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THE ORGINS OF THE FERTILITY TRANSITION IN RURAL JAPAN

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Résumé — Dans cette étude on se préoccupe surtout d'expliquer comment la fécondité maritale et la fécondité en transition ont débuté au Japon. Fondant l'approche sur un modèle économique-démographique du comportement du ménage paysan sujet aux règles institutionelles d'un système de famille souche patriarchale on développe une discussion théorique sur le début de la transition en fécondité du Japon. En suite, on montre que les données pour les régions rurales du Japon durant la période 1925-1938 tendent à appuyer la formule qu'on a développée. Ce travail implique aussi l'étude générale des facteurs de natalité des populations agrairiennes car il s'adresse aux questions concernant des modèles théoriques aussi bien qu'aux points historiques et empiriques.

Abstract — The concern in this paper is with explaining how the decline in marital fertility, the fertility transition, commenced in Japan. Basing the approach on an economic-demographic model of peasant household behaviour subject to the institutional rules of a patriarchal stem family system, a theoretical argument about the beginning of the fertility transition in Japan is developed. Then it is shown that the data for the rural districts of Japan during the period 1925-1938 tends to lend support to the framework. The work has implications for the general study of the determinants of natality in agrarian populations since it speaks to questions concerning theoretical models as well as to historical and empirical issues.

Keywords — **fertility, peasantry, education, Japan**

Introduction

The shift from a regime of natural fertility to parity specific control is probably the most discontinuous and striking transformation in demographic history. By definition, in a regime of natural fertility couples do not modify their reproductive behaviour after a birth, regardless of its parity (cf. Henry, (1961) for the original definitions of natural fertility and parity specific control). In contrast, when a couple practices parity specific control, it changes its behaviour (usually by ceasing to have additional births altogether) after the birth of a child of specific parity, say the second or third birth. The switch from the natural fertility regime to that of parity specific control is clearly a move from one family building *strategy* to another. And because levels of natural fertility vary tremendously, this innovation in strategy may be more salient than the decline in levels of marital fertility associated with it. For instance, if natural fertility in a population is fairly low, calculated values of marital fertility may be moderate; and as the population adopts the parity specific control strategy the magnitude of the decrease in marital fertility may be fairly small (since fertility levels are initially modest to begin with).

The implications of this change in strategy, which defines the fertility transition, for theories of fertility and the demographic transition are of great importance. Consider the typical model of fertility which analyzes births in terms of desired surviving family size. What are we to make of this when natural fertility prevails? The fact that couples do not stop giving birth to offspring suggests that either: (1) they do not have a target surviving family size; or (2) they desire surviving family sizes at least as large as those they secure with natural fertility. The first position is consistent with numerous variants, the most noted of which is that in a regime of natural fertility couples are not rational in their reproductive behaviour.[1] Proponents of this view typically point to the expansion of education as one of the changes which are sufficient — although not necessary — for producing a transition from a natural fertility regime to one characterized by parity specific control.[2] But while there is much to recommend this interpretation, the historical evidence does not lend strong support. The first populations to have adopted parity specific control on a national level appear to be the French and Hungarian. One is struck by the possibility that virtually illiterate peasants may have been at the forefront of the fertility transition. The second major position noted above has been taken by Richard Easterlin (1978), who has devised a model in which levels of natural fertility and infant mortality act as supply constraints, and resulting levels of fertility are determined jointly by supply and demand factors. Easterlin argues that infant mortality and natural fertility are shaped by environmental factors — health, standards of nutrition and the like — and that in many premodern societies desired surviving family size exceeds the number who are born and survive in a natural fertility regime. This is because natural fertility is low and infant mortality high due to poverty and malnutrition. Easterlin suggests that as economic development occurs, living standards improve, reducing infant mortality and enhancing natural fertility. Eventually the surviving number of children exceeds the desired number and couples begin to feel pressure to limit family size. As a result (providing the psychological costs of contraceptive behaviour are not overly excessive), parity specific control gradually gains acceptance and marital fertility drops. This thesis has gained widespread attention in the literature, and has influenced much work in demographic history (cf., *inter alia*, Knodel and van de Walle, 1979).

In an earlier paper I suggested that Easterlin's thesis might yield a plausible explanation for the pronounced rise and subsequent decline of marital fertility in Japan (cf. Mosk, 1979a). However, for reasons upon which I shall presently elabourate, I now find this hypothesis inadequate. In the next section I sketch out a life cycle model of fertility which starts from a different premise — that rational decisions about fertility are not formulated in terms of a target number of surviving children. I will show that the implications of this model for understanding the effects of a drop in infant mortality and an improvement in natural fertility are different from those in Easterlin's framework. Then I will proceed to analysis of a data set for interwar Japan, from which I will draw findings which are consistent with my model but not with Easterlin's. Finally, by way of conclusion, I will summarize my argument and suggest some implications for further research.

The Thesis[3]

The theory which I have developed in considerable detail elsewhere (cf. Mosk, 1979b, forthcoming) is applicable to most peasant populations which have a patriarchal stem family system (the relevant institutional rules governing the operation of this system are defined below). In particular I have found this approach especially useful in developing a model of fertility which explains the fertility transitions of Japan and Sweden. I briefly lay out the central features of my theory here.

The basic theory concerns the operation of a peasant household which controls a fixed amount of land, and arrives at its own decisions about production and consumption subject to: (i) institutional rules, (ii) exogenous constraints (e.g., the operation of external labour markets, and general level of health prevailing in the surrounding community).

Institutional Rules

The relevant institutional rules governing the patriarchal stem family system are twofold: (a) Labour tasks are differentiated on the basis of sex; (b) One son inherits the land when the patriarch, the household head, dies or retires; the surviving parent(s) continue to reside with the heir but the other children leave.

