 to 44) relative to that of the cohort born in 1928 is mapped on the age-cohort coordinate plane. For other notes, see footnote of Figure 1.

Figure 3 The Average Number of Children Ever Born by Wife's Cohort (Birth Year) at Age 32 and 37: Observed and the Removed with Effects of Marriage Delay and Education Upgrading

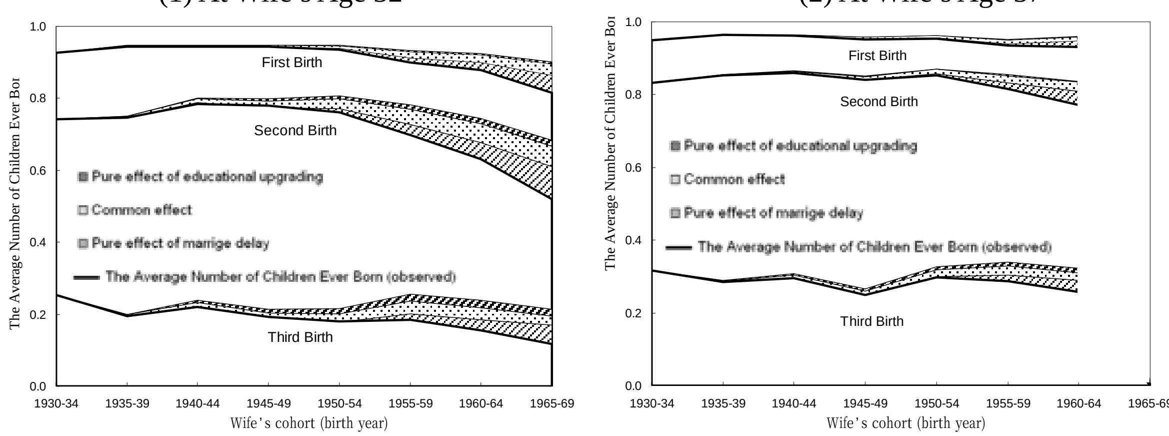
(1) At Wife's Age 32 (2) At Wife's Age 37



Note: The shifts in the average number of children ever born for the first-married couples indexed by wife's cohort (lowest thick line), at two ages 32 and 37 and the estimated counterparts from removal of the effects of marriage delay and educational upgrading (their pure effects and the common effect) are shown. For instance, if it were not for marriage delay and educational upgrading among successive cohorts since the reference cohort (1930-34), the average would have followed the topmost lines. The common effect should be the part of marriage delay effect originated from educational upgrading.

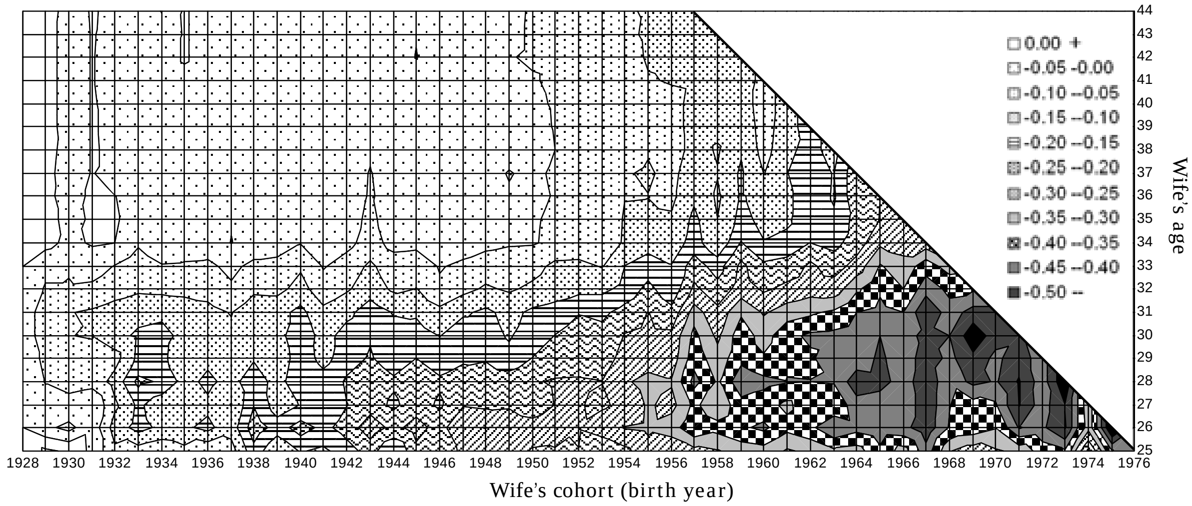
Figure 4 The Probability having First-Third Child by Wife's Cohort (Birth Year) at Age 32 and 37: Observed and the Removed with Effects of Marriage Delay and Education Upgrading

