Economic Factors in the Decline of Fertility in Japan

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I. Introduction

This paper examines certain economic factors which are postulated to be related to the decline of fertility in Japan.[1] It is usually said that the first complete demographic transition outside the western world occurred in Japan. Although the fertility decline was most dramatic after the Second World War, a persistent decline in fertility rates is clearly observable starting around 1920. Were the factors related to this decline unique to Japan, or was the operation of forces intrinsically associated with economic development significant in the lowering of fertility? It is noteworthy that the persistent decline in fertility occurred against the background of equally persistent industrial and urban growth as well as of advance in the educational attainment of the adult population.

Guided by findings recently accumulated from the economic approach to fertility analysis, a regression model of a fertility func-

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tion is specified, and its parameters are estimated to test various hypotheses. The estimated model is used then to assess the nature of the shift, if any, in the fertility function after the Second World War, and to determine to what extent the dramatic decline in fertility in the postwar years reflected a continuation of the prewar downward trend. The results reported here extend those in my previous works (Hashimoto 1974, 1979). These works relied heavily on cross-section data, and when time-series changes were considered, they did not fully investigate the nature of the shift in the fertility function.

Brief Background Information

The trend in birth rate over a sixty-two year span is shown in Table 1. Although fertility rates had followed a generally downward trend since about 1920,[2] clearly the bulk of fertility decline took place in the postwar years. The crude birth rate declined from 35.2 in the 1920-22 period to 30.7 in the 1940-42 period, or by seven percent per decade. The total fertility rate (not reported in the table) declined from 5.2 in 1920 to 4.1 in 1940, or by eleven percent per decade. Fertility data for the war years are not available, but Japan resumed the downward movement of fertility after a short postwar baby boom in the 1947-49 period. Between the 1950-52 and 1960-62 periods, the crude birth rate plummeted from 25.6 to 17.0 or by thirty-four percent, and the total fertility rate fell from 3.3 to 2.0, or by almost forty percent. Japan had clearly attained modern low rates of fertility by the end of the 1950's and maintained these low rates thereafter.[3]

Table I also summarizes the trend in three variables commonly

2 There is no obvious reason for 1920 to make the onset of the fertility decline. Before the first Census of Population was taken in 1920, birth rates were computed on the basis of registration compilations rather than enumerative censuses. The shift in data collection methods poses a problem of comparability between the pre- and post-1920 birth rates. Moreover, the registration data may become less accurate as we go back farther in history. Therefore, fertility history before 1920 is not firmly established. Among available estimates, however, none seems to show a persistently declining trend for the pre-1920 years; the decline was certainly not as pronounced as in the post-1920 years, and there is even some indication of increasing fertility. To be sure, increasing fertility rates while a registration system is being developed are always suspect. But Taeuber (1958:232) presents convincing evidence for the proposition that birth rates in 1920 were above those of the preceding decade. According to her account, crude birth rates declined slightly from 34 per thousand population in 1914 to 32 in 1919 and then rose to36 in 1920. See note 10 for further discussions.

3 The rapid decline in fertility rates during the 1950's coincided with legalization of abortion under the Eugenics Law of 1948 and liberalization of contraceptive uses. See pp. 117-180 for the relevance of these developments in the postwar fertility trend.

regarded as indicators of economic development. The infant mortality rate declined over the sixty-two year period, reflecting the improved sanitary and health conditions. As typically observed in a country undergoing economic development, the importance of agriculture as a source of employment gradually fell. The real gross national product (GNP) per capita grew at an average rate of twenty-seven percent per decade between 1900 and 1940, accelerating to a hundred and twenty-three percent between 1950 and 1960. Finally, growth in educational attainment of young adults was persistent throughout the years.

II. Specification of the Model

In this section, the relationship between the birth rate and several key variables will be specified in a regression model of a fertility function. Following the discussion of the hypothesized effects of these variables on the birth rate, an approach will be proposed to deal with the problem of comparability of the birth rate data between the pre- and post-1920 periods created by differences in the method of collecting birth rate data in these periods (cf. note 2).