Decision-Making

Decision-making in the household is characterized as follows: (a) The patriarch makes decisions for the household subject to bargaining with household members. The patriarch's principal motivations in decision-making are his own welfare and continuation of the family line on the land. (b) The patriarch has leverage over his children: specifically he arranges jobs and/or marriages for them, and he grants them bequests. Because the patriarch has leverage, he secures labour services from his offspring (i.e., he controls their labour services during a certain period of their lives). We may summarize and slightly amplify on these two points with the following simple schema:

Household Member	Motivation	Control Instruments	Constraints
Patriarch	Maximize his income and continue family.	Bequests and dowries; arrangements of marriages and jobs.	Children can leave home.
Son	Maximize son's income and marry young enough to continue his family.	Working for or denying work effort to patriarch.	Alternative forms of employment available to son.
Daughter	Maximize her income by marrying a male with earning power and ensuring her old-age security by marrying at a sufficiently young age.	Working for or denying work effort to patriarch.	Alternative forms of employment available to daughter.

With these assumptions about decision-making subject to the institutional rules elaborated above we can derive some simple and useful properties of household behaviour.

Economic-Demographic Adjustment

The adjustment mechanisms described both concern demographic variables adjusting to a combination of economic and demographic variables through a process of maximization. Specifically the patriarch has two demographic instruments which he exercises choice over: the length of interbirth intervals and the age of his wife when they marry. Variables which are exogenous to the household when the head goes about making his decisions are: the age at which he is able to marry; the general state of health of the community; the sex ratio of births; and the capacity to work as a function of age.

The model can now be formulated as a problem in constrained maximization. In order to maximize his own welfare and to perpetuate the family line the patriarch chooses optimal birth intervals and his bride's age at marriage so that there will always be a minimum total number of male workers on the land at all times (technically the total household capacity to produce a given amount of work at all times). This insures that the household does not fall below a critical minimum internal male labour supply. Subject to this constraint on internal labour supply under the patriarch's control the patriarch maximizes as follows: (a) The patriarch looks for three things in a bride: skills, a dowry, and her capacity to produce surviving children (a diminishing function of her age across the relevant ages at marriage). The older the bride the greater her skills and dowry (which she has accumulated or earned by working) but the lower her reproductive value. The patriarch maximizes the age of his bride (and thus maximizes her skills and dowry) subject to her providing sufficient reproductive value so that internal male labour supply is sufficiently large to meet the constraint on it; (b) Once married, the couple produces a steady flow of births without attempting to cease this process at some completed size (i.e.: it adopts a natural fertility strategy) because this insures a steady flow of children old enough to provide labour services and to provide substitutes for older children who might die or prove incompetent. The couple chooses the optimal birth interval (through postpartum abstinence and the length of time his wife breast-feeds the children) which maximizes the surviving number of children they produce in any given time period.

Two assumptions on the exogenous variables which constrain maximization deserve mention. First, a man marries relatively late, after inheriting or acquiring sufficient assets to found a new line. Secondly, the age schedule of mortality and morbidity depends on community health conditions: the worse is health, the higher risks of death. An important implication of the second point is that when conditions governing health are relatively poor (as in premodern Japan) the optimal level of natural fertility is relatively low and a man tends to marry a youthful bride with little dowry but sufficient reproductive value guaranteed through youth. When health conditions are relatively good (as in premodern Sweden) a man tends to wed an older bride with greater dowry since the optimal level of natural fertility is quite high.

This completes a brief overview of this simplified model of the household. Elsewhere (in Mosk, forthcoming) it is formalized in terms of a basic equation and this equation is utilized in deriving some analytical properties of the theory. Now we turn to the equilibrium properties of my theory for aggregate populations.

Equilibrium.

Health conditions are positively related to income and mortality is negatively related to income. Hence levels of natural fertility rise as income per head increases and nuptiality adjusts to this process, the age at marriage of females increasing with the rising trend in income.

Undermining Influences.

My theory emphasizes two structural changes in accounting for the disappearance of the household behaviour described by the model and of the associated aggregate demographic properties (including the end of the regime of natural fertility). These are: (a) The expansion of education which offers job certification independent of the patriarch; and (b) the growth of labour markets which offer alternatives to the children and diminish the patriarch's control. The result of the two types of structural shifts is that the costs of patriarch leverage rise and the benefits of leverage fall and this new balance of costs and benefits encourages parity specific control (i.e.: the ending of the practice of natural fertility).

With the general framework let us turn to the particular question of the fertility transition in Japan. My analysis of the Japanese materials suggests that the benefits and costs of leverage over children changed among all sectors of Japanese society in the period from about 1900 to the mid-1920s, although the relative shifts in the costs and benefits varied from group to group. Gradually within the groups whose members found themselves especially pressed by these new circumstances, certain households abandoned the natural fertility strategy, stopping reproduction at some parity and ceasing to have more than a relatively small number of children. Such a strategy under the old premodern circumstances would probably have ended in failure, the demise of the family line perhaps. But under the new circumstances this was no longer the outcome. By reducing the number of offspring the parents could educate each child to a higher level than without doing so. And this tended to facilitate their attaining decent employment in the industrial job market. Soon other families began to emulate this successful innovation; gradually diffusion via emulation to all segments of society who stood to benefit from switching categories occurred.

The critical point in analyzing the origins of the fertility transition concerns the following question. Which groups feel the pressure to reduce natality with greatest intensity? On the basis of my arguments the following points seem justified: (1) The leverage of patriarchs in higher status household is predicated on the ability to arrange relatively high status positions (or else the children will withold their labour services). Thus when education becomes a *sine qua non* for entry into these higher status positions, households of higher social status tend to be early adopters of parity specific control, because they feel the greatest pressures to educate their offspring. (2) Households in which income is substantial tend to be late adopters of the new strategy, because the gap between costs and benefits of higher parity children is fairly slight for them, measured relative to their resources (income and wealth). (3) Households in which the degree of child employability, the demand for labour services from children, is particularly great will tend to be late adopters of the new stategy.