(1) At Wife's Age 32 (2) At Wife's Age 37



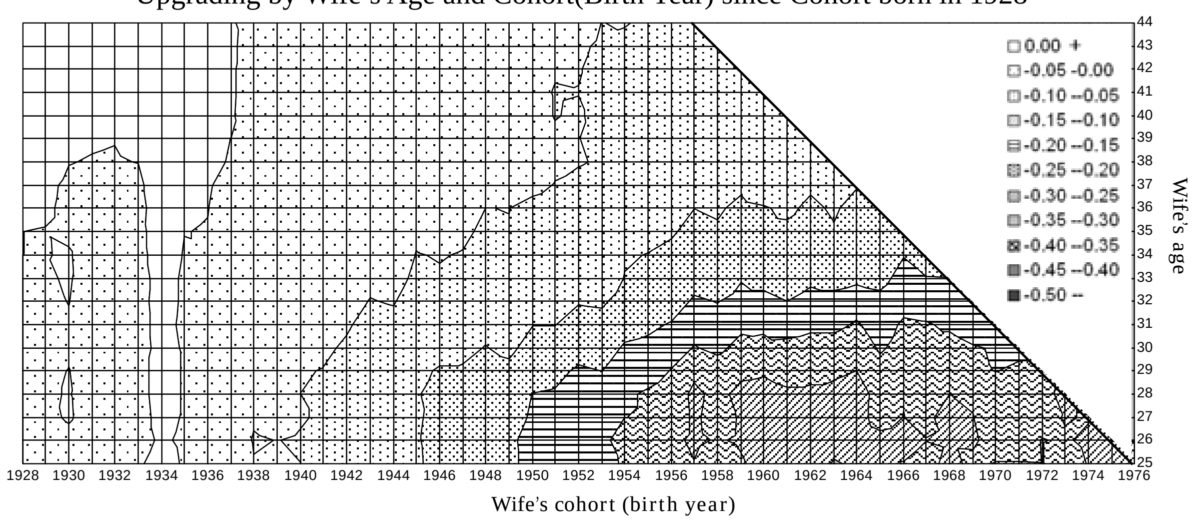
Note: The shifts in the probability of having first, second and third children for the first-married couples by wife's cohort, at two ages 32 and 37 and the estimated counterparts from removal of the effects of marriage delay and educational upgrading (their pure effects and the common effect) are shown. For more notes, see footnote of Figure 3.

Figure 5 Reduction in the Average Number of Children Ever Born Caused by Marriage Delay by Wife's Age and Cohort(Birth Year) since Cohort born in 1928



Note: The reduction in the average number of children ever born caused by marriage delay among the first-married couples at each wife's age (ranged 25 to 44) relative to that of the cohort born in 1928 is mapped on the age-cohort coordinate plane. For other notes, see footnote of Figure 1.

