Resources and the Life Course: Patterns Through the Demographic Transition

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In most mammals, and in the majority of traditional human societies for which data exist, status, power, or resource control correlates with lifetime reproductive success; male and female patterns differ. Because such correlations are often argued to have disappeared in human societies during the demographic transition of the nineteenth century, we analyzed wealth and lifetime reproductive success in a nineteenth-century Swedish population in four economically diverse parishes, subsuming geographic and temporal variation. Children of both sexes born to poorer parents were more likely than richer children to die or emigrate before reaching maturity. Poorer men, and women whose fathers were poorer, were less likely to marry in the parish than others, largely as a result of differential mortality and migration. Of all adults of both sexes who remained in their home parish and thus generated complete lifetime records, richer individuals had greater lifetime fertility and more children alive at age ten, than others. The age-specific fertility of richer women rises slightly sooner, and reaches a higher peak, than that of poorer women. These patterns persisted throughout the period of the sample (1824–1896). Thus, wealth appears, even during the demographic transition in an egalitarian society, to have influenced lifetime reproductive success positively.

INTRODUCTION

An important question is what, in any species, contributes to greater or lesser lifetime reproductive success In most mammals, access to important resources is a strong correlate of lifetime success. Humans are of particular interest In many traditional societies for which there are data, humans seem to fit the typical mammalian pattern (e g , Chagnon 1988, Betzig 1986, Irons 1979, and others, see review by Low et al 1992) Yet in modern (post-demographic transition) societies the anal-

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ysis of this relationship is complicated by temporal variation and lack of appropriate data As a result, several authors have assumed that the demographic transition destroyed any relationship (see discussion by Low et al 1992) Here, we examine 19th-century Swedish data on the impact of resource access on male and female lifetime patterns and eventual reproduction, through the demographic transition, to examine the validity of that assumption

The competitive environment into which humans are born is extremely complex, in part due to the long lifetime over which individuals must respond to changing conditions which will affect themselves and their offspring Demographic transition theory rests on the argument that environmental changes (in most arguments, linked to industrialization) caused family sizes to drop Sometimes the arguments are made at the population level (e g , Coale 1986, Wrigley 1985a,b, Viazzo 1990), sometimes at the level of perceived value of children by their parents (Hammel et al 1983) Simpler, more parsimonious arguments exist, which require no group selection, and which are a subset of the well-tested and well-supported behavioral ecological explanations of changes in reproductive output of other species Here, we analyze the relationship between wealth and relative reproductive success throughout the life patterns of people in 19th-century Sweden a population for which excellent records exist through the historic demographic transition from large to small family sizes We examine longitudinal lifetime data from individuals in four Swedish parishes, seeking correlates of reproductive success

Our behavior ecological approach begins with the argument that behaviors which become common and remain so are those that produce reproductive profit for their performers Even for nonhuman species, because the world is often far more complex than one might at first imagine, maximum fertility is not always optimum In fact, "Most successful reproduction" does not necessarily mean producing the most offspring, or even the most surviving offspring (e g , Lack 1947, 1966, Dawkins 1982, 1986, 1989, Williams 1966, Daly and Wilson 1983) The existence of a large "zero success" reproductive group contributes enormously to the variance (cf Falconer 1981), far more than the production of, for example, eight versus six offspring No species produces offspring at its maximum physiologically defined rate, reproductive success depends not only on production, but also on the investment required to produce viable, competitive, reproductive offspring Thus producing fewer, better-invested offspring, compared to the maximum physiologically possible, can be, depending on environmental conditions, reproductively more efficient Costs and benefits may differ for male and female parents (e g , see Daly and Wilson 1983, Krebs and Davies 1991) This reiterates and extends the "quantity-versus-quality" dilemma first raised by Darwin (1871)

If there is a behavioral ecology of fertility, many patterns of starting, stopping, and spacing children are possible adaptive responses to environ-

mental conditions that vary among societies and across time, rather than non-optimum-because-not-maximum patterns (see review by Low et al 1992). Behavioral ecological approaches are really cost-benefit approaches that use reproductive as well as economic currencies. Both purely economic and Darwinian views of fertility recognize that social and economic success are important goals affecting reproductive decisions. But those who do not specify such goals as proximate goals (that have over evolutionary time correlated with enhanced reproductive success) make quite different predictions from Darwinians: for example, that it is most rational to produce maximal number of children in traditional societies (e g , Handwerker 1986) An evolutionary approach argues that fertility schedules should respond to ecological conditions (e g , Turke 1989, 1990, Blurton Jones 1986, 1987, 1989), and that better- versus worse-off families should respond differently

In preindustrial human societies, resources and net lifetime reproductive success are correlated (Hill 1984, Chagnon 1988, Betzig 1986; Boone 1986; Hughes 1986, 1988, Flinn and Low 1986, Voland 1990, Voland and Engel 1990, Low 1989, 1990a,b, 1991) Human patterns, though, can vary greatly, and show many historical particulars There seems to be a stronger association between status or resource control and reproduction among traditional societies than among modern, post-transition societies, thus data from the demographic transition are important

Hypothesis and Predictions: What Influences Individual Reproductive Lives?

Here, then, we will ask, in the most synthetic manner, about lifetime reproduction and wealth, about the survivorship and fertility of richer versus poorer individuals in a society entering the demographic transiton Did the survivorship of children of richer versus poorer parents differ? Were these children more or less likely to leave the parish as children? As adults, were richer versus poorer individuals more likely to leave the parish? As adults, if they stayed, were they more or less likely to marry? Did the age-specific fertility of richer versus poorer women differ? Available resource levels should influence fertility, mortality, and migration in specific ways Abundant resources should be associated with high fertility and low out-migration from the region, reduction in resources should be accompanied by lowered fertility and greater out-migration

The hypothesis that resources contribute to enhanced survivorship and reproduction generates the following predictions

[1] Children of richer families should survive better to adulthood (here, as earlier, defined as reaching age 15)

[2] Children of poorer families, as their parents seek better opportunities elsewhere, should be more likely to move from the home region (parish) before reaching age 15