The Evidence

I have assembled a data set for interwar Japan which naturally lends itself to an exploration of the theoretical issues sketched above. The figures are for the individual counties (gun) and cities (shi) of Japan in the years 1925, 1929, 1930, 1935, and 1938. There are over five hundred and fifty counties (gun) and about one hundred cities (shi) in these cross-sections, so the number of observations is quite large. As the reader can see by perusing the Appendix the figures are derived from various censuses and vital statistics, and they include industrial classification of the labour force, distribution of cultivated land by tenancy and crop type, birth and death figures and (for 1938) infant death data. For 1925 I was able to estimate the Hutterite indices and the Coale-Trussell index of parity specific control *(m)*.[4] This was especially fortunate since the Japanese fertility transition was just commencing in the 1920s (cf. Mosk, 1979a). Thus we are afforded an especially comprehensive look into the innovation of parity specific control in Japan. For the purpose of our discussion here I will concentrate my attention mainly on the rural districts (since the thrust of my thesis concerns the peasantry) with a brief glance at the figures for cities.

In Table 1 I present averages of various measures of fertility and mortality for the counties of Japan in the period 1925-1938, classifying the gun by the proportion of labour force in primary industry (PPI). Three points immediately force themselves on us. (1) First, in 1925, there is a clear break in the averages for m at about PPI = 40 per cent. For the groupings of gun with PPI $\geq$ 40 per cent m is not substantially different from zero. It should be emphasized that this statement only applies to averages and not individual cases. Indeed, among gun with PPI $\geq$ 40 per cent, twenty had $m \geq .6$, and one hundred and seven had $m \geq .3$. (2) There is only very limited variation in female nuptiality (the Hutterite nuptiality index, I_m and, the singulate mean age at marriage, SMAMF) with respect to dependence on agriculture (PPI) (cf. Hajnal [1953] for the definition of the singulate mean age at marriage). (3) There is a sustained decline in fertility and mortality in all groups of gun between 1925 and 1935. By 1938, infant mortality is quite moderate in all groups of gun. Prefectural data for the period 1908-1925 suggests infant mortality was declining substantially in the early twentieth century from initially fairly high levels (cf. Mosk, 1981 and Table 4 below).

It would seem safe to conclude that the situation in 1925 was representative of the beginnings of the modern (Neo-Malthusian) fertility transition, a decline which was sustained. Under

TABLE 1. AVERAGES OF VARIOUS DEMOGRAPHIC RATES[a.] FOR GROUPS OF THE COUNTIES (GUN) OF JAPAN, CLASSIFIED BY PERCENTAGE OCCUPIED LABOUR FORCE IN PRIMARY INDUSTRY (PPI), 1925-1938

PPI Group	1925							1930		1935[c.]		1938[c.]
	Hutterite Indices			Singulate Mean Age of Marriage/ females	Coale-Trussell Index of Parity Specific Control	Crude Rates		Crude Rates		Crude Rates		Infant Mortality Rate
	Average Fertility (I_f)	Marital Fertility (I_g)	Nuptiality (I_m)	(SMAMF)	(m)	Birth Rate (CBR)	Death Rate (CDR)	Birth Rate (CBR)	Death Rate (CDR)	Birth Rate (CBR)	Death Rate (CDR)	(IMR)
PPI ≥ 80%	.489 (.053)	.623 (.064)	.753 (.050)	20.01 (1.18)	.009 (.210)	38.88 (4.56)	21.74 (2.94)	37.18 (4.18)	20.08 (2.17)	37.01 (3.47)	18.41 (1.85)	117.7 (23.7)
70% ≤ PPI < 80%	.461 (.050)	.596 (.066)	.740 (.047)	20.39 (1.15)	.122 (.234)	37.19 (3.95)	21.23 (2.47)	35.18 (4.07)	19.61 (2.28)	34.91 (3.57)	18.30 (1.86)	122.1 (25.8)
60% ≤ PPI < 70%	.448 (.046)	.596 (.065)	.718 (.049)	20.82 (1.14)	.092 (.262)	36.68 (3.36)	20.79 (2.34)	34.41 (3.24)	19.00 (2.21)	33.82 (3.06)	17.99 (2.17)	119.6 (23.8)
50% ≤ PPI < 60%	.423 (.046)	.580 (.068)	.697 (.049)	21.10 (1.03)	.155 (.276)	35.41 (3.40)	20.76 (2.13)	33.09 (2.97)	19.12 (2.11)	32.73 (2.98)	17.94 (1.87)	126.7 (22.1)
40% ≤ PPI < 50%	.404 (.042)	.566 (.070)	.679 (.049)	21.48 (.95)	.144 (.307)	34.75 (2.72)	20.55 (2.23)	31.70 (2.42)	18.31 (2.10)	30.77 (2.97)	17.20 (1.83)	124.0 (24.0)
30% ≤ PPI < 40%	.370 (.061)	.502 (.058)	.694 (.066)	21.04 (.81)	.266 (.297)	33.22 (3.12)	19.98 (1.38)	30.54 (2.78)	17.93 (1.56)	28.86 (2.45)	16.47 (1.25)	116.9 (20.4)
20% ≤ PPI < 30%	.327 (.063)	.472 (.033)	.653 (.118)	21.56 (1.31)	.443 (.298)	30.77 (2.89)	19.37 (2.35)	27.88 (1.79)	17.54 (2.42)	30.28 (3.55)	16.15 (4.17)	155.9 (32.8)
10% ≤ PPI < 20%	.320 (.040)	.420 (.051)	.720 (.052)	20.63 (.87)	.588 (.134)	31.45 (4.20)	19.68 (2.40)	28.40 (2.84)	16.38 (2.42)	27.08 (4.09)	14.13 (2.95)	118.3 (35.2)
PPI < 10%	.326 (.013)	.443 (.009)	.697 (.032)	21.28 (.37)	.394 (.059)	34.30 (1.51)	18.13 (1.45)	30.63 (1.91)	14.60 (1.31)	n.a.	n.a.	n.a.