The dependent variable is the crude birth rate. Movemements in this variable undoubtedly reflect the changing age-composition of the female population as well as changing socioeconomic influences. Unfortunately, the absence of annual data on the distribution of fertility rates by age for the prewar years makes it impossible to adjust the birth rate for changing age composition. Attempting to approximately adjust for the age distribution, we experimented with an explanatory variable which measured the proportion of women fifteen to forty years of age. This variable obtained an insignificant coefficient, however, without substantially altering results on other coefficients. To conserve the degree of freedom, therefore, this variable was dropped from the analysis. Unless there was a strong trend in the age composition of women,[4] movements in the crude birth rate are expected to capture the underlying trend in fertility.

The choice of explanatory variables is dictated by both theoretical considerations and the availability of data. Recent

4 In fact, there appears to be little discernible trend in the age composition of women as measured by the proportion of women who are in the 15-40 age bracket. During the 1900-40 period, this variable varied without a clear trend between 28.3 in 1915 to 39.3 in 1940 with the mean of 35.9 and the standard deviation of 4.1.

literature on the economics of fertility analysis suggests[5] certain key variables to be relevant in analyzing fertility changes over time. These variables tend to move in predictable directions with economic development, each with equally predictable influence on fertility. Thus, the demographic transition phenomenon is viewed as reflecting, at least in part, influences of these variables. They may be classified broadly as (1) child mortality variables, (2) educational attainment of parents, (3) real income, and (4) job opportunity variables, especially those related to female employment. While these variables by no means exhaust the list of relevant factors, reliable time-series data for them are available for as early as 1900. Since the theoretical models which generate the hypothesized relationships between these variables and fertility rates are by now an established part of the literature, the following discussion will be kept brief.

A decline in child mortality rate, or an increase in the survival rate of a child, decreases the number of births needed to achieve a given number of children. However, it may also be argued that an increased child survival rate operates to increase the number of surviving children wanted by parents. The reasoning is as follows: Since the bearing and rearing of children require expenditure of time and other resources, an increased survival rate lowers the cost of achieving a large-size family relative to that of achieving a small-size family. Since parents are expected to respond to changes in relative costs, demand for a large-size family will rise. It is therefore plausible for the birth rate to rise in response to a decline in child mortality if the resulting increase in the demand for surviving children is more than can be accommodated for by the increased survival rate. Thus, the direction of the effect of a decreased child mortality rate on the birth rate would appear to be ambiguous.[5a] Several studies have found, however, that a decreased infant mortality is associated with decreased birth rate.[6] Unless

5 Economists' interest in fertility research intensified after the publication of Becker's (1960) article. Subsequent theoretical and empirical research in Becker's tradition has become known as the "new home-economics" approach. For a compendium of some recent results, see Schultz (1974). More recently, Rosenzweig (1977) applied this approach to analyze fertility in U.S. farm households. This approach has met some criticisms, however, Leibenstein's (1974) criticisms and the subsequent exchange between Keeley (1975) and Leibenstein (1975) are most illuminating. Sanderson (1976) offers an interesting historical account of how the differences between the new home-economics approach and the approaches of Leibenstein and Easterlin have been narrowing. See also Williams (1976) for a useful survey.

5a However, O'Hara (1975) relies on the durable quality of children to hypothesize a positive effect of mortality on fertility.

6 See, for example, Ben-Porath (1976) and Schultz (1978).

Japan represents an exception, one would expect a positive coefficient for the child mortality variable. In estimating the model, we use the infant mortality rate as a measure of child mortality. Movement in this variable is expected to be most relevant in explaining fertility changes, since infancy is perhaps the most crucial period in determining the prospect for child survival.

Turning to the education variables, a distinguishing feature of Japanese socioeconomic development during the years under discussion is the phenomenal growth in the educational attainment of the population.[7] Of particular interest is the dramatic increase in female relative to male education. This sex differential in the growth of educational attainment is noteworthy because the "new home-economics" approach places a special emphasis on the importance of the rising opportunity cost of female time associated with increased education.[8] In that approach, child bearing and rearing are assumed to use the wife's time more intensively than the husband's. Both the wife's and husband's education is assumed to increase the value of time more in alternative uses, such as in earning income or in enjoying leisure, than in activities related to children. Thus, increased wife's education raises the cost of children and, if she works, family income as well. However, two considerations make it plausible to predict that the cost effect of wife's education on demand for children will dominate the income effect. First, the labor-force participation rate of women is lower than that of men even in modern societies, making her share of contribution to family income smaller than the husband's. Second, economists presume children to be non-inferior but the income elasticity to be rather small (cf. the argument in Ben-Porath 1973). The effect of the husband's education is mainly to increase family income because the bulk of his time is spent in the market. Thus, the wife's education decreases, while the husband's education increases, the birth rate.