[3] Of those individuals reaching maturity (age 15) in the parish, poorer

individuals, again seeking better opportunities elsewhere, should be more likely to leave the parish before marrying Theory suggests that women may typically leave the parish in order to marry, while men may be more likely to leave for occupational reasons (Clarke and Low in press) but we cannot yet test for this difference

[4] Of adults remaining in the parish, richer individuals should be likelier to marry than poorer

[5] Of individuals for whom we have full reproductive records, wealthier individuals should show higher lifetime fertility (NBC, Low 1989, 1990a) and greater completed family size (RS_{10}, Low 1989, 1990a) than poorer individuals

[6] Women married to wealthier men should show higher age-specific fertility than poorer women

THE SAMPLE AND METHODS

Our data from the 19th century, in four geographically separated parishes (Tuna, Locknevi, Gullholmen, and Nedertorneå), follow, from 1824 to 1896 (when records end for privacy reasons), the lifetimes of descendants of a cohort of men married in the parishes between 1824 and 1840 The sample includes longitudinal (lifetime) data for all individuals sex, date of birth, age at marriage, best occupation, date of record loss, type of record loss (death, emigration), dates of birth of all children, and comparable data for those children (see Low et al 1991)

The four parishes differ in economic and ecological conditions (described below) We choose this time and these places because excellent records exist, and the demographic transition is of considerable theoretical interest with regard to the issue of numbers versus investment in offspring In previous papers, we have treated specific comparisons for individual parishes involving the influence of occupational status (Low 1989, 1990a, Low and Clarke 1991, Low et al 1991), land (Low 1990a), and extrinsic economic fluctuations (Low and Clarke in press), the interaction of these with other forces such as mother's age and birth order (Low 1991), how these influence individual reproductive success (Low 1989, 1990a, 1991, Low and Clarke 1991, Low et al 1991) and probability of migration (Clarke and Low in press) and the variation in impact across time and space (Low et al 1991, 1992)

Here, new analyses summarize how 19th-century Swedish life courses varied as a result of resources, we seek the most general possible answer It is difficult to elucidate relationships that vary both temporally and spatially, hence we have structured our analyses to make comparisons by decade and by parish (below) Doing this allows us to analyze the relationship between resources and lifetime reproduction through the changing economic and social times of the demographic transition, and in parishes of very dif-

ferent base fertility levels Thus we can follow sometimes subtle relationships through the changing times of the 19th century

Nineteenth-Century Sweden

Nineteenth-century Sweden was largely agricultural, with emerging proto-industrialization (Mendels 1981) geographically scattered market activity which involved transforming raw materials into "made" commodities, but with a large part of the labor force working 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 combining an underemployed, land-poor population, with access to urban markets (e g , Tilly 1978) In Sweden it is probably related to land enclosure and inheritance changes during the nineteenth century (Jorberg 1972, 1975) 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 At marriage the new couple typically set up their own independent household, a relatively high proportion of individuals never married (Low 1989, 1990a, Low and Clarke 1991)

From 1686 to 1810, the nobility practiced "fideicommiss," or male primogeniture, with the constraint that the eldest son must continue the practice (Malmstrom 1981, Inger 1980) Until 1845, 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 which were to be their inheritance, and sons could purchase their sisters' inheritance from them (Lo-Johansson 1981, Inger 1980) 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 (not uncommon elsewhere in Europe, see Habakkuk 1955) Even after the shift from fideicommiss, and even after establishment of legally equal inheritance rules for both sons and daughters, inheritance biased by birth order was often evident (see Gaunt 1987, Low 1989, 1990a), and a bias toward the first son was perhaps more evident in the northern areas 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, there probably existed some tension both within and between generations over resources

Access to resources was important to men's reproductive success in 19th-century Sweden, although the particulars differed among the parishes Individuals might be better off because they owned land (Low 1990a, Low

and Clarke 1991, in press), because they had higher status or more stable occupations (Low 1989, Low and Clarke 1991, in press), or simply because they were first-born in a family, and therefore had higher reproductive value to the parents (e g , Fisher 1958, Keyfitz 1985) A man's best occupation was associated with differential likelihood of marrying (Low and Clarke 1991), married men had significantly more (acknowledged) children than unmarried men, and significantly more children surviving to age ten (Low 1990a, Low and Clarke 1991) Richer men married younger (higher reproductive value, Fisher 1958) women than poorer men, and had larger families (Low 1989, 1990a, Low and Clarke 1991) 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) For women, age at marriage was the most important determinant of lifetime reproduction (Low 1989, 1990a, Low and Clarke 1991), women who married richer men tended to marry earlier

Females were more likely to migrate than males, both as children and as adults, again, particulars differed among the parishes (Clarke and Low in press) Among adults, married people were less likely to migrate than were single individuals Much of the patterns reflected the importance of resources People in Locknevi (in which resource constriction occurred, Low 1989, 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 in press) Individuals born late to large families were more likely to migrate than those born before them (Clarke and Low in press) We do not know the ultimate influence of migration on the reproductive lives of dispersers (cf Easterlin et al 1978)

The four parishes we examined are scattered from south to north in Sweden, and vary greatly in their economic bases (see Low and Clarke 1991 for map)

Gullholmen. Gullholmen is an island parish Here most people earned a livelihood by fishing, and the catches could vary considerably from year to year The small population of Gullholmen rose steadily during the nineteenth century (Swedish Demographic Database, unpublished statistics) but was always less than 1000 individuals (Low and Clarke 1991) Nonetheless, the island was small, and 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)

Locknevi. In Locknevi Parish, in Småland, geography imposed constraints on farming (Gerger and Hoppe 1980) only in the central valley were there fields of sufficient fertility for farming A small iron-works in the southwestern part of the parish provided supplemental income for some farmers

until the 1880s. Population growth stagnated in the later part of the 19th century At the beginning of this study, a few very large landholdings existed in Locknevi, controlled by a small number of individuals Agricultural day-workers found employment here The amount of cultivated land increased in the 19th century However, large estates were divided and sold off (Gerger and Hoppe 1980) and their rich owners moved out of the parish, so that landholdings became progressively smaller Some newly cultivated holdings were in agriculturally marginal land Thus in Locknevi Parish during the period of this study, resource holdings shifted from being relatively uneven with some very large holdings to more even but more restricted holdings

