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Economics of Postwar Fertility in Japan: Differentials and Trends

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I. Introduction

Japan experienced a precipitous decline in fertility during the decade following the postwar baby boom of 1947–49, and then her fertility rates leveled off. The rapid decline in fertility paralleled liberalization of abortion laws and an active campaign to disseminate contraceptive information. Given these developments and the apparent subordination of women in Japanese culture, one might be inclined to ascribe the fertility decline to increased availability of abortions and other means of birth control and to doubt the explanatory relevance of economic theory which emphasizes the effects of rising wages and educational attainment of women on fertility. The conclusion that emerges from this study, however, is that the basic economic forces identified by the new economic theory of household decision making have been operating to produce a considerable part of the observed differentials and trends in Japanese fertility.[1] Indeed, increased use of abortion and contraceptive devices appears to have been induced to some extent by economic forces.[2]

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[1] Silver (1966) found that births, and to a somewhat lesser extent marriages, responded positively to both ordinary and Kuznets cycles between 1878 and 1957, and that the magnitudes of the cyclical responses of births were similar to those in the United States and Britain.

[2] It would be premature, however, to look for exact magnitudes of the parameters of the Japanese fertility function or for a complete explanation of fertility trends. The statistical model employs only a few key variables and is still formulated in static terms. The statistical analysis is performed mainly on cross-section data which are highly aggregated. Further refinements of the model and the data base are both desirable and possible.

II. Differentials and Trends in Japanese Fertility: Background

The phenomenal growth of the Japanese economy during the postwar years has been widely noted. Between 1950 and 1969, real gross national product grew at an average annually compounded rate of close to 10 percent, while the comparative rate for the United States was 4 percent. Real gross national product per capita grew at 9 percent, contrasted with 2 percent for the United States. The rapid industrialization of the Japanese economy is documented in the share of agricultural employment, which fell from about 49 percent in 1950 to 30 percent in 1960 and then declined to less than 18 percent in 1970. Employment opportunities for women grew also; the proportion of women in nonagricultural employment increased from 29 percent in 1950 to 35 percent in 1960 and to 37 percent in 1970.

Against this background of rapid economic development, Japanese fertility dropped sharply (fig. 1). The crude birth rate, which had been about 35 in the late 1940s, first dipped below 30 in 1950; 5 years later it fell below 20 and stayed there. Fertility decline in Japan began about 1920, but the rate of decline accelerated after 1950.[3] By the early 1960s the persistent decline appears to have ended, and then the leveling off began. A sharp drop in fertility in 1966 in response to the superstition of *Hinoeuma* vividly underscores that fertility is very much within the realm of deliberate control.[4] Birth rates just before and after 1966 were to some extent adjustments to the 1966 phenomenon.

Rural regions experienced a more rapid and a more persistent birth rate decline than industrial areas (see table 1). Only part of this difference is accounted for by shifts in age composition as women of childbearing age migrated from rural to urban regions.[5] Until 1962, the average number of children ever born by duration of marriage for women married before they were 30 years old continuously declined for all groups (see table 2). There was a slight increase between 1962 and 1967 among women married less than 10 years. But completed fertility measured approximately by the fertility of women married more than 10 years continued to decline. Table 3 provides more direct evidence on the decrease in desired completed fertility during the postwar years, 1950–67.

[3] Between the two periods, 1920–22 and 1940–42, the crude birth rate declined from 35.2 to 30.7 (7.1 percent per decade), and the total fertility rate declined from 5.21 in 1920 to 4.11 in 1940 (11.2 percent per decade). Between the 1949–51 and 1959–61 periods, the crude birth rate dropped from 28.8 to 17.2 (40.3 percent), and the total fertility rate from 3.72 to 1.99 (46.5 percent).

[4] *Hinoeuma* takes place every 60 years. The superstition is that a woman born in that year will "eat men alive," which is to say that she will be very aggressive and no man will want to marry her.

[5] According to Japan's Institute of Population Problems, holding constant the age composition of the population at 1930 values, the birth rate in urban areas (*shi*) dropped from 26.4 in 1950 to 17.8 in 1960 and then rose to 19.0 in 1965. The birth rate in rural areas (*gun*) continued to drop from 32.7 in 1950 to 19.0 in 1960 and to 17.6 in 1965. These results were reported in Aoki (1970, table 24).

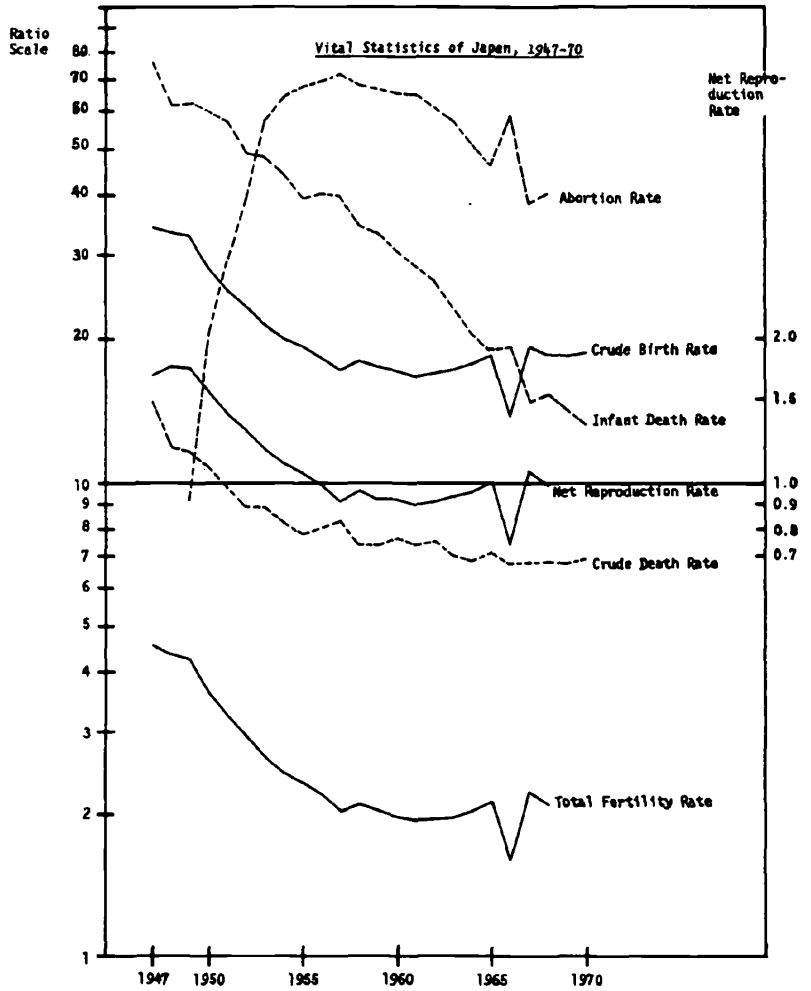

FIG. 1.—Infant death rate is deaths at ages 0–1 per 1,000 live births. Abortion rate is number of registered abortions per 100 live births. Other vital statistics have their usual definitions. (Data on births, deaths, and infant deaths are from Japan Ministry of Health and Welfare [1970]; abortion rate, total fertility rate, and net reproduction rate are from Mainichi Newspaper Company [1970, p. 246]).

For families already having two children, the proportion desiring no additional children increased throughout the years, while the proportion desiring two and three or more additional children continued to decline. Moreover, the percentage of couples with "no idea" how many additional children they wanted tended to decline, suggesting an increased

TABLE 1
CRUDE BIRTH RATES BY REGIONS

	% TOTAL EMPLOYMENT IN AGRICULTURE, 1960	CRUDE BIRTH RATES					% CHANGE IN CRUDE BIRTH RATES	
		1950	1955	1960	1965	1970	1950–60	1960–70
All Japan	30.0	28.1	19.4	17.2	18.6	18.8	−38.8	9.3
Industrial regions	11.7	25.6	16.8	16.8	20.1	20.7	−33.9	23.2
Rural regions	49.6	31.0	22.1	18.0	19.0	16.2	−42.6	−7.9

SOURCES.—Japan Ministry of Health and Welfare (1970, vol. 1) and Japan Prime Minister's Office (1970).
NOTE.—Industrial regions included are Tokyo, Kyoto, Osaka, Kanagawa, Fukuoka, and Aichi prefectures. Rural regions included are Aomori, Yamagata, Niigata, Ibaragi, and Kumamoto prefectures. Classification of prefectures as industrial or rural-farm is from Honda (1959). Crude birth rates for regions are simple averages of birth rates in each prefecture. Percent changes in crude birth rates for regions are simple averages of the percent changes in each prefecture.