Note: (a.) Number in parenthesis below the average figure is the standard deviation.

(b.) 1930 cencus classification. Because of boundary changes and incorporation, the number of observations changes from year to year (e.g.: by 1935 the most "industrial" gun had become part of, or were separately incorporated as cities (shi).

(c.) n.a. = not available

this assumption we will proceed to explore variations in I_g and m in 1925, searching out groups for which I_g is usually small and m especially large as indicators of which segments of the population are innovators in the fertility decline.

I will begin this exploration with Table 2 which provides average levels of I_g and m for all the shi (cities), the assembled gun with PPI < .4, and the assembled gun with PPI ≥ .4 for each prefecture in Japan in 1925. (The data is for the forty six prefectures of Japan as of the 1950s and 1960s. Okinawa is not included).

TABLE 2. AVERAGES OF THE HUTTERITE INDEX OF MARITAL FERTILITY (I_g) AND THE COALE-TRUSSELL INDEX OF PARITY SPECIFIC CONTROL (m) FOR THE SHI (CITIES) AND GUN (COUNTIES) OF PREFECTURES OF JAPAN, WITH GUN SUBCLASSIFIED BY PPI STATUS

	I_g			m		
		Gun			Gun	
Prefecture	Shi	PPI<.4	PPI≥.4	Shi	PPI<.4	PPI≥.4
Hokkaidō	.51	n.a.	.61	.44	n.a.	.04
Aomori	.58	n.a.	.66	.50	n.a.	.18
Iwate	.54	n.a.	.60	.31	n.a.	.11
Miyagi	.54	n.a.	.66	.56	n.a.	.09
Akita	.54	n.a.	.62	.25	n.a.	-.08
Yamagata	.56	n.a.	.64	.53	n.a.	.25
Fukushima	.55	n.a.	.62	.47	n.a.	.21
Ibaraki	.43	n.a.	.60	1.07	n.a.	.21
Tochigi	.51	n.a.	.65	.66	n.a.	.05
Gumma	.50	n.a.	.66	.64	n.a.	-.00
Saitama	.58	n.a.	.65	.36	n.a.	.15
Chiba	.46	n.a.	.59	.86	n.a.	.23
Tokyo	.48	.45	.66	.16	.35	-.39
Kanagawa	.45	.58	.69	.44	-.16	-.41
Niigata	.55	n.a.	.65	.63	n.a.	.25
Toyama	.49	n.a.	.60	.97	n.a.	.35
Ishikawa	.43	n.a.	.60	1.03	n.a.	.16
Fukui	.45	n.a.	.58	1.13	n.a.	.35
Yamanashi	.49	n.a.	.70	.95	n.a.	.10
Nagano	.50	.49	.61	.67	n.a.	.20
Gifu	.46	.55	.63	1.11	n.a.	.12
Shizuoka	.51	n.a.	.51	.57	n.a.	-.02
Aichi	.47	n.a.	.58	.85	n.a.	.23
Mie	.49	n.a.	.60	.96	n.a.	.42
Shiga	.46	.58	.58	1.28	.54	.49
Kyoto	.42	.46	.51	.75	.53	.21
Osaka	.36	.47	.50	.86	.15	.02
Hyogo	.39	.42	.55	.80	.64	-.10

TABLE 2. (Continued.)

	I_g			m		
		gun			gun	
Prefecture	Shi	PPI<.4	PPI≥.4	Shi	PPI<.4	PPI≥.4
Nara	.41	n.a.	.54	1.12	n.a.	.33
Wakayama	.40	.47	.57	1.25	.80	.26
Tottori	.48	n.a.	.53	.80	n.a.	.53
Shimane	.45	n.a.	.51	.51	n.a.	.26
Okayama	.35	n.a.	.49	.31	n.a.	.26
Hiroshima	.42	n.a.	.56	.82	n.a.	-.00
Yamaguchi	.37	n.a.	.53	1.13	n.a.	.10
Tokushima	.47	n.a.	.60	.60	n.a.	.02
Kagawa	.44	n.a.	.58	.68	n.a.	.01
Ehima	.43	n.a.	.58	1.00	n.a.	.16
Kochi	.34	n.a.	.49	1.35	n.a.	.29
Fukuoka	.41	.46	.59	.64	.34	-.23
Saga	.49	n.a.	.62	.34	n.a.	-.13
Nagasaki	.43	n.a.	.57	.62	n.a.	-.05
Kumamoto	.45	n.a.	.60	.56	n.a.	-.08
Oita	.40	n.a.	.58	.95	n.a.	-.11
Miyazaki	.45	n.a.	.54	.42	n.a.	.01
Kagoshima	.48	n.a.	.63	.44	n.a.	-.13

Notes: (a) n.a. = not available (i.e.: There is no gun in this prefecture with PPI<.4.)

The most striking finding from this table is immediately apparent. In the urban sectors of the prefectures *m* is invariably significantly different from zero. this not true for the gun, however, though it is more likely to hold for gun areas with PPI $< .4$ than the groups of gun for which PPI $\geq .4$. This is generally supportive of the hypothesis that the innovators in parity specific control are those who incur the greatest excess of costs over benefits with higher parity children, although the figures tell us little in the way of specifics. The high correlation between the shi and gun levels of I_g, and the shi and gun levels of *m*, across prefectures, should also be noted. For the forty six prefectures the correlation between the average shi and gun values of I_g is .74, and the similar correlation for *m* is .57.[5] This is consistent with the argument advanced above concerning the diffusion of parity specific control through contact and emulation (cf. Mosk [1978] for a more lengthy discussion of rural-urban differentials in fertility and urban fertility. This topic is beyond the scope of this paper).

