MEN IN THE DEMOGRAPHIC TRANSITION

Bobbi S. Low
University of Michigan

Women's fertility is the focus of most demographic analyses, for in most mammals, and in many preindustrial societies, variance in male fertility, while an interesting biological phenomenon, is irrelevant. Yet in monogamous societies, the reproductive ecology of men, as well as that of women, is important in creating reproductive patterns. In nineteenth-century Sweden, the focus of this study, male reproductive ecology responded to resource conditions: richer men had more children than poorer men. Men's fertility also interacted with local and historical factors in complex ways to have significant impact on population growth. As a result, "the" demographic transition was local, and locally reversible, in Sweden. Results cannot be simply translated from nineteenth-century studies to current attempts to promote fertility decline, because today, male and female resource-fertility curves differ in shape, not only in magnitude. When we translate studies of fertility decline, it is important to study individual fertility and to discern whether, in any particular case, male and female patterns are similar.

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The period in western Europe and North America when family sizes fell dramatically, called "the" demographic transition, is of central interest today—population growth is an increasing political and environmental

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Address all correspondence to Bobbi S. Low, Evolution and Human Behavior Program and School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI 48109-1115.

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problem, and if we understand what causes family sizes to fall, perhaps we can enhance the transition to smaller families around the world in a humanitarian fashion. The *causes* (not correlates) of the demographic transition are, however, little understood, despite more than thirty years of concentrated effort by thoughtful demographers in several countries (e.g., Schofield and Coleman 1986). We do know that the phenomenon is not unitary, but seems to respond to externalities like economic conditions, and typically proceeds locally, and reversibly (e.g., Lockridge 1983; Low 1989a).

Central to most analyses is the study of women's age-specific fertility. After all, female fertility is at the heart of population growth; in most mammals, and in many preindustrial societies, variance in male fertility, while an interesting biological phenomenon, isn't relevant—one can hunt 90% of the bucks in a deer population, and all females will still conceive. Here I argue that when the two sexes show different resource-fertility correlations and divorce exists, we should pay attention to the individual reproductive patterns of both men and women, rather than relying simply on aggregate population patterns.

In most mammals, including many preindustrial human populations, males, while having the same average number of offspring as females, experience more variance in reproductive performance. This difference is most pronounced in polygynous systems; however, Clutton-Brock (1983) notes that variance can also be high in monogamous systems because the zero-success class has so much impact (Falconer 1981)—anything increasing the size of the failure class is important in monogamous systems as well as polygynous systems (e.g., Low 1988). Typically, resources, status, and power co-vary with reproductive success for males; for females, survivorship (number of reproductive years) is most important (e.g., Clutton-Brock et al. 1982; Le Boeuf and Reiter 1988). Because male variance is high, great expenditure and risk-taking may be profitable (e.g., Low 1988, 1989a, 1989b, 1990a, 1990b). In most societies for which there is information (reviewed by Low 1993a), men use resources to gain reproductive advantage, but this merely increases the variance in men's reproductive success; what happens to men's reproduction, as in most other mammals, may have little effect on women's fertility.

In monogamous societies, if these wealth/status correlations still hold, and if family wealth remains men's wealth, then men's wealth or status will affect fertility patterns. The correlations between wealth and/or status and numbers/survivorship of offspring, and the impact such correlations have on variance, are seldom considered in demographic analyses. Sometimes the correlations are assumed to have disappeared during the demographic transition. Data from current western technological

societies look more ambiguous: Mueller and Short (1983) report some significant positive findings, some significant negative findings, and some studies showing nonsignificant trends between wealth and fertility. Daly and Wilson (1983) found that women's fertility correlated with husband's income in 1970 census data, and there is some evidence that men in industrial "monogamous" societies remarry more than do women, with resulting increased variance in men's reproduction—effective polygyny (Essock-Vitale 1984). On the other hand, Vining (1986), using proxy measures such as education (rather than income), argues for a negative correlation between wealth and fertility—although he has neither resource measures nor lifetime fertility data. Several workers have found generally positive trends between status and fertility within a single class, but significant differences among classes (Freedman and Thornton 1982; Hughes 1988; Symons 1974).

A paradox exists: within societies, even current ones, when a correlation exists between wealth or power and reproduction, that correlation is usually positive for men. I argue that it may not be positive for women who earn their own income. And when we look at aggregate multinational data (e.g., Birdsall 1980), comparing total fertility rate (TFR, the number of children a woman would have if she had average age-specific fertility at all ages, and completed her reproductive career; this measure ignores both infant and adult female mortality), and GNP/capita (gross national product per capita), we see a negative correlation: on average, the total fertility rates of poor countries are greater than those of richer countries. Only if we understand sex differences, and the connections between individual life histories and the population patterns, will we be able to make intelligent decisions about aid as it might impact wealth and fertility. It is of some interest, therefore, to explore ecological correlates of men's patterns of fertility during the demographic transition, to see if the resource-reproduction correlations seen in traditional societies disappear.

The problem is complicated by both evolutionarily novel events and techniques of data handling. Several factors are relevant (Low 1993b): serial monogamy in modern industrial societies (which may change reproductive variance); the difficulties of inference from census data; the evolutionary novelty of cheap, effective birth control; the differing responses to wealth and status in men and women; the particular difficulties women face in market-economy employment and in caring for children. What happens to populations is the statistical sum of what happens to individual lifetimes—and thus family fertility, survivorship, and mobility—as a result of familial resources and effectiveness of investment by parents in individual children. If individuals respond differently to external shifts in resources (e.g., because the shifts benefit

some while costing others), then what happens to population numbers depends on what proportion of the population comprises different kinds of families. If these responses differ systematically between the sexes in ways that may interact with other (e.g., wealth) differences, we need to know about men's, as well as women's, reproductive patterns.

SWEDEN IN THE DEMOGRAPHIC TRANSITION

Nineteenth-century Sweden provides excellent records for such analysis, because both the Lutheran Church and the government kept copious and careful records on everything from birth, death, and marriage, to occupation and land ownership, to literacy (priests gave catechism exams yearly). Sweden was largely agricultural, with emerging industrialization (Mendels 1981), and a large part of the labor force worked part-time or at home. The family could function as a form of economic enterprise (see also Flandrin 1979; Habakkuk 1955). Such proto-industrialization tended to develop in regions like Sweden, which combined an underemployed, land-poor population with access to urban markets (e.g., Tilly 1978). In Sweden it was probably related to land enclosure and inheritance changes during the nineteenth century (Jörberg 1972, 1975).

As in most western industrial nations today, marriage in Sweden followed the "European" pattern (Hajnal 1965), with women marrying for the first time in their early to mid-twenties, and men in their late twenties (see Low et al. 1991:29). At marriage the new couple typically set up their own independent household; a relatively high proportion of individuals never married (Low 1989a, 1990a; Low and Clarke 1991). Formal divorce was essentially unknown. From 1686 to 1810, the nobility practiced "fideicommiss," or male primogeniture, with the constraint that the eldest son must continue the practice (Inger 1980; Malmström 1981). Until 1845 in Sweden, sons inherited twice as much as daughters; after that date, daughters had equal inheritance rights—although in practice sons had first choice of the land and goods that were to be their inheritance, and sons could purchase their sisters' inheritance from them (Inger 1980; Lo-Johansson 1981). This meant that disputes occasionally arose over the value of the exchanged inheritance items; purchasing needed land from a sibling could prove economically onerous, but also siblings sometimes complained that they did not receive fair value (common elsewhere in Europe; see Habakkuk 1955).

Even after the shift from fideicommiss, and establishment of equal inheritance laws for both sons and daughters, inheritance biased by birth order was often evident (see Gaunt 1987; Low 1989a, 1990a), and

a bias toward the first son was perhaps more evident in the northern areas. Available land records (Low 1990a) suggest that land overwhelmingly went to the firstborn son surviving to adulthood. Legal agreements in which a father ceded his land to one (usually the eldest) of his sons before his death, typically in return for room, food, and certain other rights, were common. But as Gaunt (1987) noted, during the nineteenth century the payments delivered to the retiring father increased in size, and receiving a farm became an economic burden. Indeed, default was common, and contemporary jokes abounded about arsenic as "retirement medicine" (Gaunt 1977, 1983). Thus, some tension was evident both within and between generations over resources.

MATERIALS AND METHODS

Within-parish methods are described in detail elsewhere (Low and Clarke 1991, 1992; Low 1989a, 1991; Clarke and Low 1992); they include the calculation of actual number of biological children born to an individual, and the number of those children alive at age 10 (when many children in nineteenth-century Sweden began to work and live outside their natal home). Here, I summarize pertinent information only briefly. The sample comprised all men married between 1824 (when the computerized records begin) and 1840 in the four parishes, and all their male biological descendants (female data are summarized in Low 1991; Low and Clarke 1991) up to the termination of records (1922 in Gullholmen, 1896 elsewhere). Biological descendants were defined as those whose parenthood, through birth or baptismal records, could be reliably established; it is thus a conservative estimate, since some records might be lost, and some fathers of illegitimate children might not acknowledge them. Women did not typically own resources/land/businesses (Low 1989a, 1990a; Low et al. 1991; Low and Clarke 1992); thus, as in earlier analyses, I define wealth by father's wealth for children and unmarried daughters, by own wealth for adult men, and by husband's wealth for married women.