TABLE 2
AVERAGE NUMBER OF CHILDREN EVER BORN
(WIFE MARRIED BEFORE AGE 30)

MARRIAGE DURATION (YEARS)	SURVEY YEARS			
	1940	1957	1962	1967
1–4	0.98	0.93	0.87	1.06
5–9	2.34	2.16	1.92	1.95
10–14	3.55	2.92	2.46	2.28
15–19	4.39	3.62	2.85	2.66
20+	5.17	4.72	3.90	3.43
All groups	3.49	2.86	2.37	2.28

SOURCES.—Aoki and Nakano (1967, table 3) and Japan Ministry of Health and Welfare (1968, table 24B).
NOTE.—Includes married women with husband present.

awareness of family planning in later years. My estimates of completed fertility (table 3) also show a pronounced decline over the years.[6]

The rapid decline in fertility in the postwar years coincided with the liberalization of policies on abortions and contraceptive use. Abortion was first legalized in September 1948, and in June 1949, grounds for abortion and sterilization were extended. After May 1952, abortion could be obtained with only the consent of man and wife. Alarmed at the increased number of abortions and possible health hazards from abortion, the government in 1952 initiated programs to disseminate birth control information through local agencies. Resort to abortion continued to increase, however, until 1957, when the number of abortions per 100 live births reached its peak of 71.6.

III. Economic Framework for Fertility Analysis

The following discussion will emphasize the effect of parental education on fertility. The testing of economic hypotheses about the effect of parental education on fertility also provides a test of the usefulness of economic theory in interpreting Japanese fertility behavior.

The basic proposition in the economic theory of fertility is that observed changes and differentials in fertility reflect to a large extent changes and differentials in the demand for fertility and that resource constraints on

[6] The true decline is likely to have been even more rapid than these estimates suggest because my calculations may underestimate completed fertility to a greater extent in earlier years. First, the true mean of the open-ended class would be larger than three, the figure used for my calculations, by a larger amount in earlier years if completed fertility declined over time. Second, the group with "no idea" as to number of additional children desired was omitted from the calculations. If people gave the "no idea" answer because of greater ignorance (lower level of education) than other respondents, then economic analysis predicts their desired completed fertility to be greater than that of others. This omission would have mattered less in recent years because of general declines in fertility and because this group made up a smaller fraction of respondents in more recent years.

TABLE 3

ADDITIONAL CHILDREN DESIRED AND ESTIMATED DESIRED COMPLETED FERTILITY, BY COUPLES WITH TWO CHILDREN (WIFE'S AGE LESS THAN 50)

Number of Additional Children Desired	1950	1952	1955	1957	1959	1961	1963	1965	1967
0	29.8	39.3	42.7	56.4	57.7	64.2	71.7	70.5	71.1
1	32.8	35.2	32.3	30.0	25.5	19.3	22.3	23.5	20.0
2	19.2	14.7	15.8	6.9	7.2	4.0	3.2	2.4	3.1
3+	6.9	5.4	3.2	0.9	1.4	3.2	0.6	0.4	0.8
No idea	11.3	5.4	6.0	5.8	8.2	9.3	2.2	3.2	5.0
Estimated desired completed fertility	3.04	2.85	2.78	2.49	2.48	2.41	2.31	2.30	2.30

SOURCE.—Aoki and Nakano (1967, p. 44).

NOTE.—Estimated desired completed fertility was calculated as 2 plus the average number of desired additional children. Respondents with "no idea" were not included, and the 3+ group was assigned a value of 3. Figures are shown as percentages.

households exert appreciable effects on fertility demand. Following Becker (1960), most economic models of fertility view children as primarily consumer durables. In this conception, a flow of services emanates from the stock of children, and these services enter the parents' utility function. Since parents must make outlays (e.g., food, clothing, housing, and, most important, their time) to obtain child services, they are not free goods, but command a price. To be quite general, therefore, demand for fertility is determined by the preferences of parents, the resources available to parents, and the cost of producing child services relative to the cost of other commodities (usually identified collectively as the standard of living) that also yield utility.[7]

Typically, the fertility rate has declined in countries experiencing sustained growth in real income. Since growth in real income is usually brought about by growth in real wages, this phenomenon may be interpreted as reflecting the dominance of substitution over income effects. An increase in real income would, other things being equal, increase the number of children per family unless the number of children was an "inferior good."[8] Assuming that child services are more time-intensive for mothers than the standard of living, an increase in the wife's wage rate would raise the relative price of child services, imparting a substitution effect away from them.[9] Relying on income and wage rates alone, one may, therefore, interpret the decline in fertility accompanying growth in real income as reflecting the dominance of the substitution effect of a rise in the wife's wage rate over the combined income effects of increases in both spouses' wage rates. However, both income and wage rates are correlated with the educational levels of the parents and the level of contraceptive knowledge, relationships which complicate the empirical estimation of the magnitudes of the income and substitution effects.

The effect of educational attainment of parents on fertility has been investigated more thoroughly than that of income or wage rates by Ben-Porath (1970*a*, 1970*b*, 1973) and Michael (1971) among others. Educational attainment of parents is typically negatively associated with their

[7] Most models use the time-allocation framework (Becker 1965) and they are usually cast in a lifetime dimension, thereby avoiding the complexities of timing and spacing of births (see, for example, Ben-Porath [1973], DeTray [1972], Michael [1971], and Willis [1973]). Some problems with the use of static models are discussed by T. Paul Schultz (1973).

[8] Also relevant to the decline in fertility are changes in the quality of children as real income rises. Research on the demand for consumer durables suggests that the effect of income on the demand for quality is greater than on the demand for quantity. Even assuming numbers of children are not inferior, parents would tend to a greater extent to spend more per child than to have more children as real income rises.

[9] An increase in the husband's wage rate, however, is expected to produce mainly income effects because his time intensities are assumed to differ little between child services and the standard of living and because his wage income constitutes a large proportion of family income (see, for example, Ben-Porath [1973]).

fertility. Proposed explanations of this relationship fall generally into three groups: the tastes hypothesis, the cost-of-fertility-control hypothesis, and the cost-of-time hypothesis.

According to one version of the tastes hypothesis, parents with higher education may be more "rational" than others in that they tend to regard the number of children as a decision variable, while less educated parents regard it as something beyond their control (Ben-Porath 1970*b*). Therefore, parents with higher levels of education would control fertility more and have fewer children than other parents. Another version is that education affects the perception of child quality (Ben-Porath 1970*b*, Gardner 1972). Parents with more education may desire a greater expenditure per child to obtain a given level of child quality. Other things being equal, they will have a smaller number of children. Economists have not succeeded in incorporating such taste factors in their theory in ways that generate testable hypotheses. Such taste factors are still regarded as residuals.

The second explanation hypothesizes that parents with more education have better access to information about birth control devices and are more efficient at using them. In other words, education lowers the cost of fertility control. More educated parents would engage in fertility control to a greater extent than other parents, other things, particularly the benefit of control, being the same. This hypothesis may partly explain the negative association between education and fertility.[10]

The third explanation emphasizes the effect of education on fertility through its effects on the cost of time. In the time-allocation framework of the fertility model, education is assumed to raise the productivity of time spent at home in the production of commodities (such as child services and the standard of living) as well as that of time spent in the labor force. An increase in the productivity of time at work leads to an increased real wage rate, thereby raising the relative prices of time-intensive commodities. An increase in the productivity at home, say, at the same rate for all commodities, lowers the relative prices of time-intensive commodities. An increased productivity at home or market also results in increased real income, imparting income effects. The full effect of education on the demand for children is the net of these forces. To rely on the cost-of-time hypothesis to explain the negative correlation between education and fertility, one must argue that the substitution

[10] More educated people may also use birth control more than others because they desire fewer children, i.e., the benefit of birth control is greater for them. Both Becker (1960, p. 218) and Ben-Porath (1970*b*, p. 6) propose a test of the hypothesis that education lowers the cost of fertility control. If improvement in birth control techniques comes as a once-and-for-all change, then fertility differentials among educational groups would widen at first but would tend to narrow over time as information on birth control measures became more diffused (see Section IV below for some evidence of a differential rate of diffusion among educational groups of birth control techniques in Japan after 1948–52).

effect imparted by education outweighs the income effect. One plausible case is that education, especially of the wife, raises the productivity of time spent in the market more than that of time spent in producing child services or the standard of living. In this case, the relative price of child services rises, causing substitution effects away from them.[11] The substitution effect of the husband's education is likely to be small, assuming that time intensity varies little between the two commodities for him. The husband's education is expected, therefore, to exert mainly income effects (Ben-Porath 1973).