Education may affect fertility through channels other than the value of time. Let us discuss two often-made arguments (cf. Ben-Porath 1970). First, education may increase contraceptive

7 According to Dore (1964), 40 to 50 percent of all Japanese boys and about 15 percent of girls were acquiring some education outside their homes at the time of the Meiji Restoration in 1868. By 1920 well over half the males had finished primary (compulsory) schooling while females attained the same level by 1935. For a detailed account of the development of the Japanese educational system, see Passin (1965, particularly Chapter 4).

8 See note 5 for reference of works using this approach. One would like to use wage rates also as explanatory variables. However, we were unable to find reliable sex-specific wage rate data for the years under study.

knowledge and the efficiency of its use. As a result, educated parents tend to practice fertility control more than uneducated parents. The other hypothesis argues that education increases the taste for expenditure (quality?) per child more than the mere number of children. Thus, parents with higher level of education will control fertility more than others. Neither the fertility-control nor the taste argument appears to offer definitive predictions about differences in male and female education effects. The gist of both arguments suggests, however, that both male and female education will generate negative fertility effects thereby making them empirically indistinguishable from each other. According to the value-of-time argument, female education has a negative, and male education a positive, effect on fertility. Thus, we can assess the validity of the value-of-time argument by examining the sign of the education coefficients. We use the proportion of the population aged 20-29 which completed more than elementary (compulsory) schooling, EDMLE for males and EDFMLE for females. This age group judged to be most relevant for fertility decisions.

Parental income will affect fertility decisions just as it affects decisions in other consumption activities. Since children entail expenditure of resources for a number of years, the relevant income variable is normal or permanent income rather than current income. Transitory fluctuations in income around the normal income is likely to affect the timing of births, but not the long-term trend in fertility. Data on permanent income are not available, however. As a proxy, we use an index of real consumption per capita (INCME). According to a modern consumption theory, consumption decisions are affected mainly by permanent rather than current income.[9] If so, changes in consumption over time should reflect changes in permanent income. Other things equal, we expect INCME to be associated positively with fertility.

Employment opportunities, especially for females, affect fertili-

9 An alternative hypothesis by Easterlin (1968) asserts that the income of the couple, relative to the income of their parents prevailing when the couple was growing up, affects fertility. In view of the corroborative evidence produced by Easterlin and others supporting this hypothesis, one would want to examine its relevance in Japan. However, due to the paucity of data, we could not construct a measure of the relative income for prewar Japan. I experimented with per capita income divided by permanent income as a proxy for the relative income measure (cf. Conger and Campbell 1978). This income variable obtained insignificant and often negative coefficients. It should be remembered that the evidence of positive income effects is not firm in the literature. The ambiguity is due to the difficulty in holding constant income related variables such as contraceptive knowledge, social influence and quality of children. See Sanderson (1976) and Williams (1976) for related discussions.

ty in a predictable manner. Increased female employment opportunities result in an increased opportunity cost of time spent in bearing and rearing children, as well as an increase in her contribution to family income. Following the argument developed earlier (p. 6) that the wife's increased value of time affects family income only weakly, the cost effect is expected to dominate, resulting in a decreased fertility. To measure job market opportunities, we use the proportion of total employment that is in agriculture (PAG) and the ratio of manufacturing output in establishments with fewer than five workers to that in establishments with more than five workers (HMFG). Since costs of bearing and rearing children are lower and benefits greater in an agricultural than in urban environment, PAG is expected to be associated with the birth rate positively. In earlier stages of economic development, when small establishments--many of which operated in the home--dominated production activities, female employment detracted less from child rearing activities. As the factory system became prevalent, the center of production activities tended to shift to larger establishments necessitating workers to commute to these establishments. Also, wage rates are expected to rise with this shift. Since these changes raise opportunity costs of children, we expect HMFG to be associated positively with the birth rate.