In Locknevi, there was a substantial wage-dependent agricultural working class, the *statare* Purchasing power, as reflected by the number of days' work required to purchase a hectoliter of rye, a hectoliter of fish, and a kilogram of butter, varied more than in Tuna Perhaps, except for the few richest families, people's economic lives were more uncertain in Locknevi Family patterns in Locknevi also showed more variance than in Tuna, as economic times got worse, then better, family sizes fell, then rose (Low and Clarke in press)

Tuna. The population of Tuna Parish, in Medelpad, rose from approximately 1200 in the early 19th century to approximately 3300 in the late 19th century (Low and Clarke 1991) Tuna was largely a farming parish, though forest and mining industries were also present in the early 1800s Many men worked in the iron foundry (Matfors Bruk) as well as farmed (see Ostergren 1990; also Sundin and Tedebrand 1981) Tuna experienced rapid industrialization from 1850 onward (Norberg and Rolén 1979) Matfors Bruk closed in 1879, and reopened in the mid 1880s Tuna Parish possessed a more diverse economy (forestry, ironwork, mixed crop agriculture) than Locknevi Perhaps as a result of this diversity, and the availability of non-market alternatives (hunting, fishing), population measures did not correspond with measured economic fluctuations in Tuna Parish, while they did co-vary in Locknevi (also see Jorberg 1972, Sundin 1976) In Tuna, there was also no difference in reproductive response to economic conditions, between richer and poorer individuals, or landowners versus non-landowners Landowners, however, had larger families no matter what the times Perhaps land ownership provided a buffer against hard times, over and above the non-market alternatives Interestingly, landowners' families not only were larger, but showed less variance (Low and Clarke in press) than those of non-landowners.

Nedertorneå. Nedertorneå, the most northern parish, was a farming parish, land was generally of poor quality Throughout the first half of the nineteenth century, the Finnish habit of feeding infants on cow's milk rather than nursing was common (Brandstrom 1984) This practice has been suggested to have negative impact on infant survival (Lithell 1982), and indeed, infant

survivorship in Nedertorneå was lower than in the other three parishes (Low 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 (Swedish Demographic Database, unpublished statistics) (Low and Clarke 1991)

Comparisons

An individual can only control some of the factors influencing his or her reproductive life In this study, of extrinsic factors, some 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 also influenced the pattern of an individual's life 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

People in the four parishes responded somewhat differently to extrinsic fluctuations, and these differences in reproductive response are probably related to ecological and resource differences In many areas in southern Sweden, single crops dominated the economy Rye and corn were major crops, corn was particularly labor-intensive Bad harvests created real hardships, reflected in prices and purchasing power In the north, barley was an important grain crop, but agriculture was more mixed, and was consistently supplemented by fishing and forestry Thus, failure of any particular crop was likely to have less impact on people's lives Harvest and price information alone are insufficient reflections of conditions in such areas (see Low and Clarke in press) Sundin (1976), analyzing theft and poverty in Sweden, found that famines and high food prices were good predictors of theft in the counties relying on one principal agricultural crop However, in "mixed" counties (e g , Kalmar, which includes Locknevi Parish), the correlation was weaker In the northern "forest" counties (e g , Vasternorrland, which includes Tuna Parish), forestry and ironworks as well as hunting and fishing supplemented agriculture, yielding a diversified economy In these counties, Sundin found no significant relationship among crop yields, cost-of-living indices, and theft rates All of these differences are important, particularly in the examination of historical and parish-specific patterns

To explore the effects of wealth on lineage success in this society most broadly, we here examine patterns in the most general context Because we want to ask about better-versus-worse strategies, in terms of lifetime reproductive success relative to the reproductive competitors present at the time in each parish, we need to subsume temporal and spatial differences without ignoring them Our methods are described in detail elsewhere (Low and Clarke 1991, Low 1991, Clarke and Low in press) Here we will sum-

marize pertinent information only briefly As in our earlier analyses, we will define wealth by father's wealth for children and by own status for adult men and father's or husband's status for adult women Because women seldom if ever exceeded their father's wealth in this society, unless they married hypergynously (i e , "up"), we used father's wealth for unmarried and husband's wealth for married women

Reproductive patterns varied in time and among parishes (Lockridge 1983, Low and Clarke 1991, Low et al 1992, see also Røskaft et al this volume); to make general statements for all of the parishes, we must take that into account In one parish (Tuna) we had land ownership information (Low 1990a), in others we had only occupational information (Low 1989, Low and Clarke 1991, Low et al 1992) To make broad comparisons possible without ignoring this variation among parishes and through time, we compare each individual's wealth as "richer" (owned land and/or had occupational status of upper-middle class, lower-middle class, or bonder [=farmer]) versus "poorer" (occupational status of torpare [=cottar] or proletariat and no land ownership record) We compare each adult individual's lifetime reproduction to the median for [1] all individuals reaching "maturity" (23 years) in any decade in any parish, and [2] all individuals marrying in each decade in each parish *Thus we compare any individual's lifetime reproduction to the median for his or her parish and decade of maturation or marriage, as appropriate* Statistical analyses compare the entire sample, stratifying by richer-versus-poorer, thus reproductive measures are compared for richer versus poorer individuals, with comparisons stratified by parish and decade

We integrate these data into a picture of life prospects for people born in different conditions, and we relate these patterns to the general problem of resources, family decisions, and demographic transitions In this way we hope to take regional differences and historical particulars into account, but not to be distracted by them in this analysis

PATTERN IN LIFETIMES

These predictions are as general as we can make them If the correlation between wealth and reproductive success holds even in a society as monogamous and egalitarian as 19th-century Sweden, and even during the demographic transition there, we consider it powerful evidence of the strength of the relationship Let us examine, then, the lifetime patterns of individuals as they are influenced by wealth and resource control

Wealth and Survival

Because male and female mammals typically show very different survivorship curves, and this sample from Sweden has proved no exception (Low

et al 1991, Low 1991), we examine the survivorship of sons and daughters separately Both sons (Wilcoxin = 6 08, d f = 1, p = 0 01) and daughters (Wilcoxin = 11 7, d f = 1, p = 0 0006) survived to age 15 better in wealthier families (Prediction 1, Fig 1a) In both wealthier and poorer families, as in our previous tests (Low et al 1991) we found no evidence of significant under-valuing of daughters among wealthier or landed families (cf Voland and Engel 1990, who did find such a pattern in German villages) That is, within both richer and poorer families, daughters survived better than sons