The cost-of-time hypothesis has played a central role in the economic analysis of fertility. It emphasizes the role of the relative price of child services, and its predictions are empirically distinguishable, at least for Japan, from those of the tastes and the cost-of-fertility-control hypotheses. The latter two hypotheses predict that the education of either parent will be negatively associated with fertility, but they leave the relative importance of the effects of each parent's education an empirical question. In Japan, where the husband apparently dominates family decision-making,[12] one would expect his education to be at least as important as the wife's education, if not more so. The cost-of-time hypothesis predicts that the negative association between education and fertility is more strongly manifested when the education variable refers to the wife's rather than the husband's education. The husband's education would be positively correlated, if anything, with fertility when other things, in particular the level of contraceptive knowledge, are the same. In other words, husband's education serves as a proxy for family wealth, while wife's education represents the price of child services.

These three hypotheses, however, are not necessarily mutually exclusive. They help identify possible mechanisms through which parents' education affects fertility. For example, the cost-of-time and the cost-of-fertility-control hypotheses would best be viewed not as alternatives but as complementary hypotheses. The cost-of-time hypothesis emphasizes forces affecting the demand for the service of birth control, a demand which is derived from the desired reduction in births, given the level of fecundity. Underlying this demand is the demand for fertility. The cost-of-fertility-control hypothesis emphasizes the supply side, or the cost of

[11] Even if the wife does not work in the market in her lifetime, her shadow price of time could be increased by education, making child services more expensive (see Gronau [1971]).

[12] A survey of 422 couples in the Saitama prefecture in 1960 showed that 78 percent were using condoms, a device for the husband's use, and that 62 percent had the husband obtain the contraceptives. The same study showed that for 70 percent of white-collar workers, 52 percent of farmers, and 51 percent of laborers, the husband was responsible for obtaining contraceptive devices (Muramatsu 1962). Matsumoto, Koizumi, and Nohara (1972, p. 254) also report that husbands are primarily responsible for decisions concerning family limitation.

achieving the desired reduction in births. The cost-of-time hypothesis has been the most useful to economists for analyzing information on fertility behavior.

IV. Empirical Analysis

Study of Japan appears to offer an opportunity to obtain evidence concerning both the effects on fertility of decreases in the cost of preventing births and changes in fertility demand. Thus, I want below first to examine evidence concerning the proposition that both decreased demand for fertility and increased access to abortions and contraceptive techniques contributed to the phenomenal postwar decline in Japanese fertility.

Abortion, Contraceptive Use, and Fertility

The rapid decline in Japanese fertility in the postwar decade coincided, as I have stated, with abortion liberalization measures and the subsequent dissemination of information about other means of fertility control. It is tempting to explain the rapid decline in fertility as simply the result of a widespread resort to abortion. According to this view, many births prior to abortion legalization were unwanted: the liberalization of birth-control policies simply eliminated this excess fertility. In other words, if abortion had not been legalized, fertility would not have declined appreciably. But since fertility in Japan had been declining persistently since around 1920, there is a presumption that it would have declined even in the absence of abortion reform.

Since abortions and other fertility-control measures entail costs, both monetary and nonmonetary, the extent of use of these measures presumably was influenced by considerations of gains and costs. Abortion legalization and birth control information programs certainly decreased the costs of fertility control, leading to increased use of control measures. On the demand side, as discussed in Section III, the main determinant of the demand for fertility control is the demand for fertility. A fuller interpretation of the developments in Japan would be that the price of child services increased and demand for fertility declined, leading to an increased demand for fertility control, and that the increased availability of birth control measures and abortions facilitated the attainment of lower fertility. Put differently, even without the liberalization of abortion and other control policies, resort to illegal abortion and the use of contraceptives would have grown because of the increase in the price of child services. In fact, the availability of illegal abortions had been growing before 1948, and the Eugenics Law of 1948 was motivated by hygienics, not by intent of population control (Muramatsu 1967). In short, legalization and liberalization of control measures were not so much autonomous

events as responses by authorities to increased demand for fertility control and the health hazards of illegal practices.

How much did legalization of abortion contribute to the rapid decline in fertility? To answer this question accurately, one would have to estimate (1) the increase in the number of abortions caused by abortion legalization, and (2) the proportion of those abortions that would have terminated in births had there been no legal abortions. Since such estimates are beyond the scope of this paper,[13] I report the results of a crude calculation. Assuming that all pregnancies aborted legally would have terminated in live births if abortions had been illegal, I calculated, for each year from 1949 to 1961, the "maximum" general fertility rate as births plus abortions per 1,000 women of ages 10–49.[14] The excess of actual fertility decline over any decline in the "maximum" fertility rate can be viewed as a measure of fertility decline due to abortion.

Between the 1949–51 and 1959–61 periods, the actual general fertility rate dropped by 44 percent, from 93 to 52. According to my calculations, the "maximum" general fertility rate decreased by 22 percent, from 111 to 87. Thus, it would appear that abortions about doubled the rate of decline in the general fertility rate during the decade after 1950.[15] But resort to abortion by no means accounted for the entire fertility decline. Indeed, the rate of decline in the estimated "maximum" rate is still substantially greater than the rate of decline in the actual fertility rate during the prewar years.[16] This evidence of a substantial fertility decline—indeed, a possible acceleration of the prewar decline—after adjusting for the effect of abortions suggests that the actual fertility decline partly represents decreases in the demand for fertility.

[13] In principle, effects of legal abortions on fertility in any year could be assessed from a simultaneous-equations model in which key endogenous variables would be the fertility rate and prices of abortions and of contraceptive measures. Once the effect of legalization on the prices of abortions and contraceptive measures was estimated, the ultimate effect on fertility could be obtained from the demand-for-fertility function.

[14] These are maximum estimates for each year of the fertility rate in the absence of legal abortions because, if abortions had been illegal, some pregnancies would have been aborted illegally or prevented by other means. In other words, the abortions in each year were not solely due to decreases in costs but also to increases in the demand for fertility control. On the other hand, these estimates may understate the true maximum values because of underreporting of abortions. Muramatsu (1960) estimated that in 1955 at most 77 percent of induced abortions performed were reported. He also estimated that in 1955 the number of live births in the absence of abortion would have been twice (or more) the number actually registered. I calculated the ratio of the maximum to the actual general fertility rate to be 1.68 in 1955.

[15] Because of the underreporting of abortions, my calculations may overstate the effect of abortions on fertility decline. Since the underreporting was probably greater in earlier years, the actual drop in the max mum fertility rates would have been greater, and the effect of abortions on fertility decline smaller than I calculate.

[16] Between 1920 and 1940, the rate of decline per decade in the general fertility rate was about 13 percent.

TABLE 4
RATE AND COMPOSITION OF PREGNANCIES BY REGIONS, 1955, 1960, AND 1965

	1955	1960	1965	RELATIVE CHANGE 1955–60 (%)	RELATIVE CHANGE 1960–65 (%)	AVERAGE 5-YEAR-PERIOD CHANGE (%)
Rate of pregnancy:						
All Japan	223.32	187.01	166.01	−16.26	−11.23	−13.74
Industrial regions .	206.25	191.23	183.00	−7.28	−4.30	−5.80
Rural-farm regions	251.14	191.30	155.59	−23.83	−18.67	−21.29
Share of births (in %):						
All Japan	57.96	58.14	66.04	0.31	13.59	6.74
Industrial regions .	54.59	56.79	65.91	4.03	16.06	9.88
Rural-farm regions	59.58	59.85	65.28	0.45	9.07	4.67
Share of abortions (in %):						
All Japan	39.17	38.49	30.53	−1.74	20.68	−11.71
Industrial regions .	42.24	39.40	30.42	−6.72	−22.79	−15.14
Rural-farm regions	37.79	37.01	32.22	−2.06	−12.94	−7.66
Percentage of females (Ages 15+) of childbearing age (20–34) (in %):						
All Japan	36.88	35.73	34.21	−3.12	−4.25	−3.69
Industrial regions .	39.28	38.95	39.29	−0.84	0.87	0.01
Rural-farm regions	35.66	34.06	30.17	−4.49	−11.42	−8.02

SOURCES.—Pregnancies, births, and abortions from Shinozaki (1971); female population composition from Japan Prime Minister's Office (1955, 1960*b*, 1965).
NOTE.—Rate of Pregnancy = 1000 × (births + fetal deaths + abortions)/married women of childbearing age with husband present. Share of births = (births/pregnancies) × 100. Share of abortions = (abortions/pregnancies) × 100. Regions are the same as in table 1.