Before estimating the regression model, it is necessary to confront the problem of comparability of the pre- and post-1920 birth data.[10] Although some comparability problems exist, the pre-1920 data is not judged as totally useless, and is deemed wasteful to discard the observations for these years. We will view this problem as one of errors-in-measurement in the dependent variable. Simple corrections are introduced to account for this error, which is assumed to decrease in severity during the pre-1920 years, but to remain constant after 1920.

Consider the following regression model:

$$\ln B^* = Xb + \mu, \quad (1)$$

where $\ln B^*$ is a (n x 1) vector of the logarithm of the true value of the birth rate, X is an (n x k) matrix composed of n observations on

10 As pointed out in note 2, the quality of the official vital statistics for pre-1920 years is controversial. A number of alternative estimates of similarly controversial validity were developed by Japanese demographers. See Mosk (1977: 656-58) and Ohbuchi (1976) for useful discussions on these estimates. These estimates are available only for a few selected years or periods, however. Some information from the village reconstitution studies, e.g., Hanley (1974), appears to provide support for the trend in fertility and mortality as depicted in the official data for pre-1920 Japan.

k explanatory variables discussed earlier, B is a (k x 1) vector of regression coefficients, and μ is a disturbance term. Assume that X is measured without error and that the relationship between the observed birth rate, B, and the true rate, B*, is given by:

$$B = B^{*} \omega, \tag{2}$$

where ω is the measurement error.[11] This measurement error is specified to be:

$$\begin{aligned} \omega &= v \exp(r + \delta/t) \text{ before 1920, and} \\ &= v \text{ after 1920,} \end{aligned} \tag{3}$$

where r and v are constant parameters and t is time. This specification implies that ω before 1920 is a linear transformation of v, where v is a random variable whose distribution does not depend on time. Note also that var (ω) = var (v) exp(2(r + δ /t)) before 1920; therefore, if $\delta > 0$, the variance declines monotonically with time indicating, as might be expected, that the accuracy of the data improves over time. The variance of the error after 1960 equals var (v) and is constant.

Substituting (3) into (2) and taking logarithms, one obtains:

$$\begin{aligned} \ln B &= \ln B^{*} + \ln v + r + \delta/t \text{ before, 1920, and} \\ &= \ln B^{*} + \ln v \text{ after 1920.} \end{aligned} \tag{4}$$

Finally, substituting (1) into (4), one obtains:

$$\ln B = X\beta + r + \delta/t + \epsilon \text{ before 1920, and} \tag{5a}$$

$$\quad = X\beta + \epsilon \text{ after 1920,} \tag{5b}$$

where $\epsilon = \mu + \ln v$ and is assumed to satisfy the Gauss-Markov rules for the least squares procedure. Pooling the pre- and post-1920 observations, the regression model becomes:

$$\ln B = X\beta + rD + \delta D/t + \epsilon, \tag{6}$$

where D is a dummy variable which is unity before 1920 and zero afterwards. Thus, the use of the dummy variable facilitates the estimation of both equations (5a) and (5b) by equation (6). Although the sign of r is an empirical question, we expect δ to be

11 A similar problem exists for the infant mortality variable (INFM), which is the number of infant deaths (M) divided by the number of live births (B). We assume that M = M* kw, where k is a constant; that is, that the errors in the infant death measure are a time-independent linear transformation of the errors in the live birth measure. Since both the numerator and the denominator are obtained from the registration method of collecting vital statistics, this assumption is not farfetched. Therefore, the observed value of INFM is related to the true value by: ln (INFM) = ln (INFM*) + ln (k), and the regression estimates of the coefficients will not be biased.

positive if the accuracy of the data improved over time.

IV. Empirical Results

Ordinary least squares estimates of the model are reported in Table 2. While equation (6) does not specify how the explanatory variables are to be measured, we find that a logarithmic transformation of these variables improves the statistical fit of the model. Therefore, only the results using the logarithm of explanatory variables, except for the dummy variables, are reported. These results are obtained by using annual data between 1900 and 1962.[12] The terminal year of 1962 is chosen primarily for the practical reason that the fertility data for years surrounding 1966 are likely to reflect adjustment responses to the superstition of Hinoeuma,[13] which causes the birth rate to plummet in that year. Also, our primary interest is in the dramatic drop in the fertility rate during the 1950's, when birth-control measures, including abortions, became widely available.[14]

Regression (1) is an estimate based on the data between 1900 and 1940, while regressions (2) through (5) are estimates based on the data for the entire period of 1900-62. The specification for regression (2) is based on the hypothesis that the fertility function did not shift after the war, for regression (3) that only the intercept shifted, for regression (4) that only the coefficients for the education variables shifted, and for regression (5) that all the coefficients shifted. We shall return to the discussion of the shift of the fertility function later.