The parishes differed in many ways, and conditions changed through time during the sample; men's marital and lifetime reproduction responded. An individual can only control some of the factors influencing his or her reproductive life. In this study, some extrinsic factors were related to the family into which one was born, others to an external, broader economy. Familial factors, such as the occupation(s) of one's father, whether or not he owned land, and one's order of birth into a family clearly influenced an individual's life (Low and Clarke 1992). Factors external to the family, such as the basis of the regional economy

(in this sample, forestry, agriculture, mining, fishing, etc.) and other resource fluctuations, could also influence an individual's reproductive success (Low and Clarke 1993).

Reproductive patterns varied through time and among parishes (Lockridge 1983; Low and Clarke 1991; Low et al. 1991; see also Røskaft et al. 1992). So did wealth: what made a man "rich" in Gullholmen would only be a mediocre occupation in Nedertorneå. On the other hand, land was less productive in Nedertorneå. In one parish (Tuna) land ownership information is available (Low 1990a); in others only occupational information is available (Low 1989; Low and Clarke 1991, Low et al. 1991). Thus, it is important to analyze lifetime reproductive success *relative to that of the reproductive competitors present at the time in each parish.* To explore the effects of wealth on lineage success in this society most broadly, to ask about "better" versus "worse" strategies, one must subsume temporal and spatial differences without ignoring them (Low and Clarke 1992).

To make broad comparisons possible without ignoring this variation among parishes and through time, I will follow Low and Clarke (1992) and compare each individual's wealth as "richer" (owned land and/or had occupational status of upper middle class, lower middle class, or *bönder* [farmer]) versus "poorer" (occupational status of *torpare* [cottar] or proletariat and no land ownership record). Each adult man's lifetime reproduction is compared with the median for (1) all men reaching "maturity" (23 years) in any decade in any parish and (2) all men marrying in each decade in each parish. Thus I compare any man's lifetime reproduction with the median for his parish and decade of maturation or marriage, as appropriate. Statistical analyses compare the entire sample, stratifying by class. Reproductive measures are thus compared for richer versus poorer individuals, with comparisons stratified by parish and decade. In this way, changes through time and differences among parishes can be integrated.

RESULTS AND DISCUSSION

Resources and Men's Reproduction

Access to resources was important to men's reproductive success in nineteenth-century Sweden, although the particulars differed among the parishes (below). Individuals might be better off because they owned land (Low 1990a; Low and Clarke 1991, 1992, 1993), because they had higher status or a more stable occupation (Low 1989a; Low and Clarke

1991, 1992, 1993), or, within a family, simply because they were born first and therefore had higher reproductive value to their parents (because they start their reproductive careers earlier; e.g., Fisher 1958; Keyfitz 1985; also Low 1991). Men with "better" occupations were more likely to marry (Low and Clarke 1991), and married men had significantly more (acknowledged) children than unmarried men, and significantly more children surviving to age 10 (Low 1990a; Low and Clarke 1991). Richer men married younger women (higher reproductive value; Fisher 1958) than poorer men did, and they had larger families (Low 1989a, 1990a; Low and Clarke 1991, 1992).

Where land ownership records were available, we found that landowners were more likely to marry than non-landowners, and they married younger women (Low 1990a). Married men who owned land had more children than married men without land (Low 1990a). Within-parish analyses suggested that for women, age at marriage was more important in determining lifetime reproduction than either husband's or father's occupation (Low 1989a, 1990a; Low and Clarke 1991). However, women who married richer men tended to marry earlier, and more inclusive analyses (Low and Clarke 1992) showed that when "richer" versus "poorer" women were compared, richer women showed higher age-specific fertility at all ages than poorer women. Both sons and daughters born to wealthier fathers had a greater likelihood of surviving, remaining in the parish, marrying, and having more than the median number of children, than children born to poorer fathers (Low and Clarke 1992).

Males were less likely to migrate than females, both as children and as adults; again, particulars differed among the parishes (Clarke and Low 1992). Much of the patterns reflected the importance of resources. People in Locknevi (in which resource constriction occurred; Low 1989a, Low and Clarke 1991) were most likely to migrate. Children of farmers, with a possibility of inheriting land, were the least likely to move (Clarke and Low 1992). Individuals born late to large families were more likely to migrate than those born before them (Clarke and Low 1992). The ultimate influence of migration on the reproductive lives of dispersers is unknown.

The four parishes in which men's patterns are examined here are scattered from south to north in Sweden, and they varied greatly in their economic bases (see Low and Clarke 1991).

Gullholmen. Gullholmen Parish is an island where most people earned a livelihood by fishing; the catches could vary considerably from year to year. Its small population rose steadily during the nineteenth century (Swedish Demographic Database, unpublished statistics) but

was always less than 1,000 individuals (Low and Clarke 1991). Because the island was small, however, density was the highest of any parish. Perhaps related to the uncertainties of fish catches, and the costs associated with commercial fishing, people married late. Nonetheless, the lifetime family size of married individuals was the highest of the four parishes (Low and Clarke 1991). In this parish, there was little variation in occupational status. Men's occupation was correlated with probability of marrying but not with survivorship; only in generation 1 was occupation related to a man's lifetime fertility. Land ownership records were not analyzed.

Locknevi. In Locknevi Parish, in Småland, geographic constraints limited farming (Gerger and Hoppe 1980): only in the central valley were the fields sufficiently fertile for farming. A small ironworks in the southwestern part of the parish provided supplemental income for some farmers until the 1880s. In the early 1800s, a few very large landowners held large estates and employed agricultural day workers (*statare*). These large estates were divided and sold off (Gerger and Hoppe 1980), and their rich owners moved out of the parish, so landholdings became progressively smaller even as more (marginal) land came into cultivation. Population growth stagnated in the later part of the nineteenth century (Low and Clarke 1991). Thus resource holdings shifted from being relatively uneven, with some very large holdings, to more even but less valuable holdings. During the early periods, strong correlations existed between men's occupations and their reproductive success; when the rich landowners moved, these differences became muted (Low 1989a).

Tuna. The population of Tuna Parish, in Medelpad, nearly tripled during the nineteenth century (Low and Clarke 1991). Tuna was largely a farming parish, though forest and mining industries were also present in the early 1800s. As in Locknevi, many men worked in the iron foundry as well as farmed (see Ostergren 1990; Sundin and Tedebrand 1981); Tuna experienced rapid industrialization from 1850 onward (Norberg and Rolén 1979). Tuna's economy was more diverse (forestry, ironwork, mixed crop agriculture) than that of more southern parishes like Locknevi. Perhaps as a result of this diversity, and the availability of nonmarket alternatives (hunting, fishing), neither population measures nor reproductive patterns corresponded with market economic fluctuations in Tuna Parish (Low and Clarke 1993; also see Jörberg 1972, Sundin 1976). Landowners had larger families—and less variance in their reproduction—than others, no matter what the times. Perhaps land ownership provided a buffer against hard times, over and above the nonmarket alternatives.

Nedertorneå. Nedertorneå, the northernmost study area, was a farming parish in an area of poor land and short growing seasons. Throughout the first half of the nineteenth century, the Finnish habit of feeding infants on cow's milk rather than nursing was common (Brändström 1984) and had a negative impact on infant survival (Lithell 1982; Low 1991; Low et al. 1991). In the mid-nineteenth century, the central Swedish government established a bureaucratic outpost in Haparanda, resulting in a more varied economic environment. The population of Nedertorneå rose steadily during the nineteenth century (Low and Clarke 1991). Brändström (1984) found fertility differences related to men's occupations: richer men had larger families. In a smaller, more restricted sample, Low and Clarke (1991) found the same trend, but at nonsignificant levels.

Inheritance, Men's Status, and Men's Reproduction

Throughout the study period, as expected in a society with heritable wealth, "richer" men, those with land or a high-status occupation, tended to have "richer" sons ($n = 2065$, $\chi^2 = 1261.5$, d.f. = 1, $p < 0.00001$). Further, richer men, though they tended to come from larger families, came from families with fewer brothers than poorer men ($n = 1690$, d.f. = 1688, $t = 6.98$, $p < 0.00001$). This suggests that if there are fewer competitors within a family for the resources required to become established and seek a wife, one may have a better chance. This appears to be a problem for men rather than women (see Low 1991).

Richer men (whether their fathers were rich or poor) were more likely to marry than poorer men ($n = 2646$, $\chi^2 = 13.72$, $p = 0.0002$). Father's wealth was not related to probability of marrying ($n = 2095$, $\chi^2 = 1.52$, $p = 0.217$). A man's own status was not related to his age at marriage (richer 27.56 years vs. poorer 27.37 years; $n = 1419$, d.f. = 1417, $t = 0.563$, $p = 0.574$). However, richer men married younger women (25.5 years vs. 26.2 years) than poorer men ($n = 1414$, $t = 2.105$, $p = 0.035$). In contrast, sons of richer men married earlier (26.9 years vs. 27.9 years) than sons of poorer men ($n = 1435$, $t = -3.21$, $p = 0.001$), but there was no difference in the age of women these men married (25.03 vs. 25.5 years; $p = 0.26$). Thus, as in individual parish analyses with other measures (Low 1991, 1990a; Low and Clarke 1991, 1992), richer men married women of higher reproductive value. The "head start" of father's wealth did not persist through a man's lifetime, except as it affected a man's likelihood of becoming rich himself. Thus, sons of rich men were more likely to become rich than sons of poor men—but poor men's sons who nonetheless became rich did better reproductively.