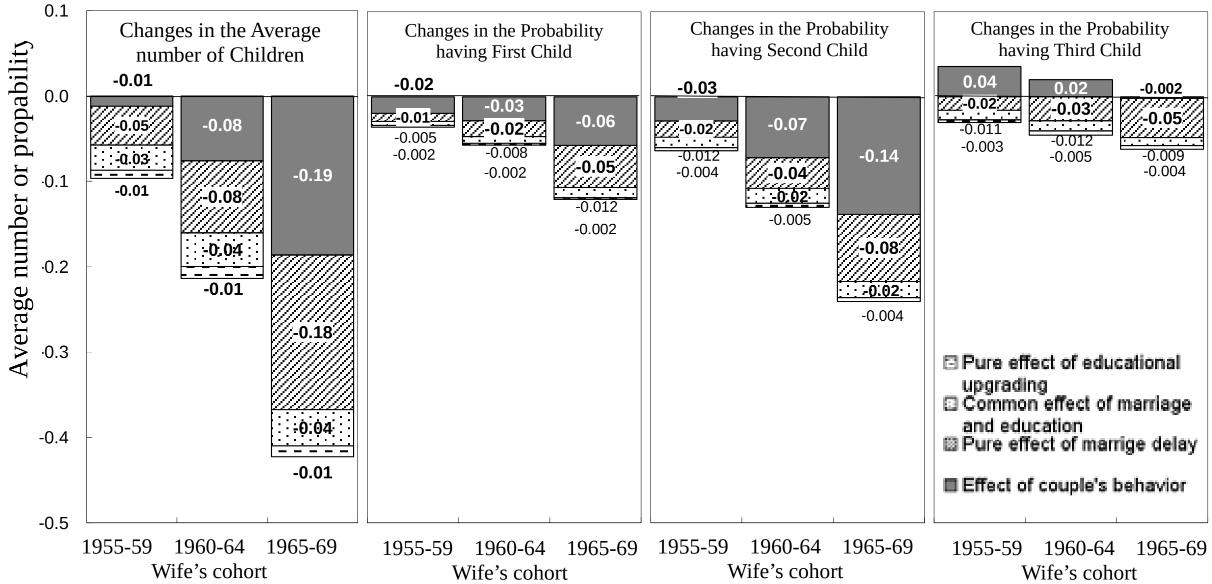
Figure 6 Reduction in the Average Number of Children Ever Born Caused by Educational Upgrading by Wife's Age and Cohort(Birth Year) since Cohort born in 1928



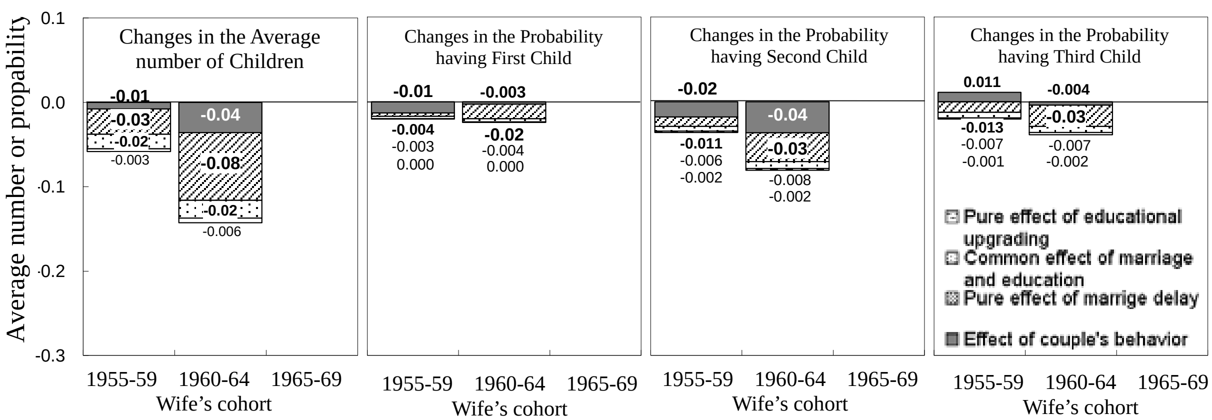
Note: The reduction in the average number of children ever born caused by educational upgrading among the first-married couples at each wife's age (ranged 25 to 44) relative to that of the cohort born in 1928 is mapped on the age-cohort coordinate plane. For other notes, see footnote of Figure 1.

Figure 7 Reduction and its Breakdown in the Average Number of Children Ever Born and in the Probability having First to Third Child by Wife's Cohort since Cohort born in 1950-54