It is noteworthy that, judging by R^2 and the Durbin-Watson statistic, the handful of explanatory variables performs well in explaining movements of the birth rate during the period under

12 Observations for the years 1947 through 1949 were not used, for the high birth rates for these years were judged to reflect the short postwar baby boom caused by the return of men from war.

13 According to the superstition, a woman born in that year will be so strong-willed and aggressive that no man will want to marry her. The crude birth rate dropped to 13.7 in 1966 in sharp contrast to 18.6 in 1965 and 19.4 in 1967. Since Hinoeuma was well anticipated, birth rates in the pre-1966 years were also affected. In fact, they rose from 17.3 in 1963 to 18.6 in 1965.

14 Abortion was first legalized in September 1948, followed by gradual extension of the grounds upon which abortion could be obtained. After May 1952, only the consent of a man and his wife was necessary to obtain abortion. Alarmed at the increased number of abortions and possible health hazards from abortion, the government initiated in 1952 programs to disseminate birth control information through local agencies and public media. Use of abortions continued to climb, however, until 1957 when the number of abortions per 100 live births reached its peak of 71.6.

study. Moreover, the signs of the regression coefficients generally agree with expectations based on economic theory, and conform to other findings in the literature (cf. note 5). The infant mortality rate (INFM) obtains positive and often significant coefficients. Because fertility decisions are made usually at least one year before actual birth, this variable is lagged one year, the choice of lag being determined by the size of R^2. Significant positive coefficients for male education (EDMLE) and equally highly significant negative coefficients for female education (EDFMLE) are obtained in all the regressions. These findings offer a persuasive evidence in support of the value-of-time argument.

The importance of agriculture (PAG) obtains mixed results with the sign of the coefficient being negative in regression (4) and (5) with the postwar shift. Only the predicted positive coefficients are significant, however. The permanent income, INCME, obtains significant and positive coefficients, indicating a positive income elasticity of considerably less than unity. This finding is noteworthy in view of mixed findings of income effects in the literature (cf. Williams 1976). The importance of small manufacturing establishments as a source of employment (HMFG) obtains positive and significant coefficients, as expected from theory, in regression (1) and (4), but coefficients in other regressions are insignificant. Finally, judging by $\bar{R}^2$, the standard error of estimates, and the Durbin-Watson statistic, the error-trend correction for the pre-1920 birth rate data improves the estimates over those obtained without such a correction (results not reported). The positive coefficients for the (DUMMY/TIME) variable supports the proposition that the variance of the measurement errors was declining over time before 1920. By and large, these results offer convincing evidence on the association between economic factors and the declining fertility trend; suggesting an important causal role for economic development in the demographic transition.

Let us now turn to the question of the shift of the fertility function after the Second World War. Numerous changes in the socio-economic as well as political environment took place after the war. Land reform, the introduction of a democratic system, increased years of compulsory schooling from six to nine years, among others, come readily to mind. Perhaps, the most significant development from the viewpoint of fertility analysis is the legalization of abortion under the Eugenics Law of 1948 and active promotion of the condom as a contraceptive measure, use of which did not enjoy official sanction in the pronatalist military regime of the prewar years. These developments surely must have increasingly facilitated family-planning practices in the postwar years. According to the rationality postulate of economic analysis, the increased ability to control fertility should have made parents more rational in their family-planning decisions and therefore strengthened the link between the explanatory variables and fertility. One would expect the fertility function as specified in our model to have possibly shifted, as a result.

To investigate the nature of the shift, several hypotheses are tested using the regression results reported in Table 2. First, consider the null hypothesis that there was no shift in the fertility function against the alternative that all the coefficients shifted. From regressions (2) and (5), one obtains $F(7, 38) = 6.55$, which is significant at the one percent level. Thus, the fertility function evidently shifted after the War. However, the shift must have been in coefficients other than the intercept, for regression (3) indicates that the shift in the intercept alone is insiginficant.