Dissemination of birth-control measures other than abortions undoubtedly played some role in the decline in actual fertility rates, but in the absence of estimates of the number of pregnancies prevented by the use of modern contraceptive measures, one cannot directly assess its impact on fertility. Since the efforts to disseminate birth-control information started only in 1952, the major effects of birth control on fertility were probably felt during the late 1950s. Assuming that most couples with accidental pregnancies turned to abortion as a last resort to control fertility, the share of abortions compared with the share of actual births in total pregnancies may provide information on the trend of fertility demand and the use of contraceptives. Since abortions had already become widespread by the middle of the 1950s, subsequent changes in the share of abortions would reflect, to a large extent, an increased use of contraceptives. Table 4 summarizes trends and differentials in the rate of pregnancy and in the shares of abortions and births in pregnancies after 1955. There was a general increase of the share of births and a decrease of the share of abortions in total pregnancies. For Japan as a whole, the pregnancy rate among fertile women declined at an average 5-year rate

of 14 percent from 1955 to 1965. The rate of decline was greater in the rural regions (21 percent) than in the industrial regions (6 percent). Indeed, by 1960 the pregnancy rate in rural regions had dropped below that in industrial regions. During the 10-year period, the rate of increase in the share of births and the rate of decrease in the share of abortions were both greater in industrial than in rural regions, suggesting that "unwanted" pregnancies declined more rapidly in industrial areas.

What can one infer from these regional differences? Suppose that all these differences are attributable to the differential spread of contraceptive methods (i.e., differential reduction in costs of control). Then the implicit assumption would be either that there was no change in demand for fertility in industrial and rural regions, or that the decline in demand for fertility did not vary systematically between the two types of regions. The slower rate of increase in the share of births and the slower rate of decrease in the share of abortions in rural regions would then presumably be attributable mostly to a slower spread of contraceptive measures in these regions. The more rapid decline of the pregnancy rate in rural regions, however, is the opposite of what one would expect if contraceptive measure did spread more slowly in these regions. Therefore, a more plausible interpretation of these differences would rely on a combination of differential change in fertility demand and differential spread of contraceptive knowledge. One interpretation would be that fertility demand declined more rapidly in rural than in industrial regions, resulting in a more rapid decline of the pregnancy rate, but that the spread of contraceptive knowledge was not rapid enough in rural regions to diminish rapidly the use of abortions as a last resort to control fertility.

Although the changing age composition of females precludes a firm judgment about the validity of the above interpretation,[17] this interpretation is supported by a comparison of the 1955–60 and 1960–65 periods. The pregnancy rate dropped more rapidly during 1955–60 than it did during 1960–65 in both regions. If this was attributable entirely to the spread of contraceptive measures, one would also expect to observe more rapid changes in both the share of births and the share of abortions in the earlier period. Indeed, given the early 1950s' reforms regarding the use of contraceptives, this expectation would appear to be quite plausible, but the course of events was just the opposite as both shares changed more rapidly in the later period (table 4). Again, a more plausible interpretation would be that demand for fertility continued to decline in both periods; that the spread of contraceptives increasingly facilitated effective

[17] The industrial prefectures experienced a slight increase and the rural prefectures a rather large decrease in the proportion of women of childbearing age (table 4). These changes in age composition undoubtedly explain in part the more rapid decline in the pregnancy rate in the rural than in the industrial prefectures.

TABLE 5
DIFFUSION OF CONTRACEPTIVE USE BY EDUCATION LEVEL
(PERCENTAGE OF COUPLES USING CONTRACEPTIVE DEVICES)

	1950	1952	1955	1957	1959
All	19.5	26.3	33.6	39.2	42.5
Husband's education:					
<9	14.2	18.2	28.2	33.4	37.6
10–12	25.4	37.0	37.7	46.5	43.9
13+	37.3	47.0	48.8	52.5	54.0
Range	23.1	28.8	20.6	19.1	16.4
(MAD/mean)	30.31	31.03	18.39	16.25	13.06
Wife's education:					
<9	13.0	20.1	28.2	33.3	35.0
10–12	32.4	38.7	46.1	48.1	51.6
13+	36.0	59.1	47.8	53.2	51.9
Range	23.0	29.0	19.6	19.9	16.9
(MAD/mean)	34.75	33.59	20.47	17.16	16.09

SOURCE.—Japan Ministry of Health and Welfare (1959).
NOTE.—Range is the difference between the largest and the smallest values. The MAD is the mean absolute deviation. In all years except 1959, the data refer to couples with wife under age 49. For 1959, wife's age is less than 50. The sample size varies from 3,500 couples in 1952 to 3,835 couples in 1959.

fertility control, thereby reducing unwanted pregnancies; and that the role of abortion continued to diminish in importance as a control measure.

The above evidence documents an increased use of contraceptive measures from 1955 to 1965. The relationship between parents' education and the use of contraceptives was discussed in Section III in the form of the cost-of-fertility-control hypothesis. If there was a period in which the use of birth control techniques was introduced or improved once and for all, then this hypothesis predicts that differences among education groups in the extent of use of birth control would widen at first, then narrow gradually. In Japan, a marked increase in the availability of abortions and birth control information occurred after 1948–52, so this period would appear to provide a reasonably proper setting for testing this hypothesis.

Table 5 presents the percentage of families within education class (husband's or wife's) that reported using some birth-control technique. The data are taken from surveys conducted in selected years to determine the attitudes of Japanese families of various socioeconomic classes toward contraceptive usage. In most education classes, the proportion of families using birth-control techniques increased over the years, presumably because costs of control declined and benefits increased. The differences across education groups in the extent of contraceptive usage as measured by either the range or the mean absolute deviation (relative to the mean) varied most in the early 1950s and persistently declined after 1952. One detects a slight increase in these measures of dispersion in 1952 with the

TABLE 6
COMPLETED FERTILITY BY EDUCATION LEVEL
(AVERAGE NUMBER OF CHILDREN EVER BORN PER COUPLE)

	1940	1952	1962	1967
All	5.10	4.47	3.91	3.36
Husband's education:				
Low	5.19	4.62	4.05	3.45
Middle	4.81	3.62	3.60	3.27
High	4.17	3.47	3.21	2.92
Wife's education:				
Low	5.19	4.57	4.04	3.48
Middle	4.39	3.58	3.47	3.14
High	4.74	3.13	3.09	2.69

SOURCES.—Aoki and Nakano (1967, table 11) and Japan Ministry of Health and Welfare (1968, various tables).
NOTE.—For 1940, the figure is for couples married more than 21 years; for 1952, couples with wife age 45 or older; and for 1962 and 1967, couples married more than 20 years. Schooling definitions are: low, less than 10 years; middle, 10–12 years; and high, 13 years or more.

start of the campaign to disseminate birth-control information. These findings, though based on sparse information, agree with the predictions of the cost-of-fertility-control hypothesis.

Education and Fertility

The preceding discussion suggests that a decline in fertility demand and increased access to abortions and birth-control information played a joint role in producing the observed decrease in fertility in Japan. I now explore the relationship between fertility and parental education in the light of the hypotheses discussed in Section III.

According to the tastes and cost-of-fertility-control hypotheses, education of either parent is expected to be negatively associated with fertility. For Japan, education of the husband, because of his dominant family role, is likely to be a more significant explanatory variable than is the wife's education. The cost-of-time hypothesis predicts that the husband's education will be weakly, but positively, associated with fertility and that the wife's education will have a strong negative association with fertility.

Table 6 presents a measure of completed fertility by education groups for 1940, 1952, 1962, and 1967. The data are from Institute of Population Problems surveys. Education of either parent generally is negatively associated with fertility, in agreement with findings for other countries. These data also document the persistently declining trend in completed fertility at all levels of parental education, underscoring that education is by no means the only factor contributing to the decline in completed fertility over time.