The fact that richer men, in general, married younger women suggests that they might have had more children in their lifetimes than poorer men. They did, but the pattern is of interest in the context of the demographic transition. Richer men waited longer to have their first child; they had an average delay from marriage to birth of firstborn of 16 months, compared with 8 months for poorer men (n = 1261, d.f. = 1259, t = 3.003, p = 0.0027). They were thus older when their first child was born, though their wives were not. Richer men were, on average, 28.13 years old, compared with 26.87 years for poorer men, when their first child was born (n = 866, d.f. = 864, t = 3.59, p = 0.003). However, they also experienced an average of 22.77 fertile years (see Low 1989a, 1990a) versus 19.32 years for poorer men (n = 2040, d.f. = 2038, t = 4.37, p = 0.00001) and thus were older when their last child was born (37.76 vs. 36.37; n = 866, d.f. = 864, t = 2.55, p = 0.011).

As a result of these differences, richer men indeed had more children than poorer men. Such patterns are often hard to discern because the fertility in one area may be persistently higher than in another (see Low and Clarke 1991 for summary fertility in this sample). But if we compare each man's fertility to the median fertility for all men in the same parish either reaching age 23, or marrying, in the same decade, the pattern is clear (Figure 1a). Richer men had higher fertility than poor men, whether one compares adult men by parish and decade of maturation (n = 1337, d.f. = 2, χ^2 = 21.8, p 8

0.00001) or married men by parish and decade of marriage (n = 1130, d.f. = 2, χ^2 = 11.7, p = 0.003).

The relative advantage of wealth varied over the course of the study period, perhaps as a result of historical particulars (Low and Clarke 1993). Figure 1b shows the reproductive success of richer versus poorer men (not including G1, all of whom were married) reaching age 23 in each decade, compared with all other men reaching maturity in the same home parish. Richer men reaching maturity in the 1840s were much better off reproductively than comparable poorer men. Poorer men reaching maturity in the 1850s fared better than richer men; richer and poorer men who reached maturity in the 1860s did about equally well, and in the 1870s and 1880s, richer men again did better. Even though the overall pattern favored the success of richer men, there were better and worse times and places for richer versus poorer men (see also Low 1989a; Low and Clarke 1991, 1992, 1993).

A man's lifetime pattern was a product not only of his father's status but his own abilities to gain wealth; wealthy men had richer—and poorer—sons, and some men were able to acquire wealth in spite of being born to a poor father. The 426 richer men of generation 1 showed a lifetime fertility of 4.83 ± 0.16, and the poorer men 3.98 ± 0.19 (d.f. = 717, t = 3.38, p = 0.0008). However, the fertility differences interacted with

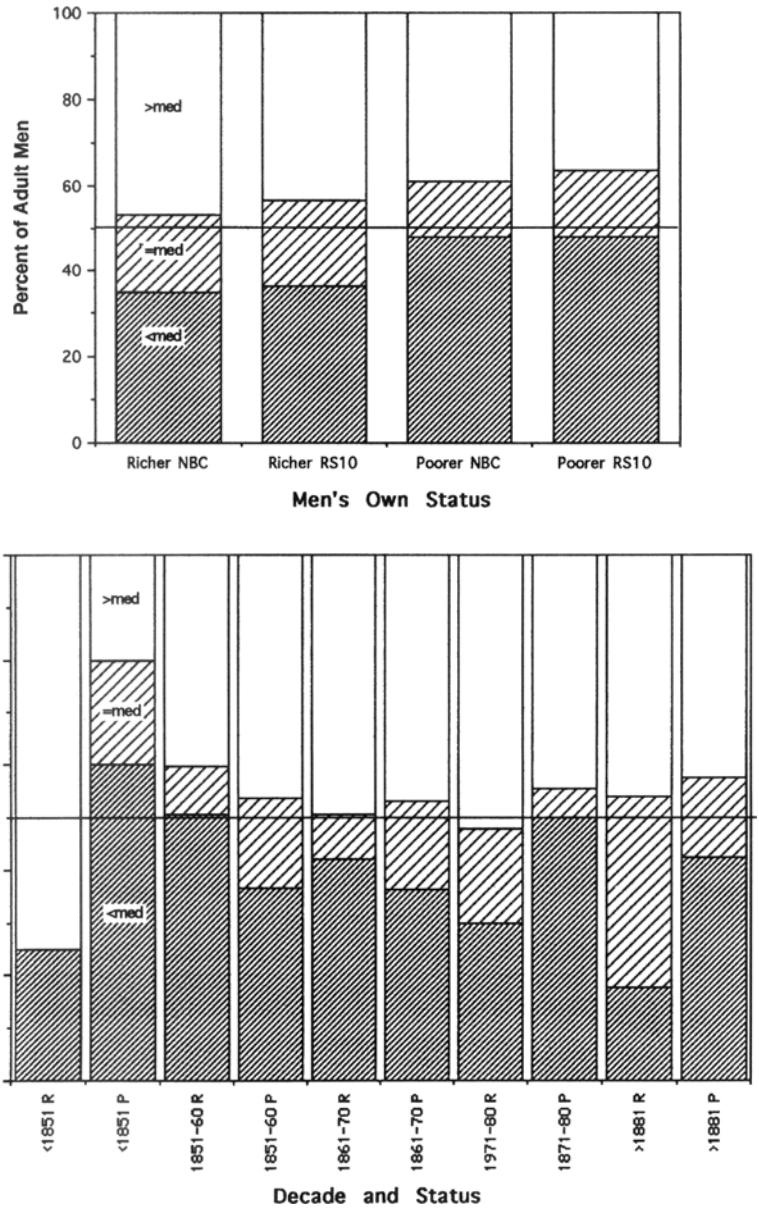

Figure 1. *(a)* Richer adult men were more likely to father at least the median number of children (compared with other men who reached maturity in the same decade in the same parish) than poorer men. They were also likelier to have at least the median or a greater number of children who survived to age 10. *(b)* These general patterns were modified by external conditions: richer men who matured before 1850 and in the 1870s and 1880s showed a considerable advantage over poorer men; poorer men who matured during the 1850s had a reproductive advantage over richer men.

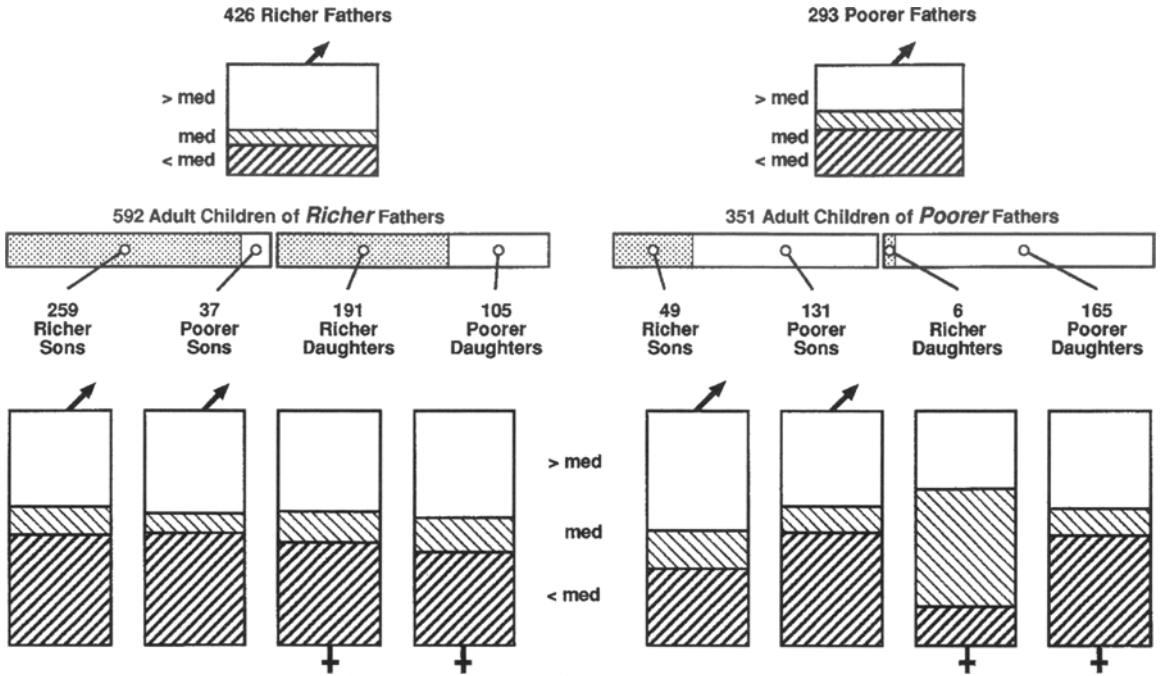

Figure 2. In generation 2, the adult sons and daughters of richer and poorer men had differential likelihoods of becoming richer or poorer, and there appears to have been an interaction between father's and own status—e.g., richer sons of poorer fathers (upwardly mobile men), though they were few, did much better reproductively than richer sons of richer men. The numbers of adult children in the different categories suggest that, although the overall sex ratio at birth was not skewed, a strong bias toward investment in sons did exist (see text).

differences in the inheritance and marriage patterns of these men's children (Figure 2). The richer men sired 626 children, of whom 592 survived to adulthood with known status: 259 richer sons (44.8%) and 37 (5.9%) poorer sons, and 191 richer daughters (35.1%) and 105 poorer daughters (37.3%). Poorer generation 1 men sired 369 children, of whom 351 survived to adulthood with known status: 49 richer sons (13.9%), 131 poorer sons (37.3%), 6 daughters who married richer men (1.7%), and 165 daughters who remained poorer (47%).