After examining several possibilities (not all results reported), we find that the most discernible shift occurred in the coefficients of the education variables. Thus, using regression (2) and (4) to test the null hypothesis that no parameters shifted against the alternative that only the coefficients for education shifted, one obtains $F(2, 43) = 18.62$, causing the rejection of the null hypothesis in favor of the alternative hypothesis. Moreover, the use of regressions (4) and (5) to test the null hypothesis that only the education coefficients shifted against the alternative that all coefficients shifted yields $F(5, 43) = 1.46$, indicating that the null hypothesis cannot be rejected at conventional levels of significance. These tests suggest that, indeed, the fertility function did shift after the War but that the most discernible shift occurred in the coefficients of the education variables.

According to regression (4), both the positive male and negative female education coefficients increased in absolute size after the War, with each of the increases being highly significant. This finding suggests the interpretation that the education effects predicted by the value-of-time argument becomes increasingly pronounced with economic development and with an attendant increase the availablility of fertility-control measures. While one would expect the increased ability to control fertility to sharpen the statistical significance of the response coefficients, our finding indicates that such an increased ability also enhances the absolute magnitudes of the responses.

One is left with a lingering question, however: Do the widening gap in the male and female education coefficients as well as statistically significant positive male and negative female education coefficients really reflect the value-of-time effects asserted in the new home-economics approach? Or can one suggest equally plausible interpretations, say, tastes or fertility-control knowledge effects? Perhaps, it would be too hasty to embrace the value-of-time argument based on the regression findings alone. Yet, it would be unwarranted to dismiss the argument out of hand merely on the ground that other intepretations may be plausible. Undoubtedly, a great deal more needs to be known about exactly what influences the education variables represent before one can answer these questions definitively. We wish to emphasize, however, that the value-of-time argument is distinguished in predicting opposite signs for the male and female coefficients, and that our findings are consistent with this prediction. Thus, while the education variables undoubtedly capture a variety of influences, the value-of-time effects evidently dominate the others in the data used.

Our findings demonstrate that the fertility function shifted after the War, with the most distinct shifts occuring in the education coefficients. Presumably, these shifts occurred in response to various postwar developments, most notably the legalization of abortion and official sanction of condom use. How significant was the shift in the fertility function in altering the downward trend in fertility? Put more directly, how much did legalized abortion, increased condom use and other related postwar developments accelerate the downward trend in fertility? To the extent that one may attribute the shift in the fertility to these developments, the discrepancy in the pre- and post-war trend patterns may be viewed as a measure of how much these developments accelerated the rate of fertility decline. To shed light on this issue, birth rates are projected for the postwar years from the prewar regression. The projections reported in Table 3 and plotted in Figure 1 were calcualted using regression (1) in Table 2.

It is noteworthy that the projections reveal a continued downward trend in the birth rate, though at a rate considerably lower than the actual birth rate decline, during most of the 1950's. Columns (4) and (5) in Table 3 show that between 1950 and 1957, the average annual drop in the actual birth rate was almost three times as large as that in the projected rate. This difference cannot all be attributed to the changes in fertility-control and related developments, for there clearly was a short period of postwar baby boom followed by subsequent downward adjustments. Since the temporary baby-boom is likely to reflect mainly the return of men from war activities, a more appropriate comparison may be for the years after 1953, when the actual birth rate reached the trend rate. The average annual rates of decline between 1953 and 1960 were 3.7 percent for the actual and 2.8 percent for the projected birth rate. Thus, assuming that the post-baby-boom adjustments were largely over by 1953, the calculations in Table 3 suggest that increased availability of fertility-control measures and related postwar developments accelerated the decline in the birth rate by some thirty percent between 1953 and 1960. Note, finally, that the projected rate declined faster than the actual rate after 1958, when the actual birth rate began to level off. Although the projected rate also appears to level off, the tendency is only slight. By and large, in spite of the evidence of the postwar shift in the fertility function, the post-1953 trend apparently reflects to a significant degree, influences of changing values of explanatory variables operating through the prewar fertility function.