TABLE 7
TRENDS IN COMPLETED FERTILITY STANDARDIZED BY EDUCATION

	Survey Years				Mean Absolute Deviation
	1940	1952	1962	1967	
Actual	5.10	4.47	3.91	3.36	0.85
Standardized:					
Husband's education	4.99	4.21	3.84	3.36	0.75
Wife's education	4.93	4.22	3.84	3.36	0.72

SOURCE.—Calculated from table 6.
NOTE.—Standardized rates were calculated by using the 1967 distribution of couples by education of husband and wife. The mean absolute deviation was calculated as the average of absolute deviations of annual values from the 1967 value.

The negative association of fertility and the education of either parent may at first appear to agree with the prediction of the tastes and the cost-of-fertility-control hypotheses. Unfortunately, these data are not cross-classified by education of parents, so that one cannot discern the "pure" relationship between the fertility rate and the wife's and husband's education separately. Since the levels of husband's and wife's education are (positively) correlated, table 6 reflects the joint influence of both levels of education. Since the correlation is not perfect, one may still attempt (see table 7) to determine the relative importance of the education of either parent in "explaining" observed differences in fertility.

Table 7 presents the observed completed fertility in the 4 survey years and estimates of completed fertility obtained by using the 1967 distribution of educational attainment of husband and wife. That the general increase in the level of school attainment played a role in the decline in observed fertility is demonstrated by standardized rates which are consistently lower than actual rates in every year. The difference between standardized fertility rates using husband's and wife's education appears to narrow in later years. One reason for this tendency may be the increased correlation of husband's and wife's educational attainment accompanying a general increase in the dispersion and level of women's educational attainment. According to the mean absolute deviation of yearly values from the 1967 value (shown in table 7), the year-by-year differences in the fertility rate are decreased when yearly rates are standardized by education of either parent, but the reduction is somewhat greater when the distribution of the wife's rather than of the husband's education is used. Standardizing by the husband's education reduces the mean absolute deviation by 12.8 percent; standardizing by the wife's education decreases it by 15.3 percent. Thus, the trend in the distribution of the wife's education appears to have been more important than that of the husband's in the fertility trend.

Since the data for table 7 were not cross-classified by parents' education, one could not directly observe the "pure" effect of the education of either

parent. To determine the relative magnitudes of the pure effects of parents' education on fertility, multiple regressions of the following form were estimated using cross-section data for 46 prefectures: $C = a + b_1(Ed_{HN}) + b_2(Ed_{HH}) + c_1(Ed_{WN}) + c_2(Ed_{WH}) + f(\text{other variables}) + u$, where C = fertility rate; Ed_{HN} = proportion of males who never attended school; Ed_{HH} = proportion of males who completed approximately 10 or more years of schooling; Ed_{WN} = the same as Ed_{HN}, for females; Ed_{WH} = the same as Ed_{HH}, for females; other variables = other standardizing variables discussed in the text; and u = disturbance term. Since time-series data on education and other variables are lacking for Japan, as for many other countries, the regression analysis was restricted to cross-section data. Regressions reported in table 8 use the average number of children ever born for selected age groups of women (completed fertility) as the dependent variable; in regressions in table 9 the live birth rate is the dependent variable. The Japanese census presents the distribution of educational attainment in four categories—none, elementary, middle, and high. Instead of estimating a single measure of educational attainment, such as the mean or median, I used two categories of the education variable for each parent. One advantage in using these measures is that the coefficients, that is, b_1 and b_2 for the husband and c_1 and c_2 for the wife, may reveal differential effects on fertility of a shift in the education distribution between the lower and the upper segments of the distribution. The expected signs of the regression coefficients according to the hypotheses discussed earlier are shown below:

Tastes and Cost of Fertility Control*		Cost of Time†	
$b_1 > 0$	$b_2 < 0$	$b_1 \leq 0$	$b_2 \geq 0$
$c_1 > 0$	$c_2 < 0$	$c_1 > 0$	$c_2 < 0$

* A weaker version of the above: $-b_1 + b_2 < 0$ and $-c_1 + c_2 < 0$.
† A weaker version of the above: $-b_1 + b_2 \geq 0$ and $-c_1 + c_2 < 0$.

Regressions of Completed Fertility

For the regressions of completed fertility reported in table 8, each observation was weighted by the square root of the number of age-specific ever-married women in each prefecture. In addition to the education variables, standardizing variables included in these regressions are the percentage of persons, age 15 and older, employed in agriculture, forestry, and fisheries, and the percentage of the population living in urban areas. These variables refer to 1960 and therefore do not reflect accurately the background in which the couples made fertility decisions. For these variables to have substantive meaning, one must assume that the majority of couples have lived in the prefecture they resided in in 1960 for most of their married lives and that the rankings of prefectures by these variables have not changed significantly over time. Unfortunately,

TABLE 8

REGRESSIONS OF COMPLETED FERTILITY, 46 PREFECTURES IN JAPAN: 1960 CENSUS (WEIGHTED REGRESSIONS)

REGRESSION NUMBER	AGE COHORT OF WIFE	% EMPLOYED		EDUCATION (MALE)		EDUCATION (FEMALE)		$\bar{R}^2$/S.E.
		Agriculture	Urban	None	High	None	High	
1	(40–49) (n = 46)	0.006	−0.010	−0.179	−0.011	0.191	0.019	.938
		(0.71)	(−1.30)	(−1.07)	(−0.52)	(1.87)	(0.21)	.297
		$F(2, 39)$ = 5.64*		$F(2, 39)$ = 0.64		$F(2, 39)$ = 2.05		
2	(50–59) (n = 46)	0.009	−0.009	−0.378*	0.006	0.213*	−0.099	.945
		(1.07)	(−1.16)	(−2.95)	(0.21)	(4.60)	(−0.84)	.325
		$F(2, 39)$ = 7.96*		$F(2, 39)$ = 5.03*		$F(2, 39)$ = 11.38*		
3	Pooled (n = 92)	0.006	−0.011	−0.307*	−0.001	0.209*	−0.043	.941
		(1.16)	(−2.01)	(−3.17)	(−0.06)	(5.25)	(−0.62)	.608
		$F(2, 84)$ = 14.18*		$F(2, 84)$ = 5.18*		$F(2, 84)$ = 14.19*		
4	Pooled	0.004	−0.012	−0.311*	−0.004	0.201*	−0.038	.942
		(0.51)	(−1.62)	(−3.15)	(−0.22)	(4.85)	(−0.55)	.612
		0.009	−0.010					
		(1.16)	(−1.17)					
		$F(4, 82)$ = 7.28*		$F(2, 82)$ = 5.03*		$F(2, 82)$ = 12.12*		

SOURCE.—Japan Prime Minister's Office (1960*b*, various volumes.)

NOTE.—Student's t-values are in parentheses. Intercepts are not reported. Regression 3 allows only the intercept to vary between the two cohorts, while 4 allows the regression coefficients of "agriculture" and "urban" as well as the intercept to vary between the two cohorts. The dependent variable (average number of children ever born) and the education variables are age-specific.

* Significant at 1%.