When the status of children is ignored, the overall sex ratio of children born in generation 2 is almost exactly equal: 111.6 sons:100 daughters (richer fathers) and 111.4:100 (poorer fathers). But both richer and poorer fathers tended to concentrate wealth in their sons (cf. Hartung 1982), even in this monogamous, relatively egalitarian society. The ratio of richer adult sons to daughters was 135.6:100 for richer fathers and 816.7:100 for poorer fathers. Poorer fathers produced richer adult sons (partly through inheritance concentration, partly through sons' initiative) at more than eight times the rate their daughters became richer (overwhelmingly through marriage). Still, poorer fathers were limited: the ratio of richer:poorer sons of poorer fathers was 37.4:100, compared with 700:100 richer:poorer sons of richer fathers. Daughters of richer men could more easily marry richer men (182:100 richer:poorer daughters of richer fathers vs. 3.6:100 richer:poorer daughters of poorer fathers).

Thus, although these families did not show the male bias in *production* of the two sexes that occurs in other samples (e.g., Voland 1984), they show a strong sex bias in *investment* in the two sexes, which differed between richer and poorer men. In particular, poorer fathers' wealth became distributed as though wealth would make a significant difference in their sons' reproduction. And the reproduction of "richer" sons of "poorer" fathers was dramatically higher than other categories; a majority had the median (16.3%) or more than the median (51%) number of children. Perhaps a sense of upward mobility—the comparison of trend in one's resources—is as important in fertility patterns as the absolute amount of resources. Johnson and Lean (1985), reviewing relevant studies, found that couples assess their income relative both to their parents' income and to that of others in their social-economic group. Similarly, Freedman and Thornton (1982) have shown that, in the United States, families make deliberate decisions about family size in response to their judgment of available resources, and that there is a correlation between income and deliberately chosen family size. When accidental pregnancies are considered, the picture becomes less clear. Other studies suggest that when income is judged as favorable relative to that of others, fertility is increased (e.g., Turke 1990).

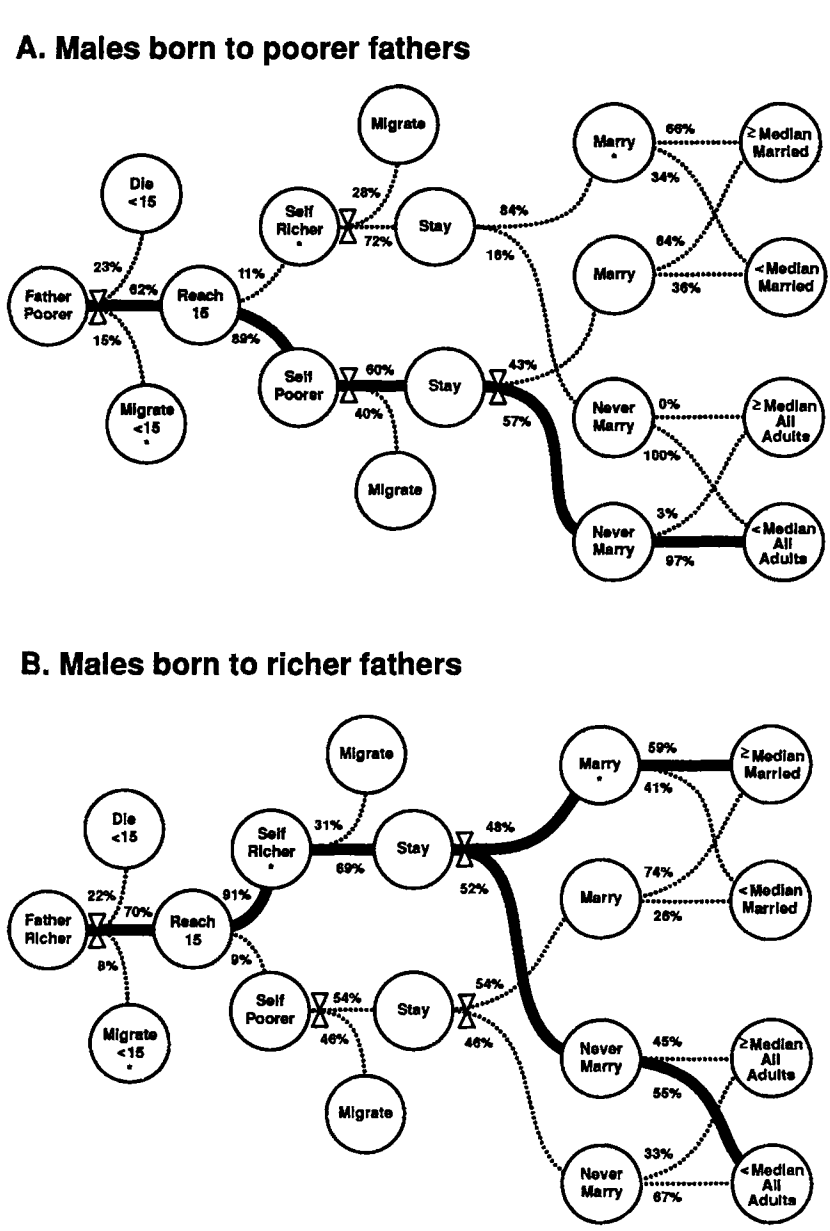

Figure 3. Some paths (heavy lines) were more likely than others for sons (generations 2–4) born to richer or poorer fathers. Reproductive comparisons are relative to all men who reached age 23 in the same decade in the same parish for unmarried individuals, and relative to all individuals marrying in the same parish during the same decade for married individuals. Statistically significant differences are highlighted by asterisks. Extrinsic factors (indicated by dotted lines) could matter, for example, in probability of out-migrating or marrying (see also Low

There are subtleties in the impact of wealth on lineages. It is obvious from Figure 2 that although the "richer" fathers of generation 1 had far more children than the "poorer" fathers, this pattern was not uniformly reflected in the lifetime reproduction of their children. All children of richer fathers had relatively high fertility, whether they themselves ended up richer or poorer. Richer generation 1 men averaged 4.7 grandchildren (3.44 in richer households); poorer men averaged 4.13 (0.77 in richer households). In this sample there is no singular pattern of fertility decline among the rich followed by a subsequent fertility decline among the poor. Fertility declined in some parishes but not others during this period (Low 1989a, 1990a; Low and Clarke 1991; Low et al. 1991). Even when fertility fell, richer men were reproductively better off than others.

Resources and Men's Lifetimes

These patterns reflect differences that begin early in life and persist for men (Figure 3). Low and Clarke (1992) analyzed the effects of wealth and status over lifetimes of men born into G2–G4. Males born to poor fathers were 7% more likely to migrate before age 15 than were sons of rich men (Low and Clarke 1992). As adults, sons of rich men were very likely (91%) to become wealthy themselves, whereas sons of poor men were likely to stay poor (89%). As adults, poor sons of rich men were

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Figure 3 (continued)
1989a; Clarke and Low 1992; Low and Clarke 1992). These greatest-likelihood pathways simply track the percentage at each comparison point of all individuals in the sample who followed one or another fate. This is a visual representation, and the numbers diminish at each juncture, so the percentages will not always suggest the results of the statistical analysis (e.g., a statistical difference may be great, while the percentage is small, or vice versa, because numbers are large or small). *(a)* Sons born to poorer fathers were likelier to leave the parish before age 15 than sons of richer fathers (15% vs. 8%); for sons of poorer men who stayed, there was an 89% chance they would be poor and a 40% chance they would migrate out as adults. For such men who stayed, they were likely never to marry (57%) and to have fewer than the median number of children (97%) compared with all adults. *(b)* Sons born to richer fathers, once they reached 15, had an excellent chance of becoming richer themselves (91%). These men were more likely to stay as adults (69%). Their chance of marrying was about 48%. Those who married tended to have the median or greater number of children (59%), compared with other married individuals; those who did not marry were likely to have fewer than the median number of children (55%), compared with all adults (modified from Low and Clarke 1992).

6% more likely to migrate than poor sons of poor men (see Clarke and Low 1992 on the influence of skills and resource liquidity on migration).