V. Summary

This paper examined the influence of certain economic factors on the Japanese fertility trend between 1900 and 1962. Guided by recently accumulated knowledge in the literature on the economics of fertility, a regression model of birth-rate determination was specified.

The results of the regression analysis generally confirmed predictions based on the economic approach to fertility analysis. In particular, we found statistically significant negative female and positive male education effects, a finding which supports the value-of-time argument. Also, changing female job opportunities and a decline in infant mortality evidently contributed to the decline in fertility. These findings largely conform to other studies in the literature, indicating that factors associated with economic development, especially those raising the value-of-time, were operating to lower fertility.

The fertility function apparently shifted after the War, with the most discernible shift occurring in the coefficients of male and female education variables. Nevertheless, the trend in the birth rate projected by the prewar regression equation for the postwar years conform rather well to the actual trend after 1953, when adjustments to the short baby boom in the late forties were judeged to have been completed. Evidently, the post-1953 experience represents as much a continuation of the gradual prewar decline as a new phenomenon associated with the increased availability of fertility control measures and associated events. The observed abrupt transition in the immediate postwar years is viewed best as a consequence of a short postwar baby boom caused by return of men from war and by the introduction of condoms and legalization of abortion.

The effects on the birth rate of legalized abortion, increased condom use, and related developments were assessed by comparing the actual birth rates with the rates projected from the prewar regression estimates. The average annual rate of decline in the actual birth rate between 1953 and 1960 was calcualted to be about thirty percent greater than the rate of decline in the projected rate.

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Table 1

VITAL STATISTICS AND RELATED VARIABLES
JAPAN: 1900-1962

Year	Birth Rate	Infant Mortality Rate	Agricultural Employment	Real GNP Per Capita	Educational Males	Attainment Females
1900-02	33.0	153.0	69.3	40.3	16.5	4.4
1905-07	31.6	152.2	65.8	41.4	26.9	9.3
1910-12	31.2	157.9	62.3	48.7	39.5	16.8
1915-17	33.8	168.0	58.4	55.7	50.8	25.6
1920-22	35.2	166.8	54.0	61.3	57.9	34.4
1925-27	34.3	140.5	51.5	77.2	64.2	43.1
1930-32	32.5	124.4	50.5	76.5	72.3	53.3
1935-37	30.8	109.7	47.0	94.9	80.7	64.3
1940-42	30.7	86.5	43.9	104.4	87.8	72.1
1947-49	33.6	57.0	51.7	59.7	93.0	86.0
1950-52	25.6	55.7	46.7	75.9	94.9	90.4
1955-57	18.3	40.1	38.5	107.1	96.8	94.7
1960-62	17.0	28.6	30.2	169.0	98.0	97.0

NOTE: Birth Rate: Number of births per 1000 population.
Infant Mortality Rate: Number of infant deaths per 1000 live births.
Agricultural Employment: Proportion of total employment that is in agriculture, forestry, and fisheries.
Real GNP Per Capita: Index (1955 = 100) of real GNP per capita.
Educational Attainment: Proportion of the population aged 20-29 completing more than compulsory (elementary) schooling.

SOURCE: See Table 2 for detailed sources for these and other variables.