These results are of interest in light of Sweden's leadership in egalitarian health care and support (e g , Brandstrom 1988) In Nedertorneå, the results were particularly striking (Brandstrom 1984, Low and Clarke 1991, Low et al 1991) Infant survivorship was low, due to the habit of feeding infants cows' milk (which often was contaminated) rather than breast-feeding them (Brandstrom 1984) The central Swedish government early in the nineteenth century moved upper-level civil servants to the outpost town of Haparanda, to shore up the local economy (e g , Brandstrom 1984), and in the 1840s, a doctor came to Haparanda, beginning a campaign to reinstitute breast-feeding He worked mainly with upper-middle class families and in the town of Haparanda rather than the surrounding countryside, and Brandstrom (1984) found significant fertility and survivorship differences both with class and with residence (town versus countryside)

Brandstrom's results confirm the value of seeking general, broad trends but also analyzing at a finer level to discern the historical and social complexities In Brandstrom's correlations, residence (which correlated with breast-feeding most strongly) was even more important than status That is, the poor people in the town of Haparanda who worked for the wealthy, also began, through contact with their employers, to breast-feed, thus their infant survivorship improved more rapidly than that of the farmers Similarly, Sundin and Tedebrand (1981) found that infant mortality rates among farmers versus factory workers varied more with social factors than simply with wealth As infant and child mortality fell during the 19th century in Sweden, it frequently fell first among the middle class and proletariat (perhaps for reasons similar to those of Brandstrom's), and later among craftsmen's families, who tended to be wealthier than proletariat (Nilsson and Sundin 1991)

Once individuals reached age 15, and were typically independent of their natal families in many ways, the pattern became more complex, results were not statistically significant Richer women (Wilcoxin = 2 35, d f = 1, p = 0 13) and richer men (Wilcoxin = 2 27, d f = 1, p = 0 13) survived slightly less well to age 55, but then lived longer than poorer men and woman (Fig. 1b) Elsewhere (Low 1991, Low and Clarke 1991) we have noted more specific adult survivorship differences associated with occupational risk. Here we find that despite all variation, throughout life, though with declining force, wealth influenced survivorship of both males and females.

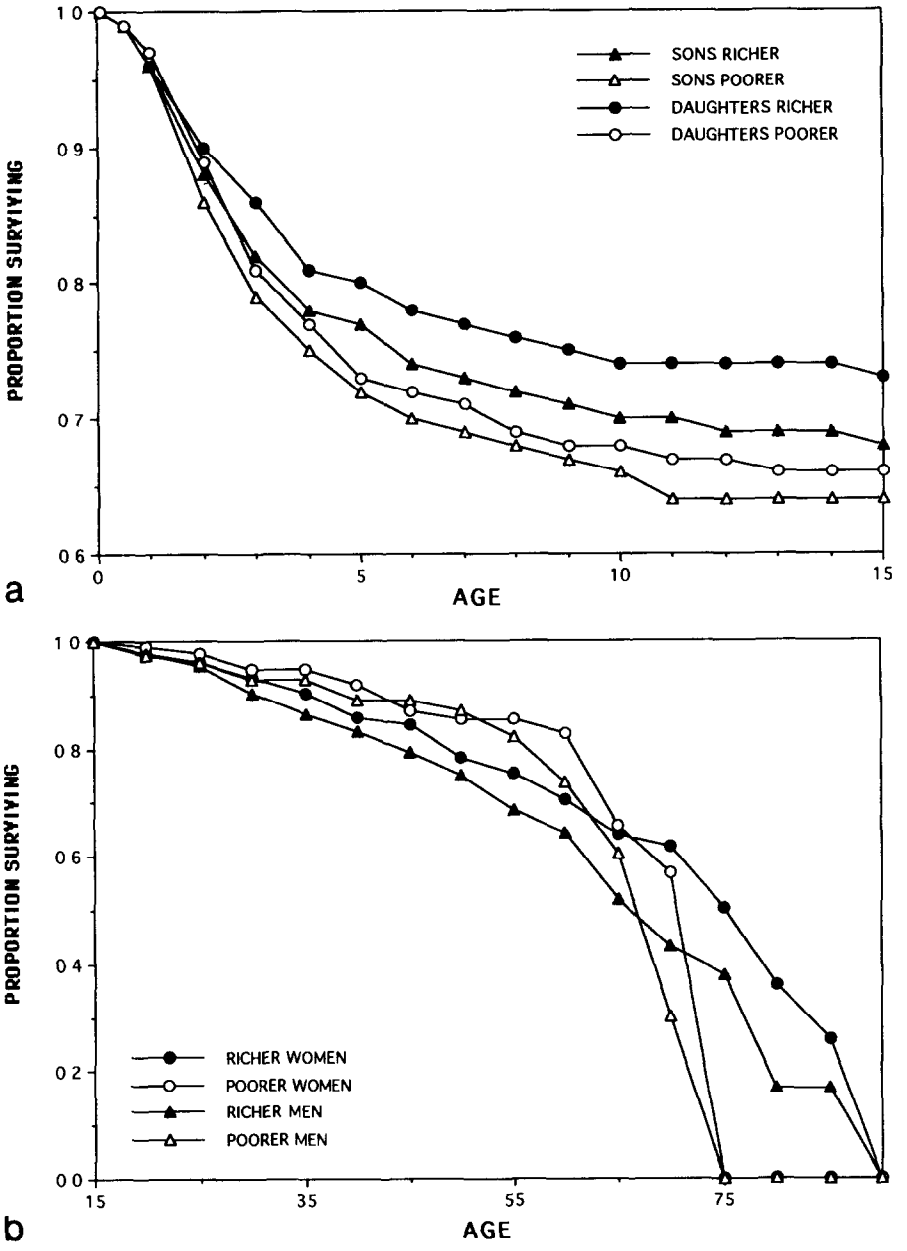


FIGURE 1. (a) Survivorship to age 15 was greater for children born to richer parents than to poorer parents, within-sex comparisons were significant for both sexes (see text) (b) After reaching age 15, poorer individuals who stayed in the parish had marginally better survivorship to age 55 than richer individuals, but then died earlier Patterns were complicated by the risks of particular occupations, childbearing, etc

Wealth and the Likelihood of Leaving

Children (< age 15) had a relatively low probability of leaving their parish of birth. Those who did move, obviously, left with their parents. Children's migration was dependent, then, on parents' probability of migration. People with children were less likely to move than those without children (Clarke and Low in press). Their probability of movement correlated with resources (Prediction 2).