Of men who stayed in their birth parish, probability of marrying varied with own and father's status (Low and Clarke 1992). Poor sons of poor fathers were most likely to remain unmarried (57%); 97% of those poor, unmarried men had fewer than the median number of children. Rich sons of rich fathers had an approximately equal chance of marrying or not (48% vs. 52%), and once married had a 59% chance of having the median or greater number of children. Rich sons of rich fathers who did not marry were, like poor sons of poor fathers, more likely to have fewer than the median number of children. Ninety-seven percent of poor sons had this fate; 55% of rich sons did (Figure 3).

Low and Clarke (1992) found two less likely but interesting paths. The few men who were able to attain wealth even though born to a poor father had an 84% chance of marrying, and once married, a 66% chance of having at least the median number of children (see Figure 2). On the other hand, poor sons of rich fathers did not fare quite so badly as the poor sons of poor fathers. Poor sons of the rich still had a greater probability of marrying (54% vs. 46%). Perhaps these men benefited from their relationship within a wealthy family in ways not measured by their occupational status.

Thus, the most likely life paths for men varied. Sons born to poor fathers were most likely to remain poor themselves, never to marry, and to have fewer than the median number of children. Sons of rich men were most likely to become rich themselves. Their chances of marrying or not were about equal; if they married, they were likely to have at least the median number of children; if they did not marry, they were likely to have fewer than the median number. A man's lifetime fertility was influenced by his, and his father's, wealth. After a one-generation lag, lineage increase through daughters as well as sons may have been greater for rich men than for poor men (Low and Clarke 1992).

Legitimacy and Status

Rates of illegitimacy varied from 2% to 7% in the study parishes (Low et al. 1991; Low and Clark 1991). The father's status of illegitimate children was never given as "upper middle class"; lower-status men were consistently named as the fathers, just as conceptions during betrothal were a lower-class phenomenon. Illegitimate children had the same survival rates as legitimate children, but they tended to disappear from the sample when their mothers left the parish before the children were independent (Low and Clarke 1991). Clearly, these children stood to inherit

less. One possibility, of course, is that richer men never fathered children out of wedlock. However, two-thirds of the illegitimate children's fathers were not identified, and there is a possibility that richer men who did father illegitimate children escaped identification. If this was true, then the fertility of richer men is underestimated.

Men's Status and Children's Survivorship

In earlier within-parish studies (Low 1989a, 1990a, 1991; Low and Clarke 1991, 1992, 1993; Clarke and Low 1992), comparisons of within-family survivorship by father's occupation showed little pattern. Within any parish, the children of upper-middle-class men, for example, did not survive significantly better than the children of farmers or cottars. Since Sweden has had social mechanisms in place to insure egalitarian treatment perhaps longer than any other European country, this is the outcome we would hope for. But since very subtle differences would be easily swamped by changes from decade to decade (see Low and Clarke 1992), a broader comparison may be useful. Children of richer men did indeed survive better to age 10 than children of poorer men (all generations, $n = 1160$, d.f. = 1158, $t = 2.69$, $p = 0.007$), and with less variance in that survivorship ($n = 1160$, d.f. = 419,739, $F = 1.26$, $p = 0.003$). These subtle differences were undetectable in the smaller samples (Low 1989a, 1990a; Low and Clarke 1991, 1992).

These results contrast with the patterns of other European nations before the demographic transition. In some cases, the practice of sending children to be raised by wet nurses resulted in a very short interbirth interval—but high infant mortality—for richer classes. However, as Hrdy (1993) has shown, the effects were not uniform. In her study, women of the richest families (who could afford the best wet nurses) did in fact profit reproductively, but the next strata who practiced wet-nursing suffered lower family sizes because of high infant mortality and long interbirth intervals. I have found no evidence of wet-nursing in the Swedish sample for the nineteenth century.

Individual Variation and Population Patterns

Fertility patterns in noncontraceptive ("natural fertility") societies make some ecological sense (e.g., Bentley et al. 1993). Wrigley and Schofield (1981), in their extensive analysis, noted that marriage rates and age at marriage in pre-transition England correlated with various cost-of-living indices, suggesting that individual fertility decisions

responded to economic costs. Such correlations of population patterns with external conditions suggest that individual fertility is shaped by natural selection to respond to ecological conditions such as fluctuations in resources. If so, it should be no surprise that the nineteenth-century European decline in fertility called "the" demographic transition was in fact variable, and dependent on local resource conditions (Lockridge 1983; Low et al. 1992). When resources are relatively ineffective in lowering children's mortality or enhancing their competitive success, fertility will be high but variable (as among many traditional, pre- and proto-industrial societies; see review by Low and Clarke 1992; Low 1993a).

Even today, fertility declines are likely to be local, and locally reversible, rather than singular events with singular causes. But they may proceed by very different paths, and our ability to predict fertility shifts will depend on a number of factors, especially (1) how much parental investment assists individual children, and (2) in societies with high divorce rates, whether the two sexes respond differently to levels of resource availability. Perhaps the relative costs and benefits of children themselves are influential (e.g., Becker and Barro 1988; Easterlin 1978; Turke 1988).

Consider proposition 1: when resources become constricted, reproductive responses may vary, even within families. In a resource-constriction period, we might find very unequal investment in children within a family, with heightened investment in sons (whose success will be more dependent on resources than will daughters'), especially older (closer to reproduction) sons. Even the richest family's wealth could be dissipated through continued even distribution of investment in many children. Unequal investment, even in the face of legal mandates for equal inheritance, is unsurprisingly common (Hartung 1982), certainly in the Swedish data (Figure 2; Low 1989, 1990a, 1991; Low and Clarke 1991, 1992; Low et al. 1991). This can be not only inheritance, but even childhood care; Voland (1984) found that elder sons of farmers provided an exception to the general rule of male-biased mortality in childhood. Similarly Kishor (1993) found that sex differences in expected economic and kinship returns affected excess female mortality in India. The implications of sex differences (proposition 2) are explored more fully below.

Focusing on individuals in the demographic transition leads us to reconsider the phenomenon first described by MacArthur and Wilson (1967:145–150): when any conditions (in their case, increased population density) increase the importance of competitiveness among offspring, then parents are favored who shift from *production* of large numbers of offspring to increased *investment* in fewer offspring, in order to produce highly competitive offspring. This is true whether one considers cases in

which investment enhances survivorship directly, or cases such as those proposed by Tilly (1978) in which survivorship shifts are considered to be exogenous. MacArthur and Wilson argued that, when the density of conspecific competitors was low, selection favored "productivity," and competitive efficiency of offspring was relatively unimportant to their eventual success; in more competitive environments, selection favored the production of more competitive (better nourished, better taught) offspring—at the cost of number of offspring. Parents should shunt resources into offspring investment, even at the expense of offspring numbers—net lifetime reproduction was enhanced not by high fertility, but by lowered fertility—producing fewer but better-invested offspring. Unless there is a net increase in total resources, the allocation of available resources must be to fewer children (e.g., Rogers 1990, 1991). Rogers (1992) has modeled this process and concludes that optimal reproduction for a resource-rich parent may be less than the maximum possible number (see also Low 1993a; Low et al. 1992). Thus, under certain conditions we do expect to see real fertility shifts. Yet within each stratum, families with more resources are still likely to be better off reproductively (see Hughes 1988:91; Low and Clarke 1993).

Human parents have far more options than parents in other species. Human complexity, and conscious decision, can (as many demographers and economists have subtly appreciated) add special dimensions. For instance, not just amount of resources held but also the economic liquidity of those resources may influence an individual's success. In a deteriorating environment, a farmer's land may be less easily converted than alternative resources held by the upper- and lower-middle class. Under these circumstances, ownership of land, usually a valuable resource, may limit migration options (Clarke and Low 1992).

When increased investment in individual children enhances their ability to survive, marry, and reproduce, net lineage success can be enhanced by shifting more resources into investment in particular children (education, savings, health insurance, resource gifts, etc.). In many societies there is a strong sex difference in a child's ability to convert investment into marriage and a new generation. Thus several strategies are open to wealthier parents: a few, superbly invested children; more children, evenly and relatively well invested; and more children with uneven investment, perhaps by sex. This argument converges on several demographic models; it differs in maintaining that not primarily financial, but genetic lineage (reproductive) returns have shaped patterns of human fertility, and that financial considerations are most important in their influence on fertility and sometimes survivorship. Different predictions arise and can be tested; indeed, Boone (1986), Borgerhoff Mulder (1988), Hughes (1986), Mueller (1991), Turke (1989, 1990), Voland (1984,

1989, 1990), and Voland and Engel (1990) have begun just such tests.

The conceptual contribution of a behavioral ecological approach to demographic work is this: if we consider not only monetary but reproductive currencies, previously perplexing fertility patterns of some societies may become understandable, and we will expect the sorts of complexity we see—all individuals in a population are not affected equally by shifts in resources. The perceived lack of generalizability of some earlier models may be due not to flaws in the postulated relationships but to the difficulties of trying to explain patterns partly based on reproductive "decisions" by considering only the value of children in monetary (rather than lineage) currencies (cf. Becker's 1981 work). Following this logic, complexities across human societies in either the ecological or the social environment that result in increased effectiveness of parental investment should result in more investment, at the expense of fertility itself (Low et al. 1992; Low 1993a).