To ascertain in greater detail which groups were initiating the fertility transition I decided to concentrate on gun with PPI $\geq .4$.[6] My strategy was to construct a set of variables which serve as proxies for variables I am unable to measure for the gun. The list of variables is as follows:

Acronym	Definition	Proxy	Year(s) Available
PPMI	Percentage male labour force in primary industry	Demand for child labour	1930
PCHO	Percentages cultivated acres which are owned by farmer	Status	1929
IMR	Infant mortality rate	Risk of loss of child	1938
SBR	Stillbirth rate (stillbirths per 1,000 live births)	Natural fertility[7]	1925, 1930
D	Density: Adults 15-49 per cultivable acre	Demand for labour (inverse); relative dearth of land which a male can acquire for his own.	1929-1930
PCHM	Percentage cultivated acres in mulberry production; proxy for silk production since coccoons are raised on mulberry plants	Demand for child labour. Silk production requires tremendous labour inputs	1929
SR	Sex ratio: $\frac{\text{males 15-29}}{\text{females 15-29}}$	Relative abundance of potential spouses for women in principal marriage ages.[8]	1925, 1930
E_f	$\frac{\text{Females employed outside of primary industry}}{\text{women 20-24}}$	Job opportunities for women in work outside the home	1930
PDSFO	Percentage women in occupations who are domestic servants	Income per head[9]	1930

With the exception of infant mortality all of these data were constructed from data for 1925, 1929, or 1930.[10]

Before turning to the regression analysis it is useful to consider the areas dependent on silk production, as an example of the ecological approach I am adopting here. The assumption is that the characteristics of the gun are sufficiently representative of the circumstances of individual households in the gun on average to yield useful proxy variables for the analysis. In Table 3, I provide measures of demographic rates for all the gun for which PCHM $\geq$ .5.[11]

Two points are especially worthy of note. (1) First, marital fertility is substantial in these gun and this in spite of relatively slight mortality. with the single exception of gun #6 in Nagano prefecture there is no evidence that parity specific control has made substantial headway by 1925 in these areas which are dependent on the highly labour-intensive production of raw silk. (2) The fairly advanced singulate mean age at marriage for females in these gun are equally

TABLE 3. AVERAGES OF VARIOUS DEMOGRAPHIC RATES FOR THE SILK PRODUCING DISTRICTS OF RURAL JAPAN (GUN), AND FOR THE RURAL SECTORS (ALL GUN AREA) OF THE PREFECTURES IN WHICH THE SILK PRODUCING DISTRICTS ARE LOCATED, [b.] 1925-1938

	1925						1925		1935		1938
Prefecture, *shi* or *gun* designation	Overall Fertility (I_f)	Marital Fertility (I_g)	Nuptiality (I_m)	Singulate Mean Age of Marriage: Males (SMAMM)	Singulate Mean Age of Marriage: Females (SMAMF)	Coale-Trussell Index of Parity Specific Control (m)	Crude Rates: Birth Rate (CBR)	Crude Rates: Death Rate (CDR)	Crude Rates: Birth Rate (CBR)	Crude Rates: Death Rate (CDR)	Infant Mortality Rate (IMR)
Gumma, all *gun*	.44 (.02)	.66 (.04)	.64 (.04)	24.9 (.5)	22.7 (.7)	-.000 (.122)	37.9 (1.7)	21.3 (1.1)	34.8 (1.6)	16.8 (1.1)	97.1 (8.3)
Gumma, *gun* #3	.40	.65	.60	25.5	23.6	.000	39.3	22.9	34.0	18.0	90.7
Gumma, *gun* #4	.46	.68	.64	24.7	23.0	-.067	36.8	17.9	35.6	18.1	89.8
Yamanashi, all *gun*	.48 (.03)	.70 (.04)	.67 (.03)	25.6 (1.1)	22.5 (.6)	.099 (.113)	37.9 (2.8)	19.8 (1.3)	33.8 (2.3)	17.2 (1.6)	100.2 (14.7)
Yamanashi, *gun* #1	.48	.72	.64	26.6	23.3	.035	36.8	17.9	32.1	16.9	98.6
Yamanashi, *gun* #3	.52	.77	.65	26.7	22.9	-.086	38.4	19.0	35.2	16.8	94.4
Yamanashi, *gun* #9	.48	.70	.65	24.5	22.6	.079	34.0	18.5	35.8	17.2	80.2
Nagano, all *gun*	.41 (.07)	.60 (.06)	.65 (.09)	25.8 (.7)	22.7 (1.3)	.196 (.188)	34.5 (2.9)	19.5 (2.4)	32.3 (2.6)	16.5 (1.8)	89.3 (13.2)
Nagano, *gun* #3	.36	.64	.53	27.3	25.1	.059	32.8	16.8	30.3	16.0	68.6
Nagano, *gun* #5	.41	.61	.64	26.4	22.9	.165	34.9	17.2	31.1	15.9	70.4
Nagano, *gun* #6	.39	.54	.69	25.0	21.6	.482	33.4	18.9	31.9	15.9	73.0
Nagano, *gun* #8	.42	.62	.66	26.0	22.8	.142	35.1	22.7	31.0	16.8	78.9
Nagano, *gun* #12	.42	.66	.62	26.7	23.9	.015	34.8	19.5	33.3	18.0	92.2

Note: (a.) In the case of the "all *gun*" averages the standard deviation is given in parentheses below the mean.

(b.) Because of incorporations and boundary changes, the number of observations on which the "all *gun*" averages are calculated changes from year to year.

noteworthy. It substantiates a point I made in formulating my life cycle model. Where the market for young female labour is brisk and infant mortality low, women tend to marry at older ages and acquire a dowry through savings.