Once individuals reached age 15, many were financially independent, in the sense of living independently and relying on their own income. Elsewhere (Clarke and Low in press) we have suggested that resource control ability may be important, especially for men, in decisions about whether to leave the parish. Women whose fathers were richer were, like richer men, far likelier to remain in the parish ($n = 1557$, $df = 1$, $X^2 = 12.98$, $p = 0.0003$). Richer men (including all landowners) were far likelier to remain in the parish of their birth ($n = 1599$, $df = 1$, $X^2 = 18.25$, $p < 0.00001$) than poorer men (Prediction 3). Complexities described in Clarke and Low (in press) suggest that land ownership was the dominant resource influencing philopatry. Children of the upper-middle class and lower-middle class were actually more likely to leave their parish of birth than were farmers. We believe that the movement of these classes may be related to the "liquidity" of their resources and skills, proving beneficial when conditions became very poor at home relative to those elsewhere (Clarke and Low in press).

Wealth and Marriage

Independent of the probability of leaving is the probability of marrying. Individuals may leave as married or single, or stay and marry or not. Of all individuals born, richer men ($n = 1599$, $df = 1$, $X^2 = 7.63$, $p = 0.0057$), and women whose fathers were richer ($n = 1557$, $df = 1$, $X^2 = 5.01$, $p = 0.025$) were likelier to marry than their poorer counterparts (Prediction 4). Carlsson (1977) similarly showed that daughters of landless Swedish men were less likely to marry than daughters of landowners, and that among non-landowners, daughters of manual workers were less likely to marry than daughters of wealthier non-landowners. Similarly, Sundin (1989) found that daughters of Swedish landowners were more likely to marry than daughters of landless men, and that among daughters of iron foundry workers, daughters of the more skilled workers were more likely to marry than others.

Examining only those who remained in the parish for their entire adult lives highlights an interesting sex difference. Of men who remained in the parish, richer men were likelier to marry than poorer men ($n = 1058$, $df = 1$, $X^2 = 6.01$, $p = 0.01$). Of women who stayed, their father's wealth showed no pattern with their likelihood of marrying ($n = 893$, $df = 1$, $X^2 = 0.79$, $p = 0.37$).

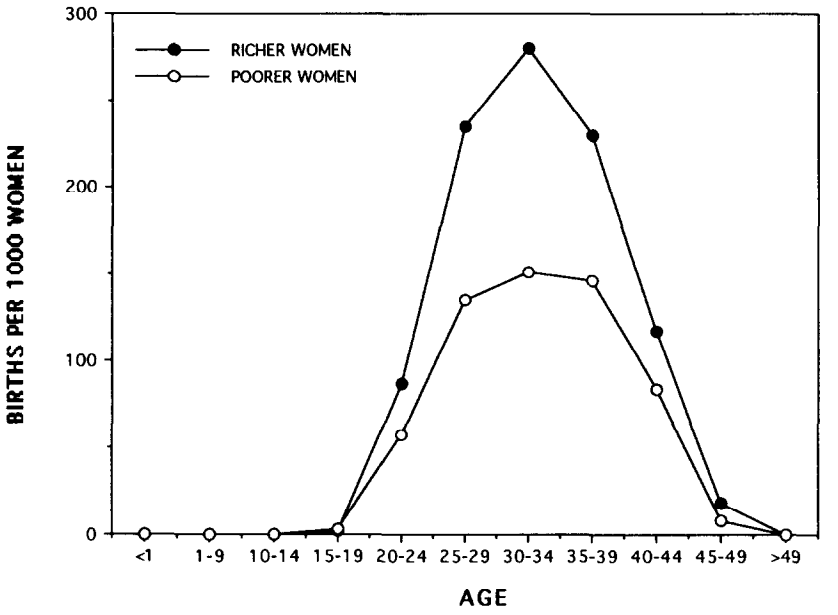
Wealth and Lifetime Fertility

Of all men who remained in the parish of their birth, richer men had more children (NBC. n = 1043, d f = 2, X^2 = 10 84, p = 0 004), and marginally more children alive at age ten (RS_{10} n = 1043. d f = 2, X^2 = 4 26, p = 0 118) than poorer men (Prediction 5) Similarly, of all women who stayed their whole lives in the parish of their birth, richer women had more children (NBC n = 594, d f = 2, X^2 = 13 49, p = 0 001), and more children alive at age ten (RS10 n = 594, d f = 2, X^2 = 10 08, p = 0 007), compared to the medians for all adults reaching maturity in the same decade in the same parish

In our by-parish analyses, in which we did not compute the median reproductive patterns by decade, we observed these differences for men, but were unable to see them for women, because of remarriage patterns, sample size, and within-parish (e g , temporal) variation, which swamped the differences (Low 1989, 1990a, Low and Clarke 1991 in press) Here we find the impact of wealth on fertility is also reflected by the age-specific fertility of richer versus poorer women richer women's fertility rises faster and remains higher than poorer women's fertility throughout their reproductive lives (Prediction 6, Fig 2) Note that the sample in Figure 2 is not women whose entire reproductive lives are under observation

The impact of resources is less when one compares only married in-

FIGURE 2. Women married to richer husbands (in spite of interparish differences, Low and Clarke 1991) had higher age-specific fertility throughout their reproductive lives



dividuals who remained in the parish, perhaps reflecting the fact that migration is an option open to individuals not marrying or establishing successfully in the parish. Of married men who stayed, lifetime fertility was greater for richer men (NBC: $n = 872$, $df = 2$, $X^2 = 6.83$, $p = 0.03$), but family size was not (RS10: $n = 872$, $df = 2$, $X^2 = 1.08$, $p = 0.58$). Because survivorship of children born to richer parents was greater, we suspect this means that families who were not prospering left the parish at a greater rate (even though in general individuals with children were less likely to leave). In the restricted sample of married women who stayed, there was no difference with (husband's) status in either the number of children born (NBC: $n = 434$, $df = 2$, $X^2 = 2.78$, $p = 0.25$), or children alive at age ten (RS_{10}: $n = 434$, $df = 2$, $X^2 = 0.29$, $p = 0.87$) (see also Low 1989, 1990a; Low and Clarke 1991; Low et al. 1991). As we have noted elsewhere, men's and women's patterns diverge in this sample sometimes because the women in this sample are not necessarily married to the men in this sample, they are the sisters and daughters of these men.