Men, Women, Resources, and Demographic Transitions

It is not surprising that wealth differentials promote fertility differentials, even in western societies like nineteenth-century Sweden, which were/are socially monogamous and attempt to be egalitarian. And unequal investment leads us to the problem of proposition 2 stated above: that men and women, like other male and female mammals, have probably used resources differently: men largely, though seldom exclusively, as mating effort, women as parental effort. These two kinds of expenditure have different return curves (Low 1993a), and as a result, the effect of "own" wealth on fertility appears to be positive for men and nonlinear for women (Figure 4). This has profound effects on just what happens to fertility in demographic transitions, and on our attempts to forge policy relative to fertility and population growth.

Wealthier men, whether they inherit or earn their wealth, can use that wealth in mating effort and in parental effort that is generalizeable (Low 1978), yielding higher fertility. Men at the low end of the socioeconomic scale may lack the resources to attract a mate, yet this may simply mean that they channel most of their effort into mating effort—gaining copulations—and a minimum into (nongeneralizable) parental investment (Trivers 1972).

I know of no studies with real data on the variance in reproductive success (RS) of poor men; most are anecdotal. Studies that actually measure lifetime success are, often by necessity, rather narrowly focused (Mueller 1991). Many studies attempting to consider the lifetime fertili-

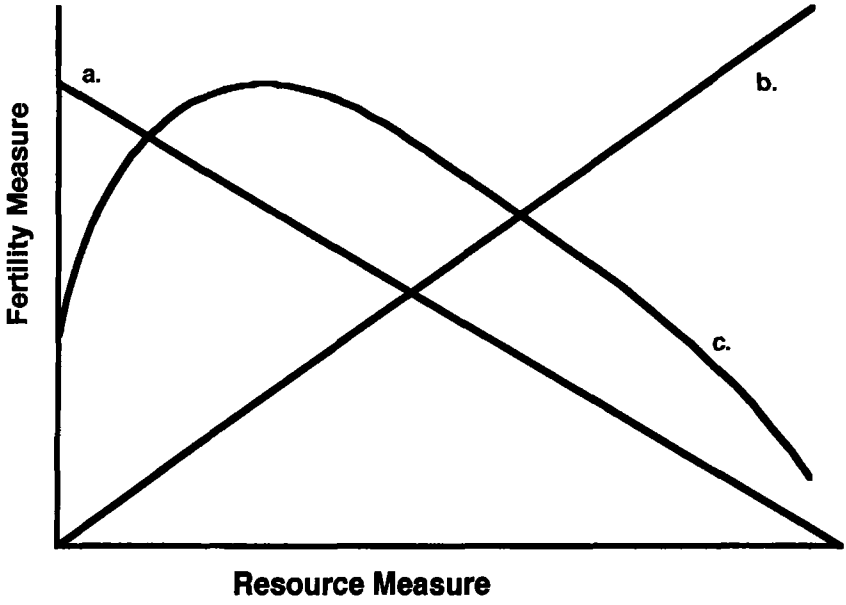

Figure 4. *(a)* Comparisons of aggregate data across countries (e.g., Birdsall 1980; Dixon-Mueller 1993) typically show fertility declining with wealth per capita. But these measures typically ignore both infant and maternal mortality, and there are complexities. *(b)* Within societies, or within strata in societies, wealthier men show higher fertility than poorer men (e.g., Irons 1979; Low 1993a), perhaps responding to their predictions of their own future success compared with that of others (Freedman and Thornton 1982; Johnson and Lean 1985). *(c)* When women are active in a market economy and providing their own resources, very poor (Rank 1989) and richer, better-educated (Kasarda et al. 1986) women suffer reduced fertility. Thus, accurate predictions about fertility must be based on knowledge of the family and market structures.

ty problem are methodologically flawed (e.g., Vining 1986). Other studies, ones that are not asking questions about lifetime fertility or are specifically about men versus women, also have methodological problems that would prohibit this type of assessment (e.g., Dixon-Mueller 1993; United Nations 1976). Two difficulties are most common: either fertility itself is not measured (e.g., Vining), or fertility is measured but men who never marry are excluded from the analysis! These are precisely the individuals whose lifetimes make the principal difference in wealth-fertility correlations (see Low 1988)—and in most societies, more poor men than rich fail to marry, so systematic bias is likely.

The *proximate* correlates between wealth and fertility still hold. Pérusse (1993) has shown that richer men have greater sexual access than poorer men. At the less-studied "low" end of the socioeconomic scale, both sexes probably suffer lowered fertility through lowered access to resources, though for somewhat different functional reasons. My prediction would be that poor men's mean RS is low but has a higher variance than that of poor women.

Women experience more conflict between resource-garnering and fertility than men, whether they gather food for themselves and their children (Blurton Jones 1986, 1987, 1989; Hurtado et al. 1992) or become highly educated and earn salaries in the marketplace (e.g., Kasarda et al. 1986), since more of women's effort is directed to parental, not mating, effort. And when women are single parents, or provide the bulk of resources (Lancaster 1989) in a market economy, this conflict will be exacerbated. When monetary resources become central to children's success, women's shift from traditional maternal investment patterns to market employment has a negative impact on fertility (e.g., Farooq and DeGraff 1988; Mueller and Short 1983). This may show up as a correlation with industrialization, but the apparent link to industrialization appears to be an example of a general phenomenon: technological advances may require more education or training (e.g., Knodel et al. 1990) and thus more investment to produce each competitive child. Such education (or other required skills) is seldom free; thus we might expect fertility declines frequently to start among the rich (who have the most to invest in competitiveness and, as noted above, typically the largest family sizes). Women's work can affect fertility in another way. Turke (1989) argues that, as family and kinship networks are weakened (e.g., by spatial disruption), fertility will fall. Older children and non-descendant relatives initially constitute a resource for mothers—nepotistic effort. When that resource declines, as when other caretakers also enter the market, children pose an increased cost to their parents (especially mothers), a cost no longer defrayed by kin help—and women's fertility will decline.

In societies like nineteenth-century Sweden, in which wealth was typically men's wealth and divorce was virtually unknown, women's resource-fertility patterns look like men's (Low and Clarke 1993). In western industrialized nations today, in which women are a large part of the labor force (with the conflicts noted above) and divorce is prevalent, the wealth-fertility correlation for women is probably not linear (Figure 4, curve c). Rank (1989) found that at low socioeconomic levels, women on welfare have fewer children—their age-specific fertility is lower at all ages—than women not on welfare. These welfare recipients specifically cited the need for resources to invest in their existing chil-

dren as their reason for avoiding further pregnancies (Rank 1989). These women were seeking resources explicitly as parental investment. Both their mean reproductive success and the variance in that reproduction are low. Thus, women at the low end of the socioeconomic scale in market economies, many of them single mothers, find themselves in situations in which children require considerable investment. They are likely, as Rank (1989) found, to have low fertility deliberately, in an attempt to break out of the poverty cycle.

Women who reach high socioeconomic status through their own work also have low fertility (e.g., Kasarda et al. 1986), since they experience more conflict between efforts at earning and parental effort. And this result may transfer to developing nations: one of the strongest correlates with fertility decline in developing nations is women's participation in the labor force (Rodriguez and Cleland 1981). About half the difference between rural and urban fertility in developing nations is due to women's educational and employment opportunities in the cities.

Thus there are important sex differences in correlations between resources and fertility (Figure 4). Men's reproductive patterns appear to vary more linearly with resource control than do women's patterns; this difference between the sexes is greatest when resources are abundant. If the results of this study are representative, men's reproductive patterns are likely to have significant influence on the population fertility outcomes of demographic transitions in monogamous societies, including most developing countries. In human populations in general, as in this study, male fertility typically increases with income within socioeconomic groups (see Figure 4, curve b). When a child's eventual effectiveness in obtaining resources requires more (especially monetary) parental investment in individual children (western European industrialization, Thai labor markets requiring costly education), we predict fertility decline, but when it does not (many protoindustrial and other labor markets using unskilled labor), we do not.

Thus, the difference in men's versus women's fertility responses to own versus others' (father's, spouse's) wealth may be important. The general pattern that, across countries, as resources (measured as GNP) increase, fertility (measured as women's total fertility rate, not counting within-society variance, maternal or infant death) declines (Birdsall 1980; Figure 4, curve a) may be the result not of industrialization but of a complex of non-covarying factors. When the fertility of all adult men is considered, as resources increase, fertility increases (Hughes 1988; Low and Clarke 1993; also see Figure 4, curve b). When women's income and fertility become more independent from men's, as is common today, the pattern is likely to be nonlinear (Figure 4, curve c). Further, increasing GNP may be a correlate of cultural/technological/economic

changes that result in a competitive requirement for increasing investment in individual children (sons more often than daughters) to ensure their success (Low and Clarke 1992)—and increased investment, by even a few families, will raise the stakes for all competing families in the population (Rogers 1990; Turke 1989). Some of the "mixed" nature of data on fertility and income in current societies may arise here.