Now let us turn to the regressions on all the gun with PPI $\geq$ .4. The results I report on are simultaneously for nuptiality and marital fertility, since my model incorporates them both. This simultaneity property, however, raises some complicating statistical issues. Consider, for example, I_g and the SMAMF. We can decompose marital fertility into its two components: the natural fertility component, M, and the parity specific control parameter *m*. According to the life cycle hypothesis M and SMAMF are inversely correlated; according to the hypothesis concerning the inception of parity specific control *m* and SMAMF are inversely correlated. But M is directly correlated with I_g and *m* inversely related to I_g. Moreover, there is an additional issue. As *m* rises the relationship between I_g and the SMAMF may change altogether. The natural fertility strategy is no longer relevant, and as the populace learns to control its reproduction within marriage the age at marriage may fall.[12] This is an additional complicating simultaneous relationship which affects the pair of equations with *m* and the SMAMF. The problem has implications for the formulation of the statistical analysis since the typical parameter estimates in ordinary least squares for each equation in a two-equation simultaneous system may be biased.[13] The usual remedy is application of an instrumental variable method like two-stage least squares. But this methodology reduces possible biases at the expense of increasing variance around the parameter estimates: it is inherently a less precise estimation technique than ordinary least squares. For this reason I report my findings using both methods of estimation.

Table 4 summarizes the ordinary least squares results The findings are instructive. Consider first the equation with nuptiality as dependent variable. It shows that infant mortality, the sex ratio, and job opportunities for women are fundamental determinants of the age at marriage; density, which presumably indicates restrictions on the opportunities for males, also plays some role.[14] Elsewhere I have demonstrated that M, the index of natural fertility, is a critical determinant of the SMAMF, although this cannot be directly ascertained here because the only available proxy for natural fertility, the stillbirth rate, is not an accurate representative of natural fertility.[15] The equations with *m* and I_g as dependent variables are equally strong. The proxies for demand for labour, status, and income enter with the predicted signs. It is interesting that the female employment variable, which plays such a preeminent role in many economic models of marital fertility, does not appear to be significant in these regressions. It is also noteworthy that the infant mortality rate enters with a *positive* sign in the estimated equation for *m*.[16] These results bear out my contention thay my life cycle model has greater explanatory power in this context than the Easterlin hypothesis, which places especially heavy weight on infant mortality and natural fertility. In short, the regressions offer valuable confirmation of my life cycle model of natality.

The results of the two-stage least squares estimates reported in Table 5 are somewhat less supportive. Table 5 reports on two separate sets of two-stage least squares regressions: one involving I_g and the SMAMF; the other *m* and the SMAMF. It should be noted that choice of instrumental variables for identification of these systems of equations was difficult and to some extent I was forced to make ad hoc choices in regard to this issue. I will not dwell on these results at great length. What is immediately apparent from these regressions follows. In the equations with the SMAMF as dependent variable infant mortality, the sex ratio, and employment opportunities play the same role they do in the earlier results. And proxies for income, status, and demand for child labour, emerge as important factors in accounting for variations in M and I_g.

In sum, the findings suggest that the life cycle model of fertility which I have advanced has considerable explanatory power in accounting for the origins of the fertility transition in the gun

TABLE 4. ORDINARY LEAST SQUARES ESTIMATES OF EQUATIONS WITH I_g, M AND THE SMAMF AS DEPENDENT VARIABLES: ALL COUNTIES (GUN) WITH PPI ≥ .4

Dependent Variable	Number of Observations	Constant	Percentage Male Labor Forces in Primary Industry (PPMI)	[b] Percentage Cultivated Acres Owned (PCHO)	Infant Mortality Rate (IMR)	Still-birth Rate (SBR)	[b] Density "Productive" Adults per Acre (D)	Silk Dependence: Percentage Cultivated Acres in Mulberry (PCHM)	[b] Sex Ratio males 15-29 / females 15-29 (SR)	Female Employment Ratio (E_f)	Percentage Occupied Females Domestic Servants (PDSFO)	[b] I_g	[b] m	[b] SMAMF	R^2
								Independent Variables							
I_g	528	$.23^{*}$	$.22^{*}$	$-.10^{*}$	$.003^{*}$	$-.01^{*}$	$-.005^{**}$	$.11^{*}$	n.e.	-.03	$.78^{*}$	n.e.	n.e.	$.01^{*}$	.34
		(3.15)	(5.40)	(-4.36)	(2.590)	(-6.39)	(-2.381)	(4.55)		(-.73)	(6.21)			(4.99)	
SMAMF	528	21.38^{*}	-2.20^{*}	n.e.	$-.12^{*}$	.03	n.e.	3.06^{*}	-1.27^{*}	2.98^{*}	6.44^{*}	3.26^{*}	n.e.	n.e.	.51
		(28.67)	(-4.05)		(-7.15)	(.94)		(9.04)	(-3.65)	(4.73)	(3.35)	(5.20)			
m	528	1.24^{*}	$-.93^{*}$	.19	$.009^{**}$	$.05^{*}$	-.01	.14	n.e.	-.06	-3.10^{*}	n.e.	n.e.	$-.04^{*}$	.29
		(4.34)	(-5.80)	(2.02)	(2.050)	(7.93)	(-1.45)	(1.43)		(-.37)	(-6.26)			(-3.94)	
SMAMF	528	23.16^{*}	-2.12^{*}	n.e.	$-.11^{*}$	-.03	3.54^{*}	-1.25^{*}	2.94^{*}	2.94^{*}	7.34^{*}	n.e.	$-.66^{*}$	n.e.	.50
		(28.92)	(-3.33)		(-6.11)	(-.83)	(10.42)	(-3.56)	(4.59)	(4.59)	(3.80)		(-3.96)		

Notes: (a.) t-statistics are in parenthesis below estimated coefficient.
(b.) n.e. - not entered into the regression as an independent variable.
* significant at the 1% level (two-tailed test).
** signi ficant at the 5% level (two-tailed test).