TABLE 9
REGRESSIONS OF LIVE BIRTHS PER 1,000 MARRIED WOMEN, AGES 15+
(46 PREFECTURES IN JAPAN: 1960 CENSUS)

REGRESSION NUMBER	AGE COMPOSITION	% EMPLOYED		EDUCATION (MALE)		EDUCATION (FEMALE)		LOG OF MONTHLY EARNINGS		LABOR-FORCE PARTICIPATION RATE		$\bar{R}^2$/S.E.
		Agriculture	Urban	None	High	None	High	Male	Female	Male	Female	
1	2.765**	0.189	−0.184	0.647	1.729	3.279*	−6.322	...	...	...	...	0.739
	(8.34)	(1.35)	(−1.29)	(0.17)	(1.27)	(2.34)	(−1.67)					5.411
		$F(2, 38)$ =	3.29*	$F(2, 38)$ =	0.83	$F(2, 38)$ =	4.30*					
2	2.339**	0.148	−0.039	−5.287	−0.565	5.008**	−0.659	13.422	−9.624**	...	...	0.790
	(6.78)	(1.04)	(−0.27)	(−1.31)	(−0.38)	(3.26)	(−0.16)	(1.28)	(−2.74)			4.981
		$F(2, 36)$ =	0.82	$F(2, 36)$ =	0.84	$F(2, 36)$ =	6.05**					
3	2.618**	0.262	−0.138	−0.855	1.518	3.743*	−6.111	...	...	−0.063	−0.189	0.744
	(6.12)	(1.35)	(−0.88)	(−0.20)	(1.03)	(2.35)	(−1.58)			(−0.07)	(−1.90)	5.502
		$F(2, 36)$ =	2.33	$F(2, 36)$ =	0.57	$F(2, 36)$ =	4.51*					
4	2.325**	0.158	0.021	−7.208	−1.131	5.430**	−0.263	13.799	−10.045**	−0.635	−0.062	0.797
	(5.74)	(0.87)	(0.14)	(−1.59)	(−0.69)	(3.33)	(−0.06)	(1.23)	(−2.87)	(−0.72)	(−0.54)	5.043
		$F(2, 34)$ =	0.40	$F(2, 34)$ =	1.30	$F(2, 34)$ =	6.20**					

SOURCES.—Earnings: Japan Prime Minister's Office (1960*a*). Other variables: Japan Prime Minister's Office (1960*b*, various volumes).
NOTE.—Student's *t*-values are in parentheses. Age-composition variable is birth-rate-constant age distribution of women calculated by

$$\sum_{i=1}^{9} B_i W_{ij},$$

where B_i is the birth rate in the *i*th age class for all women in Japan, W_{ij} is the proportion of women in the *i*th age class in the *j*th prefecture (i = 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55+). Monthly earnings are average monthly contract wages and salaries for household head (male) and average monthly contract wages and salaries for wife and other household members (female) in 1959; each is deflated by a regional price index. Labor-force participation rates are percentages of populations ages 15+ in the labor force in 1960.

*$p < .05$.
**$p < .01$.

neither income nor earnings is held constant in these regressions for lack of data pertaining to these age groups.

Regressions 1 and 2 were run for married women, ages 40–49 and 50–59, respectively. No coefficient in regression 1 is significant. The ambiguous result obtained for this cohort may be partly because the majority of these women were married during World War II times. Uncertainty about the future and participation by males in war activities may have distorted family-size decision making. The sizes of the regression coefficients for the education variables satisfy the weaker prediction of the cost-of-time hypothesis, however. For regression 2, the results are less ambiguous. Judging from the t-values, both Ed_{HN} and Ed_{WN} are significant at the 1 percent level, and the F-values for the education variables indicate that both the husband's and the wife's education are statistically significant at better than 1 percent. Both husband's and wife's education obtain regression coefficients that are largely consistent with the cost-of-time hypothesis.

To determine if the fertility relationships for the two groups of married women were different, I tested three null hypotheses using Chow's (1960) test for equality of two regressions. The three null hypotheses were that (1) the two relationships are completely the same; (2) the two relationships are the same except for the intercept; and (3) the two relationships are the same only with respect to the education variables. The first null hypothesis was rejected ($F_{7,78} = 10.93$), but the latter two were accepted. Based on these findings, I pooled the observations for the two groups and obtained regressions 3 and 4. Regression 3 assumes that only the intercept differs, while regression 4 assumes that everything except the education coefficients differs between the two groups. The results for pooled regressions 3 and 4 are quite similar. Both husband's and wife's education are statistically significant at better than 1 percent, with regression coefficients as expected from the cost-of-time hypothesis.

The results of these regressions clearly support the economic framework based on the cost-of-time hypothesis. According to the coefficients of the pooled regressions, male education variables higher by one standard deviation unit, holding female education constant, are associated with higher fertility by about 0.13 children. Holding male education constant, female education variables higher by one standard deviation are associated with about 0.30 fewer children. However, the relationship between education and fertility is apparently nonlinear. The distribution of either parent's educational attainment has a greater effect on average completed fertility when it shifts from no education to some education than when it shifts from some to high education.[18] While influences of

[18] Ben-Porath (1973) reported a similar finding for Israel. In particular, the sharpest decline in fertility was observed between women with no education and women with some education.

education on fertility through tastes and the cost of fertility control are undoubtedly present, the dominant influences appear to be through income and prices.

These regressions refer to families which made fertility decisions before and during World War II. One would expect the decision-making process to have been more male-dominated in these than in postwar years. Yet female education is one of the most important variables in these regressions, a finding which strongly supports the relevance of the economic analysis of fertility. For this paper, regressions of completed fertility could not be run for families making fertility decisions during the postwar years, since the 1970 census was not available for all prefectures. As an alternative, I now turn to regressions of live birth rates in 1960.

Regressions of Live-Birth Rates

Multiple regressions of the number of live births in 1960 per thousand married women, age 15 or older, are reported in table 9. In addition to the percentage employed in agriculture and the percentage living in urban areas, these regressions hold constant the age composition of women and, in some cases, wage rates and labor-force participation rates. The age-composition variable is a weighted average of age-specific birth rates for Japan, the weights being the percentage of women in each age class in each prefecture. The percentage distributions of all women rather than of only married women were used because the latter may reflect endogenous decisions about the timing and duration of marriage. Both the female wage rate and the female labor-force participation rate are expected to affect fertility negatively. The male wage rate and the male labor-force participation rate would capture income effects and are expected, therefore, to obtain positive regression coefficients.

The results for the birth-rate regressions are largely consistent with the predictions of the cost-of-time hypothesis. An increase in male education, holding constant female education, increases, and an increase in female education, holding constant male education, decreases the birth rate. Female education is always more significant than male education. Female education tends to remain statistically significant with negative effects on fertility even after the female wage rate and labor-force participation rate, either separately or together, are introduced in the regressions. As expected, the female wage rate obtains negative and significant regression coefficients. The male wage rate obtains coefficients that are insignificant, though with expected signs. Neither the agricultural employment nor the urbanization variable has significant coefficients, perhaps because urban-rural differences in birth rates had largely disappeared by 1960 (see table 1).

Adding wage-rate variables to the regressions greatly reduces the effect of female education on the birth rate. Without the wage-rate variables in regressions 1 and 3, a uniform percentage shift upward in the female education distribution reduces the birth rate by about 10, for example, $-3.279 - 6.322 = -9.6$ for regression 1, but the magnitude drops to about five when the wage-rate variables are introduced in regressions 2 and 4. This finding is not surprising since the cost-of-time effects are likely to be captured jointly by female education and wage rates. The female wage rate also reduces the magnitude and significance of the female labor-force participation rate, as expected if decisions about fertility and labor supply are made simultaneously on the basis of the wage rate.[19] The nonlinearity usually observed in the effects of female education is observed only when wage rates are held constant. Otherwise, the results are ambiguous: the deterrent effect of female education appears greater when education increases from some to high than from none to some schooling, though the regression coefficients for "high" are never statistically significant.

These regressions suggest that area differences in the birth rate reflect differences in the female variables more than in the male variables. For example, according to regression 2, increasing all the male variables by one standard deviation unit, holding constant other variables, increases births per thousand married women by about three, but similar increases in female variables decrease the birth rate by 10. Calculations for regression 4 show the effect of male variables to be $+1.2$ and the effect of female variables to be -10.9.

V. Summary and Agenda

Increased access to abortions in Japan undoubtedly contributed to the post–World War II acceleration of that country's decline in fertility. But I conclude that fertility would still have declined at a more rapid rate than in the prewar period, which had been characterized by a mild and rather monotonic decline, if abortion had not been legalized. Therefore,

[19] A rise in the female wage rate, other things being equal, increases the attractiveness of labor-force participation relative to home production, including child rearing. Therefore, increased female wage rates not only directly reduce fertility demand but also increase labor-force participation, which in turn indirectly reduces fertility still more. Moreover, the direction of causation may also run from higher birth rates in an area to lower female labor-force participation there. To allow for such simultaneity, regressions 3 and 4 were also estimated by two-stage least squares, treating female labor-force participation as endogenous. However, these estimates did not substantially differ from the ordinary least-squares estimates. The labor-force participation regressions seem to have been plagued by multicollinearity. Although the regressions were statistically significant, judging by the F-values, with coefficients of determination above 0.70, they did not successfully disentangle the effects of the exogenous variables.

dissemination of contraceptive information and/or an accelerated decline in the demand for fertility must also have contributed to the trend.