(1) At Wife's Age 32



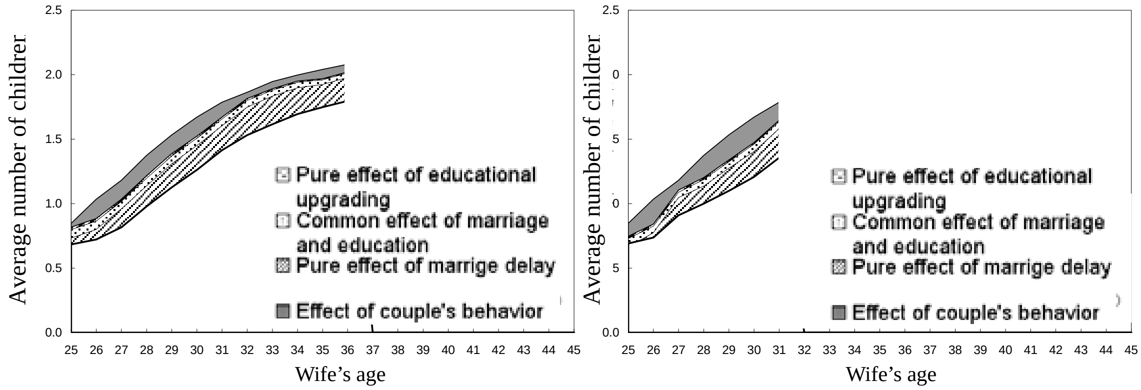
(2) At Wife's Age 37



Note: The reduction in the average number of children ever born and the probability of having first to third children and their breakdown by factor effects among the first-married couples at each wife's age (32 and 37) relative to that of wife's cohort born in 1950-54 is shown.

Figure 8 Reduction and its Breakdown in the Average Number of Children Ever Born by Wife's Age since Cohort born in 1950

(1) Cohort born in 1965 (2) Cohort born in 1970



Summary and Conclusion

In this paper, the history of Japanese marital fertility along with 48 years of wife's birth cohort since cohort born in 1928 is reconstructed using data from six national representative surveys extended over 25 years. As a result, a detailed process of the onset of the recent marital fertility reduction is revealed. An outline of the process is as follows.

(1) Until the cohort (born in) 1950, there has been almost no change observed in marital fertility, though educational upgrading started to have a slight effect on marital fertility during cohorts born in 1940s.

(2) by the cohort of1952/53 , marriage delay (Kaneko 2003) started to have an effect on the timing of the birth of the first and second child. However, this delay did not change the completed fertility for cohorts born in the 1950s. That is, they caught up to the previous overall fertility level by age 40. The effect of educational upgrading increased until the cohort of 1957, having little change thereafter. The probability having a third child showed a slight upward tendency amongst the cohorts of 1952-58, followed by a recession to the previous level.

(3) After the cohort of 1960, the decrease seen before age 35 becomes conspicuous and gradually increases until late 30s. For the cohorts of 1960-64, although there is some catching up it is not enough to match the fertility of previous cohorts by age 37. The effect from couples behavioral changes become quite large (36% at wife's age 32, 25% at age 37), though the effect of marriage delay is still substantial (58% at age 32, 70% at age 37%).

(4) For cohorts born after 1965, the decline before age 35 becomes even more rapid (-0.4 children from the previous 5-year cohort at age 32). The effect from couple's behavioral

change expands to 44% at age 32. The effect on the second child is greater than other birth orders, implying a diffusion of only child families in these younger cohorts. Similar traits are found in succeeding cohorts born in the early 1970s.

This detailed information about the process of fertility decline is naturally crucial to understanding the qualitative and causal factors underlying Japanese fertility decline. Such explanations will of course be useful in devising state countermeasures against undesirable prospects. In addition, they may also provide useful resources for studying this specific kind of fertility decline process, which we expect will be experienced by many other countries (in particular, Asian nations).

From the methodological point of view, this paper demonstrates the effectiveness of the Lexis mapping and certain other visual representation in allowing interpretation of the fertility data. The fertility transition is represented by a two-dimensional map indexed by wife's cohort and age with multiple layers of the birth order and of components decomposed by regression techniques. This representation is not only intuitive but also quantitatively precise. It is particularly useful when the number of dimensions to examine is large, as is often the case with fertility study involving socio-economic factors. For our case of marital fertility, a total map of the fertility rates should be constructed by preparing a map layer of the proportion married, and including data about illegitimate fertility.

Another methodological contribution of the present study is the standardized techniques presented via the logistic regression model for controlling compositional distortion of exogenous factors on marital fertility. To avoid excessive complication in the visual analysis, effects of only two major factors, marriage delay and/or educational upgrading, are examined here. Quantitative improvements such as addition of other factors and the inclusion of interaction terms between factors are straightforward, as long as they are within the scope of regression technique. Though the results from such a model are unlikely to be amenable to visual interpretation, they are effective in computational studies such as simulation and projection.

Selected References

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