Table 2

REGRESSIONS OF BIRTH RATE IN JAPAN: 1900-1962

	Explanatory Variables									
	INTER-CEPT	INFM	EDMLE	EDFMLE	INCME	PAG	HMFG	DUMMY (Pre-1920)	DUMMY/TIME	$\bar{R}^2$ / SEE / Durb-Wats
1900-1940										
(1) Coeff.	-3.863	0.164*	1.978**	-1.098**	0.152**	0.376	0.088**	-0.198**	0.729	0.758
t-value	(-1.57)	(2.05)	(3.51)	(-3.00)	(2.08)	(0.67)	(2.08)	(-3.86)	(1.64)	0.034
										1.989
1900-1962										
(2) Coeff.	-7.914**	0.057**	3.045**	-1.663**	0.204**	0.910**	0.063	-0.300**	1.358**	0.961
t-value	(-5.45)	(2.93)	(5.17)	(4.58)	(2.92)	(5.94)	(1.90)	(-6.10)	(3.54)	0.047
										1.161
(3) Coeff.	-7.679**	0.054*	2.932**	-1.604**	0.202**	0.927**	0.053	-0.292	1.278**	0.961
t-value	(-4.73)	(2.47)	(4.30)	(-3.96)	(2.88)	(5.71)	(1.21)	(-5.19)	(2.82)	0.047
Postwar Sft.	-0.021	—	—	—	—	—	—	—	—	1.158
t-value	(-0.34)									
(4) Coeff.	-1.706	0.016	2.681**	-1.683**	0.274**	-0.332	0.120**	-0.189**	0.232	0.979
t-value	(-1.10)	(0.94)	(5.29)	(-5.61)	(5.12)	(-1.38)	(3.49)	(-4.19)	(0.61)	0.035
Postwar Sft.	—	—	9.416**	-9.509**	—	—	—	—	—	1.860
t-value			(6.08)	(-6.08)						
(5) Coeff.	-4.932*	0.026	2.311**	-1.318**	0.238**	0.588	0.079	-0.0220**	0.636	0.980
t-value	(-2.15)	(1.44)	(4.43)	(-3.87)	(4.26)	(1.10)	(1.89)	(-4.64)	(1.46)	0.034
Postwar Sft.	2.836	0.100	7.550	-7.024*	-0.388	-1.103	-0.103	—	—	2.154
t-value	(0.15)	(0.93)	(1.73)	(-2.42)	(-0.84)	(-1.26)	(-0.73)	—		

Table 2 (continued)

VARIABLES AND THEIR SOURCES:

BR (Birth Rate): Number of births per 1000 population from Japan Ministry of Health and Welfare, *Vital Statistics*, and Irene Taeuber, *The Population of Japan*, Table 6, p. 41.

INFM (Infant Mortality Rate): From the same source as birth rate. This variable is lagged one year.

EDMLE (Male Education) and EDFMLE (Female Education): Percent of males or females ages (20-29) who completed more than elementary (compulsory) schooling. The variable was estimated by using the education-by-age table of *Census of Population of 1960 (Vol. 2, Part 1, Table 6)*--the 1950 census does not contain detailed age break-downs. The calculations assume that the death rate is independent of education. The data were interpolated between bench-mark years.

INCME (Permanent Income): Index (1955 = 100) of real consumption per capita from Alan H. Gleason, "Economic Growth and Consumption in Japan," in William Lockwood, ed., *The State and Economic Enterprise in Japan* (Princeton University, 1965, pp. 391-444, Appendix Table 1).

PAG (Proportion Agriculture): The proportion total employment that is in agriculture, forestry, and fisheries from Kazushi Ohkawa, *Nihon Keizai No Seicho Ritsu (The Growth Rate of Japanese Economy)* (Iwanami, Tokyo, 1957, Table 5, pp. 130-31).

HMFG (Household Manufatturing): The ratio of output produced in establishments with fewer than five workers to output produced in larger establishment, from Ohkawa, *ibid.*, (Table 1, pp. 72).

NOTE: * Significant at 5%.
** Significant at 1%.
All the variables except the dummy variables are in logarithms.

Table 3

BIRTH RATE PROJECTIONS

(1) Year	(2) Actual	Projected	(3) % Difference $\frac{(2)-(1)}{(1)} \times 100$	(4) Annual Changes (%) Actual	(5) Projected
1950	28.1	22.3	-20.6	-10.0	-3.6
1951	25.3	21.5	-15.0	- 7.5	1.4
1952	23.4	21.8	- 6.8	- 8.1	-5.5
1953	21.5	20.6	- 4.2	- 7.0	0.0
1954	20.0	20.6	3.0	- 3.0	-1.9
1955	19.4	20.2	4.1	- 5.2	-5.4
1956	18.4	19.1	3.8	- 6.5	-1.0
1957	17.2	18.9	9.9	4.7	-1.1
1958	18.0	18.7	3.9	- 2.8	-4.8
1959	17.5	17.8	1.7	- 1.7	-2.8
1960	17.2	17.3	0.6	- 1.7	-1.7
1961	16.9	17.0	0.6	0.6	-0.6
1962	17.0	16.9	0.6		

NOTE: Projected values are calculated by using regression (1) in Table 2.

Figure 1

POSTWAR TREND IN BIRTH RATE