Wealth and Life Patterns

Wealth, viewed simply as "richer" versus "poorer," thus influences the life patterns of both males and females (Fig. 3). Above, we have discussed individuals as "richer" or "poorer," "married" or "never married," without discussing how likely they were to reach any particular status. Some of the statistical tests we used above do not reflect the fact that one's probabilities (e.g., of marrying) may change throughout life: the probability of marrying for a daughter born to a poor father is different at birth, if she survives and remains in the parish to age 15, and if she remains in the parish after age 15. Figure 3 highlights in bold lines the likeliest paths followed by sons and daughters of rich and poor men to greater (above-to-median marital fertility) or lesser (below-median fertility for all adults) reproduction. Here, our goal is to emphasize that within existing variation there were still dominant patterns.

Females (Fig. 3a, b). Daughters of poor fathers were about 10% more likely to die or migrate from their parish of birth before the age of 15 than were daughters of rich men. Women were also more likely to leave as adults if born to poor fathers. Overall, daughters of richer men were more likely to remain in the parish and marry (above), however, of the women who stayed in their parish of birth to reproductive age, daughters of both rich and poor men were equally likely to marry (Fig. 3a, b). The likely remaining life-paths for married women and unmarried women differed, depending on whether they were born to poor or rich fathers. Of women who married, virtually all women (98%) born to poor fathers married men who were poor, while 77% of women born to rich fathers married rich men. Married women's fertility was compared to that of other women in the same parish of birth

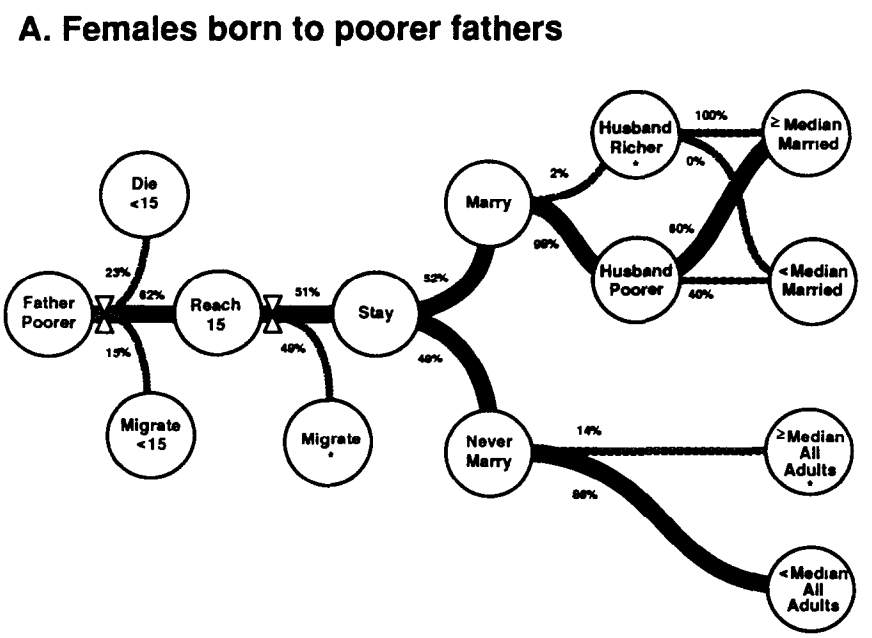
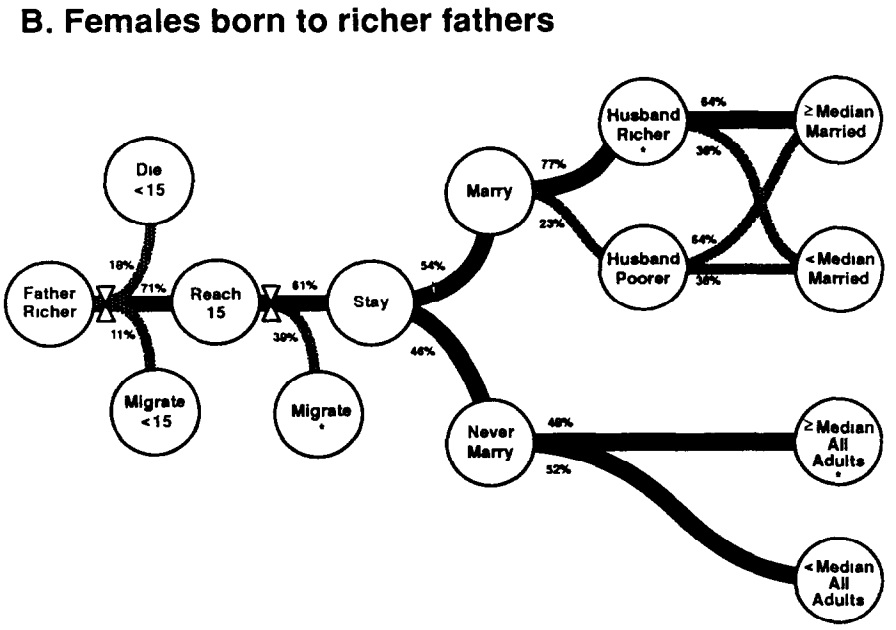