Cross-section analyses of 1960 data reveal that the economic theory of fertility, with its emphasis on the effects of female education and earning power on fertility demand, provides a useful framework for analyzing fertility differentials in Japan. In particular, regressions of completed fertility and live birth rates in 1960 show that female education and earnings affect fertility negatively and are the most significant variables in the regressions. Male education and earnings tend to have positive but less significant effects. On the basis of only sociological, demographic, or taste considerations, one would not necessarily expect to find female education more important than male education in explaining fertility differentials. Indeed, in Japan, because of the male's generally dominant role in household decisions, one would have expected to find male education to be at least as relevant as female education, if not more so, in explaining fertility differences.

How useful are these results in interpreting the fertility trends in Japan? A tentative answer can be obtained from the regressions in table 9. Assuming that the parameter estimates remain stable over time and using the observed magnitudes of change between 1950 and 1960 for all the explanatory variables except for the age-composition variable, my results predict the decline of births per thousand married women to be only 4 percent at the mean according to regression 2, and 3 percent according to regression 4. The actual decline between 1950 and 1960 was about 42 percent, of which one would hope to explain about half if legalization of abortion explains another half. For the period 1960–70, both regressions predict a decline, while in fact births per thousand married women increased somewhat. On the basis of these results, one may be inclined to doubt the usefulness of cross-section regressions in interpreting the trend.[20]

However, since the regression models and the economic hypotheses underlying them pertain to long-run adjustments, one would expect from these regressions better predictions of longer-term changes in fertility. It is possible that the sharp decline of fertility during the 1950s and the subsequent leveling off in the 1960s represent swings around a longer-term trend that has persisted since 1920.[21] If so, a more appropriate comparison of actual and predicted declines might be made between 1950 and 1970. The predicted decline for this period was 19 percent according to regression 2 and 15 percent according to regression 4. The actual decline was about 30 percent. These regressions appear, therefore, to be more helpful in providing an interpretation of the longer-term fertility

[20] T. Paul Schultz (1973) discusses problems in the interpretation of time series from cross-section estimates of parameters. Here I ignore the kinds of problems he raised.

[21] A similar observation is made by Okazaki (1970, p. 26).

TABLE 10
A COMPARISON OF TRENDS IN FERTILITY AND ECONOMIC VARIABLES: 1950–69
(JAPAN AND UNITED STATES)

				RATES OF CHANGE		
	1950	1960	1969	1950–60 (%)	1960–69 (%)	1950–69 (%)
Crude birth rate:						
Japan	28.1	17.2	17.9*	−38.8	4.1	−36.3
U.S. (white)	23.5†	23.2‡	16.6	−1.3	−28.5	−29.4
Total fertility rate:						
Japan	3.63	1.99	2.10§	−45.2	1.05	−44.6
U.S. (white)	3.05†	3.56‡	2.37‖	16.7	−33.4	−22.3
Real GNP per capita: (1950=100)						
Japan	100	247.4	529.3	147.4	114.0	429.3
U.S.	100	115.2	152.7	15.2	32.5	52.7
Real wage (1950=100):						
Japan	100	170.2	253.9	70.2	49.2	153.9
U.S.	100	136.2	177.3	36.2	30.2	77.3
Percentage employed in agriculture:						
Japan	48.7	30.0	17.8	−38.4	−40.7	−63.4
U.S.	12.1	8.3	4.6	−31.4	−44.6	−62.0
Percentage female in non-agricultural employment:						
Japan	29.0	35.1	36.6	21.0	4.3	26.2
U.S.	31.3	34.6	38.3	10.5	10.7	22.4

SOURCES.—U.S. data: U.S. Bureau of the Census, *Statistical Abstract of the United States* (various issues) and U.S. Department of Health, Education, and Welfare (1968*a*); Japanese data: Japan Prime Minister's Office, *Statistical Yearbook of Japan* (various annual issues) and Mainichi Newspaper Company (1970).

* Average between 1965 and 1970.
† Average between 1949 and 1951.
‡ Average between 1957 and 1960.
§ Average between 1965 and 1968.
‖ For 1968.

decline in terms of price and income variables, but they are not likely to facilitate understanding of the shorter-term movements by which the decline may actually occur.

In table 10 some of the salient features of the United States and Japanese experiences during the postwar years are compared. If the economic framework for fertility analysis has general validity, it would predict more rapid fertility changes for countries experiencing more rapid changes in their economies. Clearly, both the economic variables examined and fertility rates changed more rapidly in Japan than in the United States during 1950–69. A similar point is observed if one confines the comparison to the periods in which fertility declined: 1950–60 for Japan and 1960–69 for the United States.

Much more work is needed before we fully understand the reasons for the possible acceleration in the decline of fertility demand in Japan in the 1950s and the leveling off in the 1960s. A promising area for investigation is the interaction of the demands for quality and quantity of children in Japan. There may have been an accelerated substitution of quality for quantity during the postwar years because of income effects.

Also, the prospect of future economic growth may have raised the expected return to education and rising family income increasingly facilitated the financing of children's education beyond the level required by law. It is noteworthy that the enrollment rate in kindergarten (which is not compulsory) increased more sharply between 1950 and 1960 (by 95 percent per 5 years) than between 1960 and 1965 (by 58 percent). Also, the enrollment rate in senior high school (not compulsory) rose more rapidly between 1950 and 1960 (by 26 percent per 5 years) than between 1960 and 1965 (by 20 percent). The model may also be extended to include such interrelated aspects of behavior as marriage and female labor-force participation. Such a model may be estimated using more disaggregated data, say by age, than I use here. The rapid decline in Japanese fertility from 1950 to 1960 coincided with an increase in the labor-force participation of females and a decrease in the proportion of married women among women of childbearing age. For example, among females, ages 20 to 39, living in urban areas, the labor-force participation rate increased from 38 percent in 1950 to 43 percent in 1960, and the proportion ever married decreased from 75 to 70 percent. The most dramatic changes occurred for females, ages 20 to 24, among whom the proportion ever married dropped from 43 percent in 1950 to 31 percent in 1960 but showed no appreciable change in the 1960s. The pace of all these developments appears synchronous with the fertility history of postwar Japan, and possible relationships among them deserve rigorous analysis.

Finally, it would greatly enhance the scope and accuracy of analysis to have micro, or household, data for Japan on such related characteristics as fertility; wage rates and family wealth, age, and work experience; parents' and children's education; and contraceptive use. Ideally, such data would be collected longitudinally for a given set of families and made available to interested researchers in raw rather than summarized form.

Comment

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At a conference of distinguished specialists on human capital theory my comparative (absolute?) advantage is in the study of the Japanese economy. Much the same can be said for Hashimoto's paper. No attempts at any significant new departures in human capital theory or in the testing of such theory are made in this paper. Rather, one finds here an extension of a now-familiar approach to Japanese data with now-familiar results.[1] This is a study that can stand alongside the Israel and Taiwan studies by Ben-Porath (1973) and T. Paul Schultz (1973), respectively. Hashimoto's paper is another line, and an admirably executed line at that, in T. Paul Schultz's table A1 (1973).

Hashimoto's ultimate concern is in explaining the acceleration in the 1950s of the long-term decline in Japanese fertility and the subsequent bottoming out of this decline in the 1960s. The achievements of this particular paper are more modest. An attempt is made to challenge what Hashimoto finds is a simplistic overemphasis on the diffusion of abortion and contraceptive practice after 1948 (i.e., a downward shift in the supply of birth-control schedules). As an alternative, Hashimoto stresses outward shifts of the demand schedule for birth control resulting from the increasing cost of female time in postwar Japan.[2]

[1] Hashimoto states that, previous to this paper, there had been but one other economic study of fertility in Japan. This is a bit unfair. Only if the literature is restricted to that in English and one assumes the economic study of fertility starts with Becker is this statement true. Unlike the United States, in Japan throughout the twentieth century demographic study remained within the province of economists. For a sample of Japanese work, see Tachi and Arao (1935) and Tachi (1946).

[2] My reading of the Japanese literature suggests that most Japanese demographers would applaud Hashimoto's stress on changes in both the demand and supply schedules. Some Japanese demographers do appear to part company with Hashimoto when it comes to a discussion of the determinants of the demand-schedule shifts. There is a Japanese emphasis on the role of wealth. Relative to the period prior to World War II, Japan of the early 1950s is seen as a poor country.