TABLE 5. TWO-STAGE LEAST SQUARES ESTIMATES[(a.)] OF STRUCTURAL EQUATIONS FOR I_g AND SMAMF; AND FOR m AND SMAMF; FOR ALL GUN WITH PPI $\geq .4$

Dependent Variable	Number of Observations	Constant	Percentage Male Labor Forces in Primary Industry (PPMI)	(b.) Percentage Cultivated Acres Owned (PCHO)	Infant Mortality Rate (IMR)	Still-birth Rate (SBR)	(b.) Density "productive" adults per acre (D)	Silk Dependence: Percentage Cultivated Acres in Mulberry (PCHM)	(b.) Sex Ratio males 15-29 / females 15-29 (SR)	Female Employment Ratio (E_f)	Percentage Occupied Females Domestic Servants (PDSFO)	(b.) I_g	(b.) m	(b.) SMAMF
			Explanatory Variables											
I_g	528	.36	.21*	-.11*	.002	-.01*	-.49**	.13	n.e.	-.006	.83*	n.e.	n.e.	.008
		(.95)	(4.78)	(-4.21)	(1.043)	(-6.37)	(-2.39)	(1.99)		(-.081)	(4.08)			(.441)
SMAMF	528	21.23*	-2.29	n.e.	-.12*	.03	n.e.	3.01*	-1.26*	2.97*	6.05	3.63	n.e.	n.e.
		(17.22)	(-2.79)		(-6.86)	(.78)		(6.44)	(-3.63)	(4.65)	(1.89)	(1.46)		
m	528	1.57	-.94*	.18	.008	.05*	-.01	.19	n.e.	-.001	-2.96*	n.e.	n.e.	-.06
		(1.05)	(-5.38)	(1.83)	(.877)	(7.90)	(-1.46)	(.73)		(-.003)	(-3.67)			(-.84)
SMAMF	528	23.60*	-3.39*	n.e.	-.08*	.11	-.03	3.54*	-1.13*	2.64*	1.40	n.e.	-2.25	n.e.
		(23.31)	(-2.06)		(-2.61)	(1.05)	(-1.00)	(9.59)	(-2.77)	(3.38)	(.19)		(-1.20)	

Notes: (a.) The terms in parentheses below the estimated coefficients are the ratios of the estimates to their estimated asymptotic standard errors. Since the number of observations is large in each data set, these retios are probably good approximations of their t statistics. Significance levels on the assumption that these t statistics are accurate indicators of significance are reported accordingly. R^2 does not have the usual meaning in two-stage least squares estimates and is not reported.

(b.) n.e. = not entered as explanatory variable in the equation.

*significant at the 1% level.

**significant at the 5% level.

of Japan. The evidence also casts some doubts on the empirical validity of the framework suggested by Easterlin, at least for Japan.

Conclusions

In this paper I have laid out a model of fertility and have demonstrated its usefulness in explaining why families switch from a natural fertility strategy to parity specific control. The model provides a coherent framework for analyzing the effects of changes in natural fertility and infant mortality on the choice of fertility strategy, and it also helps pinpoint those subgroups within the population who would feel especially strong pressure to innovate with parity specific control. Finally, I have shown how this model leads to different implications from that advanced by Easterlin.

Evidence for interwar Japan confirms my thesis. To what other national fertility transitions might this model be applicable? Some of my own research suggests that the life cycle model may be applicable to the Swedish case.[17] If so, it might prove to be a useful thesis for understanding the European demographic transitions in general. And, perhaps, it may also prove to be helpful in understanding the evolution of fertility in currently less developed countries as well.

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Footnotes

1 By the word "irrational" many scholars using the standard economist's notion of rationality mean the following. Couples do not know how to calculate the opportunity costs, the "prices," of children, relative to those for nonhuman capital goods or consumption goods. That is, they do not have a well-defined income constraint line which expresses the trade-offs in the market between children and other objects useful for production or consumption. It should be noted that this definition, which is consistent with standard economic definitions of "irrationality," does not deny that couples have a consistent preference ordering for children and other goods. This concept of "irrationality" appears to be what Ansley Coale is concerned with when he refers to fertility not being "within the calculus of conscious choice." Cf. Coale (1973: 65).

2 Educated people are presumably better able to perform the calculations of the opportunity costs of children than their less well-educated compatriots according to this thesis. As I will suggest later in the text, I do not accept this view.

3 This section draws heavily on section 2.2 of Chapter 2 of Mosk (forthcoming).

4 For the definitions of the Hutterite indices cf. Coale (1967). For the definitions and computation of the index of natural fertility (M) and the index of parity specific control *(m)*, cf. Coale and Trussell (1974, 1978).

5 For the ten prefectures for which there are gun with PPI < .4 the correlations between the I_g values for all shi, gun with PPI < .4 and gun with PPI ≥ .4 are as follows:

	shi	gun with PPI < .4	gun with PPI ≥ .4
shi	1.00	.44	.72
gun with PPI < .4		1.00	.49
gun with PPI ≥ .4			1.00

For *m* the correlations are:

	shi	gun with PPI < .4	gun with PPI ≥ .4
shi	1.00	.50	.84
gun with PPI < .4		1.00	.66
gun with PPI ≥ .4			1.00

6 Recall that my working hypothesis is that it is considerations of cost and benefits of leverage over children that are critical. As a practical matter, it is easier to secure relevant proxy variables for rural areas than for urban zones. The question may be raised, however, as to why parity specific control is not *always* present in cities. Here I would note that the benefits of employing children in small family shops are important when the need to provide offspring with

education is not pressing. And secondly, I would point out that when urban populations are relatively minor in size in proportion to rural districts and natural fertility is the dominant strategy in the rural areas, religious and ethical norms critical of parity specific control develop which keep high the psychological costs of control for all segments of society. Cf. Mosk (1979a).