FIGURE 3. Some paths (heavy lines) were more likely than others for individuals born to richer or poorer fathers Reproductive comparisons are relative to all adults who reached age 23 in the same decade in the same parish for non-married individuals, and relative to all individuals marrying in the same parish during the same decade for married individuals Strong within-sex differences are highlighted by asterisks Extrinsic factors (indicated by valve symbols) could matter, for example, in probability of out-migrating or marrying (see also Low 1989, Clarke and Low in press) These greatest-likelihood pathways simply track, for all individuals born in the sample, the percentage at each comparison point who follow 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) A daughter born to a poorer father was more likely than her richer cohorts to leave the parish before age 15, if she stayed, she was about equally likely to marry She was overwhelmingly likely to marry a poorer husband Though her fertility could be great (33% had the median number of children for their decade of marriage and parish), her sons were likely to leave the parish, and, if they stayed, to do poorly reproductively if she did not marry, there was an 86% chance she had fewer than the median number of children for all adults

Figure continues



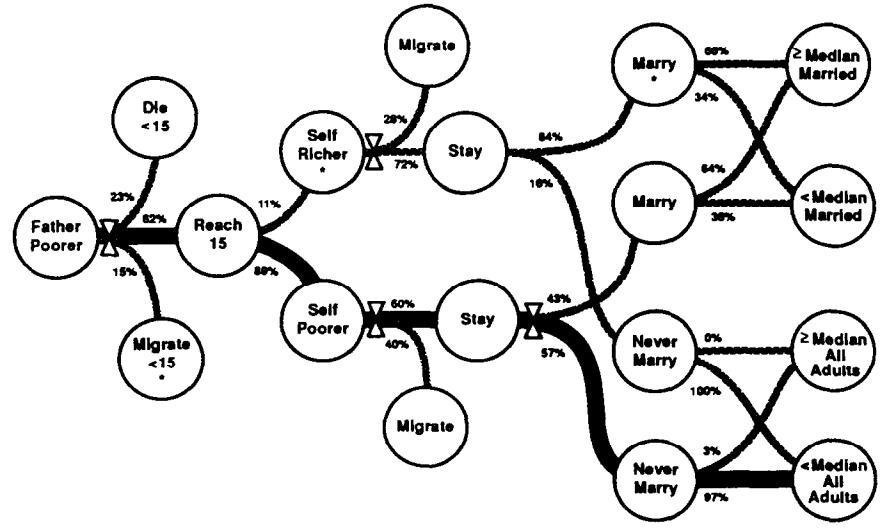


FIGURE 3 (*Continued*) (B) A daughter born to a richer father had a higher chance of remaining in the parish, and an equal chance of marrying If she married, there was a 77% chance her husband was richer If she did not marry, there was a 48% chance she would have greater than or equal to the median number of children for all adults (C) Sons of poorer fathers were likelier to leave the parish before age 15, compared to sons of richer fathers (15% versus 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 Such men who stayed were likely never to marry (57%), and (97%) have fewer than the median number of children compared to all adults

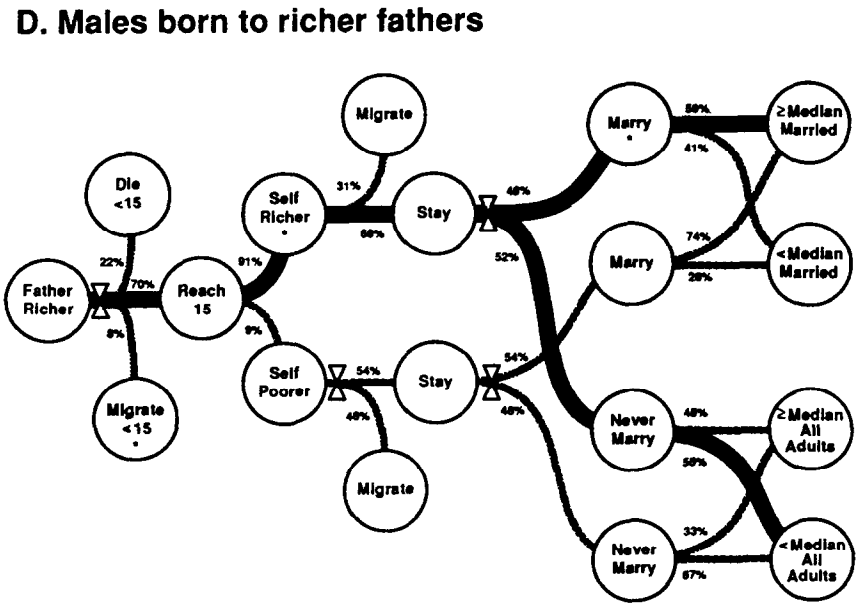


FIGURE 3. (*Continued*) (D) Sons born to richer fathers, once they reached age 15, had an excellent chance of becoming richer themselves (91%) These men were more likely to stay as adults (69%) Their chance of marrying was about 48% Those who married tended to have the median or greater number of children compared to other married individuals (59%), those who did not marry were likely to have fewer than the median number of children, compared to all adults (55%)

who married in the same decade Fertility of unmarried women was compared to all adult females in the same parish of birth who reached age 23 in the same decade Women who were born to poor fathers and never married were far more likely (86%) to have fewer than the median number of children born to all adult women Daughters born to rich men and never married nonetheless had a 48% chance of having greater than the median number of children, suggesting that illegitimate births occurred at higher rates among the rich (cf Low and Clarke 1991, who found illegitimacy rates from 2% to 7%)

In summary, women born to rich fathers were more likely to survive to adulthood and stay in their parish of birth than were women born to poor fathers While all daughters staying had about the same probability of marriage, their paths nonetheless diverged daughters of poor fathers married poor men, and daughters of the rich married rich men Fertility of unmarried women was related to father's status, daughters of poor men were likely to have fewer than the median number of children relative to all adults

Males. (Fig 3c, d) Males born to poor fathers were 7% more likely to migrate before age 15 than were sons of rich men (Fig 3c, d) As adults, sons of rich men were very likely (91%) to become wealthy themselves,

while sons of poor men were likely to stay poor (89%) As adults, poor sons of rich men were 6% more likely to migrate than poor sons of poor men (see Clarke and Low in press for a discussion of the influence of skills and liquidity of resources on migration)

Of men who stayed in their birth parish, probability of marrying varied with own and father's status Poor sons of poor fathers were most likely to remain unmarried (57%), 97% of such poor, unmarried men had fewer than the median number of children Fertility comparisons for men were done in an analogous manner to those for women Rich sons of rich fathers had an approximately equal chance of marrying or not (48% versus 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 Although 97% of poor sons had this fate, only 55% of rich sons did