Thus, the level of investment required to produce successful offspring will vary with environment, and specifically with the investment threshold required for a child's success—often a correlate of competition, and in this sense, precisely analogous to the proper use of MacArthur and Wilson's (1967) concept. If poorer parents cannot substantially enhance their children's success, then we might expect larger families and concentration of resources in one or a few children, with others living with the family or leaving early (behavioral ecologists would call this an "alternate strategies" situation). Couples at the high end of the socioeconomic "ladder" might do better by investing more per child to allow them to be competitive with their peers (e.g., education, clothing, status acquisitions). The required investment may limit the number of children they can afford (see Rogers 1992 for a formal assessment with simple assumptions). Within subgroups, however, those with more than sufficient resources may be able to support additional children and still provide all with adequate investment. Further, because of the differences in impact of resources for the two sexes, we may find differential treatment of sons and daughters by richer versus poorer families (an extreme would be the class-related sex-preferential infanticide reported in Dickemann 1979). When women raise children alone, the problems are exacerbated for them.

In this study, men's resources positively influenced their lifetime reproductive success, both through production of and investment in children. Sex biases in investment existed (e.g., sons virtually always inherited any land), and the effect of investment was generally greater for sons than for daughters (Low and Clarke 1992). Sons of richer men were more likely to stay in the parish, to inherit wealth, to be rich as adults, to marry, and thus to continue wealth-fertility disparities into the next generation. Clearly, historical events complicate the picture, but the generally positive wealth/status-fertility relationship appears to hold not only for traditional societies but also through the demographic transition in nineteenth-century Sweden. External conditions that influence competitiveness influence the relative potency of investment versus production, and that potency differs for men versus women. Perhaps a reexamination of existing data in this broader, behavioral ecological perspective would be useful.

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Bobbi S. Low is Professor of Resource Ecology at the School of Natural Resources and Environment. Her background is in behavioral and evolutionary ecology and her current research interests are human sex differences in risk-taking and resource use.

REFERENCES

Becker, G.
1981 *A Treatise on the Family*. Cambridge: Harvard University Press.

Becker, G., and R. J. Barro
1988 Reformulating the Economic Theory of Fertility. *Quarterly Journal of Economics* 103:1–25.

Bentley, G. R., T. Goldberg, and G. Jasienska
1993 The Fertility of Agricultural and Non-Agricultural Traditional Societies. *Population Studies* 47:269–281.

Birdsall, N.
1980 Population Growth and Poverty in the Developing World. *Population Bulletin* 35(5):3–46.

Blurton Jones, N.
1986 Bushman Birth Spacing: A Test for Optimal Interbirth Intervals. *Ethology and Sociobiology* 7:91 105.
1987 Bushman Birth Spacing: Direct Tests of Some Simple Predictions. *Ethology and Sociobiology* 8:183–203.
1989 The Costs of Children and the Adaptive Scheduling of Births: Towards a Perspective on Demography. In *Sexual and Reproductive Strategies*, A. Rasa, C. Vogel, and E. Voland, eds. Pp. 265–282. Kent: Croom Helm.

Boone, James L. III
1986 Parental Investment and Elite Family Structure in Preindustrial States: A Case Study of Late Medieval–Early Modern Portuguese Genealogies. *American Anthropologist* 88:859–878.

Borgerhoff Mulder, M.
1988 Kipsigis Bridewealth Payments. In *Human Reproductive Behaviour: A Darwinian Perspective*, L. Betzig, M. Borgerhoff Mulder, and P. Turke, eds. Pp. 65–82. Cambridge: Cambridge University Press.

Brändström, A.
1984 De Kärlekslösa Mödrarna: Späd Barnsdödligheten i Sverige under 1800-talet med Särskild Hänsyn till Nedertorneå. *Acta Universitatis Umensis* 62:1–271.

Clarke, A. L., and B. S. Low
1992 Ecological Correlates of Dispersal in Nineteenth Century Sweden. *Animal Behaviour* 44:677–693.
Clutton-Brock, T. H.
1983 Selection in Relation to Sex. In *Evolution from Molecules to Man*, D. S. Bendall, ed. Pp. 457–481. Cambridge: Cambridge University Press.
Clutton-Brock, T. H., F. E. Guinness, and S. D. Albon
1982 *Red Deer: The Behaviour and Ecology of Two Sexes*. Chicago: Chicago University Press.
Daly, M., and M. Wilson
1983 *Sex, Evolution, and Behavior*, second ed. Boston: Willard Grant Press.
Dickemann, M.
1979 Female Infanticide, Reproductive Strategies, and Social Stratification: A Preliminary Model. In *Evolutionary Biology and Human Social Behavior: An Anthropological Perspective*, N. A. Chagnon and W. Irons, eds. Pp. 321–367. North Scituate, Massachusetts: Duxbury Press.
Dixon-Mueller, R.
1993 *Population Policy and Women's Rights: Transforming Reproductive Choice*. Westport, Connecticut: Praeger.
Easterlin, R.
1978 The Economics and Sociology of Fertility: A Synthesis. In *Historical Studies of Changing Fertility*, C. Tilly, ed. Pp. 57–134. Princeton: Princeton University Press.
Essock-Vitale, S.
1984 The Reproductive Success of Wealthy Americans. *Ethology and Sociobiology* 5:45–49.
Falconer, D. S.
1981 *Introduction to Quantitative Genetics*, second ed. London and New York: Longman.
Farooq, G. M., and D. DeGraff
1988 Fertility and Development: An Introduction to Theory, Empirical Research, and Policy Issues. World Employment Programme Background Papers for Training in Population, Human Resources, and Development Training No. 7.
Fisher, R. A.
1958 *The Genetical Theory of Natural Selection*, second rev. ed. New York: Dover.
Flandrin, J. L.
1979 *Families in Former Times: Kinship, Household, and Sexuality*, R. Southern, trans. Cambridge: Cambridge University Press.
Freedman, D. S., and A. Thornton
1982 Income and Fertility: The Elusive Relationship. *Demography* 19(1): 65–78.
Gaunt, D.
1977 I Slottets Skugga. Om Frällse-bönders Sociala Problem i Borgeby och Löddekoppinge under 1700-talet. *Ale* 15–30.
1983 The Property and Kin Relations of Retired Farmers. In *Family Forms in Historic Europe*, R. Wall, J. Robin, and P. Laslett, eds. Cambridge: Cambridge University Press.

1987 Rural Household Organization and Inheritance in Northern Europe. *Journal of Family History* 12:121–141.

Gerger, T., and G. Hoppe
1980 Education and Society: The Geographer's View. *Acta Universitatis Stockholmensis* 1:1–124.

Habakkuk, H. J.
1955 Family Structure and Economic Change in Nineteenth-Century Europe. *Journal of Economic History* 15:1–12.

Hajnal, J.
1965 European Marriage Patterns in Perspective. In *Population in History: Essays in Historical Demography*, D. V. Glass and D. E. C. Eversley, eds. Pp. 101–143. London: Edward Arnold.

Hartung, J.
1982 Polygyny and Inheritance of Wealth. *Current Anthropology* 23:1–12.

Hughes, A. L.
1986 Reproductive Success and Occupational Class in Eighteenth-Century Lancashire, England. *Social Biology* 33:109–115.
1988 *Evolution and Human Kinship*. Oxford: Oxford University Press.

Hurtado, M., K. Hill, H. Kaplan, and I. Hurtado
1992 Tradeoffs between Food Acquisition and Child Care among Hiwi and Ache Women. *Human Nature* 3:185–216.

Hrdy, S. B.
1993 Fitness Tradeoffs in the History and Evolution of Delegated Mothering with Special Reference to Wet-Nursing, Abandonment, and Infanticide. *Ethology and Sociobiology* 13(5/6):409–442.

Inger, G.
1980 *Svensk Rättshistoria*. Lund: Liber Laromedel.

Irons, W.
1979 Cultural and Biological Success. In *Evolutionary Biology and Human Social Behavior: An Anthropological Perspective*, N. A. Chagnon and W. Irons, eds. Pp. 257–272. North Scituate, Massachusetts: Duxbury Press.

Johnson, N. E., and S. Lean
1985 Relative Income, Race, and Fertility. *Population Studies* 39:99–112.

Jörberg, L.
1972 *A History of Prices in Sweden: 1732–1914*, 2 vols. Lund: CWK Gleerup.
1975 Structural Change and Economic Growth in Nineteenth-Century Sweden. In *Sweden's Development from Poverty to Affluence, 1750–1970*, S. Koblik, ed. Pp. 92–135. Minneapolis: University of Minnesota Press.

Kasarda, J. D., J. O. G. Billy, and K. West
1986 *Status Enhancement and Fertility: Reproductive Responses to Social Mobility and Educational Opportunity*. New York: Academic Press.

Keyfitz, N.
1985 *Applied Mathematical Demography*, second ed. New York: Springer-Verlag.

Kishor, S.
1993 "May God Give Sons to All": Gender and Child Mortality in India. *American Sociological Review* 58:247–265.