7 This is a poor proxy for natural fertility unfortunately. The correlation between M, the index of natural fertility, and the stillbirth rate for the prefectures in 1925 is very low. This probably explains why the stillbirth rate is not a significant variable in the regressions I report on below.

8 I introduce this variable to control for sexual imbalances in the composition of the marriageable population — imbalances which may affect the precise ages at which marriages are consumated.

9 This is the natural interpretation of the PDSFO variable. However, to the extent that the domestic servants do not work on farms, but rather in inns and restaurants, this proxy may be imprecise. The degree to which this is the case is impossible to ascertain from the census data. Another possible interpretation of this variable, it should be noted, is that it represents constraints on nuptiality not captured elsewhere in my specification.

10 Unfortunately, infant mortality rates are only available for 1938, a year *after* 1925 — the year for which the fertility variables are calculated. But *relative* levels of infant mortality for the different prefectures changed very little over the period 1900 to 1940 despite the decline everywhere, so I have included this variable despite these reservations.

11 The gun are nmbered according to their order within each prefecture in the 1935 census which remained virtually unchanged throughout the interwar period.

12 For a discussion of these issues for Europe see Lesthaeghe and van de Walle (1976).

13 See, *inter alia*, Schultz (1976).

14 In Mosk (1981) I show that the income proxy, PDSFO, is associated negatively with the singulate mean age at marriage of males (SMAMM) in the gun with PPI $\geq$ .4, lending additional support to this interpretation.

15 See Mosk (1979b).

16 For the prefectures in 1930 the correlation between M and *m* is —G.48 lending additional evidence to this criticism of Easterlin's interpretation.

17 See Mosk (1979b, forthcoming).

18 For a detailed discussion of the data set, see C. Mosk and J. Faris, "A Description of a Data Tape Concerning the Counties (Gun) and Cities (Shi) of Japan, 1925-1938," University of California (Berkeley), Department of Economic, Working Paper No. 133, October 1979.

19 Cf. Coale and Trussell (1974, 1978).

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Appendix

The Data for the Shi and Gun. 1925-1938.[18]

The Sources:

The sources for the data are as follows:

Type of Source	Dates	Title of Source	Nature of Source
Census	1925, 1930 & 1935	Nihon. Naikaku Tōkeikyoku [Japan. Cabinet Bureau of Statistics] *Kokusei chōsa hokoku* [Report of the Population Census] (for 1925, 1930, and 1935) (Tokyo, various years)	Enumerative census; 1925 census has populations by quinquennial age class 1930 census has industrial and occupational classifications.
Vital Statis- tics	1925, 1930 & 1935	Nihon. Naikaku Tōkeikyoku. *Shi, chō, son betsu jinkō dōtai tōkei* [Vital Statistics for Cities, Towns and Villages] (Tokyo, 1927, 1932, and 1938)	Births, stillbirths, deaths by sex, and total population.
Agricul- tural Census	1929	Nihon. Naikaku Tōkeikyoku. *Nōgyō chōsa kekka* [Report of the results of the Agricultural Census] (Tokyo,1932).	Distribution of land area in villages by ownership status (tenancy) and crop type.
Special Mortality Survey	1938	Nihon. Kōseisho Shakaikyoku [Japan. Ministry of Health and Welfare. Bureau of Social Affairs]. *Showa jūsannen tenkoku do, fu, ken, shi, ku, chō, son betsu shussan, shussei, shisan oyobi nyuyoji tōkei* [Statistics on births, live births, stillbirths, and infant and child deaths for the whole country, the prefecture, cities, and wards, towns, and villages in 1938] (Tokyo, 1941)	Detailed figures on infant deaths commissioned as a special survey.

Calculation of the Variables

I computed the variables directly from the figures in these sources. I adjusted for illegitimacy in calculating estimated legitimate births (ELB) by applying the ratio of legitimate to illegitimate births for the prefecture in which an individual gun or shi was located, to the data on births for each gun or shi.

To calculate m for the indivdiual gun or shi I assumed M for a gun or shi was equal to the M value which I estimated for the entire prefecture using Coale and Trussell's procedure.[19] Then I approximated the solution to the equation (A.4) for m, given the assumed value of M, for each gun and shi. The precise formulas are as follows:

The age specific marital fertility rate is;

$$(A.1) \qquad MFR_i = \frac{\text{legitimate births to women in } i^{th} \text{ class}}{\text{married women in } i^{th} \textit{ class}}$$

Coale-Trussell write:

$$(A.2) \qquad MFR_i = n_i \bullet M \bullet [exp(m \quad v_i)]$$

where n_i and v_i are constants for each age group i. Then total legitimate births (ELB) is:

$$(A.3) \qquad ELB = \sum_{i=1}^{7} MFR_i \bullet MF_i$$

where MF_i = married females in the i^{th} age class.

Thus

$$(A.4) \qquad ELB = \sum_{i=1}^{7} \{n_i \bullet M \bullet [exp(m \bullet v_i)]\} \bullet MF_i \,.$$

The n_i and v_i are as follows:

	$i=1$	$i=2$	$i=3$	$i=4$	$i=5$	$i=6$	$i=7$
	15-19	20-24	25-29	30-34	35-39	40-44	45-49
n_i	.411	.460	.431	.395	.322	.167	.024
v_i	0.0	0.0	−.279	−.667	−1.042	−1.414	−1.671

I used a computer program for approximating the solution to a non-linear homogeneous equation (i.e., equation A.4) to estimate m, given the values of M, v_i, n_i, ELB, and MF_i for each shi and gun in 1925.