I am much in sympathy with Hashimoto's hypotheses. There is considerable evidence to suggest that control of fertility within marriage was widespread long before 1948, and I do find stress on the cost of female time provocative.[3] At the same time, I do not think Hashimoto's various analyses are altogether persuasive. For example, if instead of using maximum crude birth rates and maximum general-fertility rates, maximum total-fertility rates for 1950 and 1960 are calculated, it appears that the practice of abortion might very well have tripled the rate of fertility decline.[4] The decline in the estimated maximum total-fertility rate between 1950 and 1960 is 16.8 percent. This is only a modest acceleration of the 12.6 percent rate of decline exhibited in the actual fertility rates between 1930 and 1940. An acceleration of this magnitude might easily be explained by the diffusion of modern contraceptive techniques during the 1950s. This mild acceleration might also be viewed as a reaction to the much higher-than-trend total-fertility rates between 1940 and 1950. Thus, it would appear that if Hashimoto wishes to stress the role of demand factors in the acceleration of Japanese fertility decline, he more than likely cannot avoid an inquiry into the extent to which legal abortions were substitutes for older forms of birth control.

Regardless of the magnitude of the acceleration remaining to be explained by some factor other than the legalization of abortion, I am not satisfied with Hashimoto's analysis of the spread of contraception. That the share of abortions in total births is high and rising in the rural regions of Japan in the presence of a sharply declining pregnancy rate can be taken as evidence that the spread of contraception is not sufficient to explain fertility changes unexplained by the legalization of abortion only if (1) abortion as a technique of birth control is already completely diffused, and (2) abortion is viewed as a technique of last resort.[5]

I doubt either of the above conditions held for Japan during the 1950s. Abortion diffused throughout Japan in much the same manner and only slightly in advance of modern contraception. At any point during that decade, for any age cohort, the better educated a couple and the larger the city in which a couple lived, the higher the probability they had experienced an abortion. Among couples who had never practiced contraception, the probability of an abortion experience was relatively low. Significantly, high rates of abortion were found among couples who had practiced contraception and for one reason or another discontinued

[3] For a discussion of the history of birth control in Japan, see Honjo (1941).

[4] The maximum total fertility rates in 1950 and 1960 are 4.16 and 3.46. I have calculated these rates with data taken from Japan Ministry of Health and Welfare (1967) and Aoki (1967).

[5] The industrial-rural dichotomy presented in Hashimoto's table 4 is based on a comparison of six urban prefectures with five rural ones. As an alternative, the share of induced abortions among pregnancies of Japanese women not living in cities of 50,000 or more (the rate typically regarded as the rural rate) can be examined. This rate rose throughout the 1950s, reaching a peak in 1961 (see Aoki [1967, p. 44]).

this practice.[6] I would conclude that abortion was not necessarily a birth-control technique of last resort and that the rising share of abortions in total pregnancies in rural areas during the 1950s might very well reflect a positive reaction to the diffusion of a new technique.[7]

While Hashimoto does not make manifest the need for a new demand variable to explain the movement of postwar Japanese fertility, the final section of his paper does stand on its own as a test of competing hypotheses in explaining regional differentials. The results reported in tables 8 and 9 tend to support Hashimoto's de-emphasis of the role of the cost of fertility control. In both sets of regressions, I have a particular problem with the education variables Hashimoto chooses to use as explanatory variables. The male education variables in the completed-fertility regressions are based on the assumption that Japanese women are marrying Japanese men of the same age. Actually, Japanese women of the age cohorts in question were marrying men who were, on the average, 4 to 5 years older than themselves.[8] The peculiarities of the Japanese enforcement of their compulsory-education legislation make it a matter of some importance whether a male reached school age before 1900 (as a substantial proportion of the husbands of the women in these cohorts did) or after 1905. There was considerable variability among prefectures in the degree of male compliance with the compulsory education laws before 1900. After 1905, compliance was almost complete among the prefectures.[9] The degree of compliance across prefectures is only weakly correlated between the two periods. Interestingly enough, noncompliance for males in the earlier period is rather strongly correlated with noncompliance for females in the later period.[10] It follows that if one is a believer in the cost-of-fertility hypothesis (and only if one is a believer in the cost-of-fertility hypothesis), it is possible to argue that the errors in the male education variable are imparting a positive bias to the estimate of the

[6] The surveys on which the above analysis is based were conducted and periodically published by the Mainichi Newspaper Company (1950); see also Taeuber (1958, p. 282).

[7] There is every reason to believe that the spread of contraceptive methods in rural Japan was rapid in the late 1950s. The aforementioned Mainichi surveys indicate a better-than-25-percent increase in contraceptive practice between 1955 and 1959. These same years saw family-planning expenditures by Koseisho (Ministry of Health and Welfare) at their real height. Also, survey evidence analyzed by Aoki (1967, p. 57) suggests that increases in contraceptive efficiency were also greatest during this period.

[8] Summary statistics on the average age at first marriage, by sexes, are available in the annual reports, *Descriptive Materials on Japanese Vital Statistics*, published by the Japan Prime Minister's Office (1917*f*).

[9] In 1900, the percentage of the male school-age population attending primary school or otherwise complying with the compulsory-education laws ranged across prefectures from 79.1 to 97.5 percent. By 1905 the degree of compliance varied from 94.7 to 99.5 percent. These statistics are from annual reports published by Japan Ministry of Education (1904*f*).

[10] Using the 1960 census data, the simple correlation coefficient between the prefectural pattern of males with no education, age cohorts 50–59 and 60–69, is .39. The simple correlation coefficient between the prefectural pattern of males with no education in the age cohort 60–69 and females with no education in the age cohort 50–59 is .83.

coefficient of the no-education variable for females and a negative bias to the estimate of the coefficient of the no-education variable for males. These biases could be quite substantial and might account for Hashimoto's interesting results.

Unlike the completed-fertility regressions, Hashimoto's regressions reported in table 9 deal entirely with postwar reproductive activities and specifically with 1960 live births. The education variables in these regressions refer to the entire (over age 15) prefectural population. Unfortunately, virtually the entire interprefectural variation in the proportion in the no-education variables relates to the experience of age cohorts that in 1960 were well beyond their reproductive years! I do not doubt that, inspired by Leibowitz's paper in this volume, work can be done on how a mother's education affects a daughter's fertility, but this is not the hypothesis in question.[11]

Also with respect to these same regressions, I am a bit puzzled by the use of the logarithm of earnings rather than arithmetic earnings. I suspect one gets a higher *t*-statistic on female wages when this form is used, but when using what should be thought of as grouped data, I am unsure of the theoretical justification.

In concluding my remarks, I would like to offer a suggestion for future research. Notwithstanding Hashimoto's very useful analysis, I do not find the postwar period to be the most interesting stretch of Japanese demographic history. While there are many instances of fertility decline in the context of rapid economic growth, the experience of Japan between 1875 and 1920 appears to be unique. There was rapid economic growth starting from a relatively high income base, a declining agricultural labor force, a revolution in female education coexisting with a high and, as recent research indicates, very likely a rising level of fertility.[12] Further, in view of the Japanese experience after 1920, I

[11] Nationwide, 82 percent of men with no education and 96 percent of women with no education came from the age groups 50 and older and 40 and older, respectively. The simple correlation by prefecture for never-educated men above age 50 and younger than age 50 is .25. The simple correlation by prefecture for never-educated women above and below age 40 is .21.

[12] The official statistics collected for Japan suggest rising fertility throughout most of this period. These statistics have been traditionally treated with considerable skepticism on account of underreporting in the earliest periods. Taeuber, in analyzing these statistics, suggests that fertility probably rose substantially during the first part of this period and subsequently declined slowly (see Taeuber [1958, pp. 52–54]). Estimates which allow for the traditional criticisms of the official statistics have been prepared by Okazaki (1965). Okazaki estimates that the Japanese population in 1875 was almost 2 million above the official statistics. More recently, Akasaka Keiko has provided another series of alternative estimates. Somewhat surprisingly, in view of the earlier criticisms, she finds that the official statistics overestimate population by 600,000 in 1875 and understate the rate of population growth at least through 1910. For Akasaka's estimates, see Hitotsubashi University Institute of Economic Research (1968). For an informative discussion of the alternative estimates, see Umemura (1969).

would submit that this episode constitutes a fascinating and important puzzle for those who would stress the role of economic factors in general, and the cost of time, in particular, in the explanation of fertility history.