Knodel, J., N. Havanon, and W. Sittitrai
1990 Family Size and the Education of Children in the Context of Rapid Fertility Decline. *Population and Development Review* 16(1):31–62.

Lancaster, Jane B.
1989 Evolutionary and Cross-Cultural Perspectives on Single-Parenthood. In *Sociobiology and the Social Sciences,* R. W. Bell and N. J. Bell, eds. Pp. 63–72. Lubbock: Texas Tech University Press.

LeBoeuf, B., and J. Reiter
1988 Lifetime Reproductive Success in Northern Elephant Seals. In *Reproductive Success: Studies of Individual Variation in Contrasting Breeding Systems,* T. H. Clutton-Brock, ed. Pp. 344–362. Chicago: University of Chicago Press.

Lithell, U.-B.
1982 Poverty and Marital Fertility: A Low Standard of Living as a Determinant of a Low Level of Marital Fertility and a High Infant Mortality. In *Marriage and Fertility: Local Patterns in Pre-industrial Sweden, Finland and Norway,* J. Rogers, ed. Pp. 67–95. Reports of the Family History Group No. 3. Uppsala: Department of History, University of Uppsala.

Lockridge, K. A.
1983 The Fertility Transition in Sweden: A Preliminary Look at Smaller Geographic Units, 1855 1890. *Demographic Database Report* 3:1–135. Umeå: Umeå University.

Lo-Johannsson, F.
1981 *Sveriges Rikes Lag: Gillad och Antagen Parisdagen Ar, 1734, faksimilutgava.* Malmo: Giulunds.

Low, Bobbi S.
1978 Environmental Uncertainty and the Parental Strategies of Marsupials and Placentals. *American Naturalist* 112:197–213.
1988 Measures of Polygyny in Humans. *Current Anthropology* 29:189–194.
1989a Occupational Status and Reproductive Behavior in Nineteenth-Century Sweden: Locknevi Parish. *Social Biology* 36:82–101.
1989b Cross-Cultural Patterns in the Training of Children: An Evolutionary Perspective. *Journal of Comparative Psychology* 103(4):311–319.
1990a Occupational Status, Landownership, and Reproductive Behavior in Nineteenth-Century Sweden: Tuna Parish. *American Anthropologist* 92:457–468.
1990b Sex, Power, and Resources: Ecological and Social Correlates of Sex Differences. *International Journal of Contemporary Sociology* 27:49–73.
1991 Reproductive Life in Nineteenth Century Sweden: An Evolutionary Perspective on Demographic Phenomena. *Ethology and Sociobiology* 12: 411–448.
1993a Ecological Demography: A Synthetic Focus in Evolutionary Anthropology. *Evolutionary Anthropology* 1(5):177–187.
1993b Resources and Reproduction: What Hath the Demographic Transition Wrought? *Behavior and Brain Sciences* 16(2):300.

Low, Bobbi S., and A. L. Clarke
1991 Family Patterns in Nineteenth Century Sweden: Impact of Occupational Status and Land Ownership. *Journal of Family History* 16(2):117–138.
1992 Resources and the Life Course: Patterns through the Demographic Transition. *Ethology and Sociobiology* 13:463–494.
1993 Historical Perspectives on Population and Environment: Data from Nineteenth Century Sweden. In *Population-Environment Dynamics: Ideas and Observations,* G. Ness, W. Drake, and S. Brechen, eds. Pp. 195–224. Ann Arbor: University of Michigan Press.
Low, Bobbi S., A. L. Clarke, and K. Lockridge
1991 *Family Patterns in Nineteenth-Century Sweden: Variation in Time and Space.* Demographic Database Monograph No. 6. Umeå, Sweden.
1992 Toward an Ecological Demography. *Population and Development Review* 18(1):1–35.
MacArthur, R. H., and E. O. Wilson
1967 *The Theory of Island Biogeography.* Princeton: Princeton University Press.
Malmström, A.
1981 *Successsionsratt II.* Uppsala: Iustrus Forlag.
Mendels, F. F.
1981 *Industrialization and Population Pressure in Eighteenth-Century Flanders.* New York: Arno Press.
Mueller, U.
1991 *Social and Reproductive Success. Theoretical Considerations and a Case Study of the West Point Class of 1950.* Mannheim, Germany: ZUMA (Zentrum für Umfragen, Methoden und Analysen).
Mueller, E., and K. Short
1983 Effects of Income and Wealth on the Demand for Children. In *Determinants of Fertility in Developing Countries,* R. A. Bulatao and R. D. Lee, eds. Volume 1: Supply and Demand for Children. Pp. 590–642. New York: Academic Press.
Norberg, A., and M. Rolén
1979 Migration and Marriage: Some Empirical Results from Tuna Parish, 1865 1894. In *Time, Space, and Man: Essays on Microdemography,* J. Sundin and E. Söderlund, eds. Pp. 133–135. Stockholm: Almqvist and Wiksell.
Ostergren, R.
1990 Patterns of Seasonal Industrial Labor Recruitment in a Nineteenth Century Swedish Parish: The Case of Matfors and Tuna, 1846–1873. *Demographic Data Base Report* No. 5:1–100. Umeå, Sweden.
Pérusse, D.
1993 Cultural and Reproductive Success in Industrial Societies: Testing the Relationship at Proximate and Ultimate Levels. *Behavior and Brain Sciences* 16(2):267–283.
Rank, M. A.
1989 Fertility among Women on Welfare: Incidence and Determinants. *American Sociological Review* 54:296–304.

Rodríguez, G., and J. Cleland
1981 The Effects of Socioeconomic Characteristics on Fertility in 20 Countries. *International Family Planning Perspectives* 7(3):93–101.
Rogers, A. R.
1990 The Evolutionary Economics of Human Reproduction. *Ethology and Sociobiology* 11:479–495.
1991 Conserving Resources for Children. *Human Nature* 2:73–82.
1992 Resources and Population Dynamics. In *Evolutionary Ecology and Human Behavior*, E. A. Smith and B. Winterhalder, eds. Pp. 375–402. New York: Aldine de Gruyter.
Røskaft, E., A. Wara, and A. Viken
1992 Reproductive Success in Relation to Resource-access and Parental Age in a Small Norwegian Farming Parish during the Period 1700–1900. *Ethology and Sociobiology* 13:443–461.
Schofield, R. S., and D. Coleman
1986 Introduction: The State of Population Theory. In *The State of Population Theory: Forward from Malthus*, D. Coleman and R. S. Schofield, eds. Pp. 1–13. London: Blackwell.
Sundin, J.
1976 Theft and Penury in Sweden, 1830–1920: A Comparative Study at the County Level. *Scandinavian Journal of History* 1:265–292.
Sundin, J., and L.-G. Tedebrand
1981 Mortality and Morbidity in Swedish Iron Foundries, 1750–1875. In *Tradition and Transition: Studies in Microdemography and Social Change*, A. Brändström and J. Sundin, eds. Pp. 105–159. Umeå: Demographic Database, University of Umeå.
Symons, J.
1974 *The Effects of Income on Fertility*. Carolina Population Center Monograph 19. Chapel Hill, North Carolina.
Tilly, Charles
1978 The Historical Study of Vital Processes. In *Historical Studies of Changing Fertility*, C. Tilly, ed. Pp. 1–55. Princeton: Princeton University Press.
Trivers, R.
1972 Parental Investment and Sexual Selection. In *Sexual Selection and the Descent of Man*, B. Campbell, ed. Pp. 136–179. Chicago: Aldine.
Turke, P. W.
1988 Helpers at the Nest: Childcare Networks in Ifaluk. In *Human Reproductive Behaviour: A Darwinian Perspective*, L. Betzig, M. Borgerhoff Mulder, and P. Turke, eds. Pp. 173–188. Cambridge: Cambridge University Press.
1989 Evolution and the Demand for Children. *Population and Development Review* 15(1):61–90.
1990 Which Humans Behave Adaptively, and Why Does it Matter? *Ethology and Sociobiology* 11:305–339.
United Nations
1976 Fertility and Planning in Europe around 1970. Population Series, No. 58.

Vining, D. R.
1986 Social versus Reproductive Success: The Central Theoretical Problem of Human Sociobiology. *Behavior and Brain Sciences* 9:167–216.
Voland, E.
1984 Human Sex-Ratio Manipulation: Historical Data from a German Parish. *Journal of Human Evolution* 13:99–107.
1989 Differential Parental Investment: Some Ideas on the Contact Area of European Social History and Evolutionary Biology. In *Comparative Socioecology: The Behavioural Ecology of Humans and Other Mammals,* V. Standen and R. A. Foley, eds. Pp. 391–402. Special Publication 8. London: British Ecological Society.
1990 Differential Reproductive Success within the Krummhörn Population (Germany, 18th and 19th Centuries). *Behavioral Ecology and Sociobiology* 26:65–72.
Voland, E., and C. Engel
1990 Female Choice in Humans: A Conditional Mate Selection Strategy of the Krummhörn Women (Germany, 1720 1874). *Ethology* 84:144–154.
Wrigley, E. A., and R. S. Schofield
1981 *The Population History of England, 1541–1871.* Cambridge: Harvard University Press.