Two less likely but interesting paths also occurred Most dramatically, the few men (11%) 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 On the other hand, poor sons of rich fathers did not fare as badly as the poor sons of poor fathers Poor sons of the rich still had a greater probability of marrying (54% versus 46%), and once married had a 74% chance of having at least the median number of children 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

Figure 3 reflects likelihoods through individual lifetimes, but these patterns may translate into population trends For example, a man's lifetime fertility was influenced by his, and his father's, wealth Even though a woman's husband's wealth did not clearly determine her lifetime fertility (above), lineage success could nonetheless be influenced Women born to rich fathers were more likely to marry at somewhat younger ages (above), and marry richer men Their sons, likely to be richer themselves, had greater likelihood of fertility Thus, after a one-generation lag, lineage increase through daughters as well as sons may have been greater for rich men than for poor men Extrinsic factors interact with these patterns (shown as "regulators" in Fig 3), as in other studies (e g , Wrigley and Schofield's 1981 classic *Population History of England*, Low and Clarke in press) Thus here we have stratified all comparisons by decade and parish to analyze the influence of wealth. These patterns reflect the possible diversity, and show the likelihoods facing

individuals in different categories Importantly, similar aggregate patterns can arise from differing underlying individual-level patterns

DISCUSSION

What, if Anything, has Changed Over Time?

In 19th-century Sweden, life-patterns of survivorship, migration, and fertility were clearly related to resources, wealth, and status Over their lives, both daughters and sons of wealthier men were likely to have more children than daughters and sons of poorer men, as a result of interacting factors variously related to wealth. survivorship, likelihood of becoming wealthy in turn, and women's age at marriage This pattern remained true throughout the 19th century, including periods commonly designated as "demographic transition " As Figure 3 shows, father's wealth is certainly not all that matters some percentage of both sons and daughters of wealthier men fail to marry and have children The most dramatic pattern of children's lives with father's wealth is that sons of poorer men, even in egalitarian 19th-century Sweden, had almost no chance of becoming wealthy and having more than the median number of children (Fig. 3c)

Our results (also see Voland 1990, Turke 1989, 1990, Low 1989, 1990a, b) suggest that, even in relatively modern times, in Western societies which are monogamous and attempt to be egalitarian, wealth differentials promote fertility differentials When resources become constricted, (e g., Low 1989), family reproductive differentials are likely to disappear Others also have found this generally to be true Individual patterns in such important items as age of marriage typically vary with resources (e g , Wall 1984, Sharpe 1990, Cain 1985; McInnis 1977, Pfister 1989a,b; Thompson and Britton 1980, Hayami 1980; Schultz 1982, Simon 1974) Depending on their own resource bases (e g , Galloway 1986, Schultz 1985), families may respond quite differently to such influences as market shifts, treat their children quite differently (e.g , Mitterauer and Sieder 1982 110), even aggregate data tend to reflect resource influences as individuals make decisions (e g , Thomas 1941; Wrigley 1983a,b)

Why then do so many studies of modern fertility fail to find these patterns? We suggest several possibilities.

[1] Census data are not designed to elucidate information about family lineages, but households It is, for example, impossible to tell "own" children, from stepchildren, from other relatives living in the household from nonrelatives living in the household When actual lineage data are examined (e g , Mueller 1991), wealth and status are likely to be correlated with fertility for men even today

[2] The existence of effective, cheap contraception is bound to complicate any relationship between wealth and fertility (though we note that

various forms of fertility limitation, including sex taboos, abortion, and infanticide are widespread in "natural fertility" populations, e g , see Campbell and Wood 1988, Low et al 1992) Pérusse (1992) examined copulation frequency in a modern, contraceptive society, and found that wealth correlated with copulation frequency for men, even when number of children produced did not

[3] When offspring must compete for limited resources, parental shifts from production of offspring to investment in offspring (MacArthur and Wilson 1967, Rogers 1990, 1991) will be favored True parental investment, specific to particular offspring, must reduce the number of offspring, unless parental resources increase This will reduce the range, and possibly the variance, of reproductive success, though it need not reduce any correlation between fertility and wealth

[4] In the Swedish sample, wealth was men's wealth Today, much household income is earned by women As we have noted elsewhere (Low and Clarke in press), the effort which must be expended by women to earn money in market economies often represents a real conflict—a woman cannot do child care at work In traditional societies, women could do a variety of tasks while doing child care, and women could call on older daughters to help during much of the day (not after school) with child care (nonetheless, some conflicts existed between work versus child-care requirements, Hurtado et al in press)

We cannot analyze the impact of the first two possibilities, but will discuss the third and fourth points here

Reproductive Production vs Investment

When resources are relatively ineffective in lowering children's mortality or enhancing their competitive success, fertility will be high Such conditions obtain in many traditional societies, and, we suspect, in a good many pre- and proto-industrial societies Wealth or status and reproductive success (at least among men) are positively correlated in many quite varied societies (e g , Hill 1984) In the Turkmen, Irons (1979) found that richer men had more wives and more children than poorer men Borgerhoff Mulder (1987, 1988) found that among the agricultural and pastoral Kipsigis, richer men produced more children than poorer men, the brideprice required for a woman was directly related to her reproductive value, so that richer men could afford younger wives with more reproductive potential With the introduction of western technology and medicine, differentials were reduced In the pastoral Mukogodo of Kenya, Cronk (1991) found that wealth enhances reproductive success for men, in his study he was able to show the direction of causality Similarly, the Meru use livestock for bridewealth, and richer men can marry more wives (Fadiman 1982), much conflict occurs over cattle (and thus, ultimately, women) In societies as diverse as the Hausa (Barkow 1977), Trinidadians (Flinn 1986), and Micronesian islanders

(Turke and Betzig 1985), status and wealth correlate with male reproductive success

In some traditional societies, such as the Ache (Kaplan and Hill 1985, Hill and Kaplan 1988) and the Yanomamo (Chagnon 1979, 1982, 1988), few physical resources are owned; even here, status represents a resource In the Yanomamo, male kin available for coalitions also represent a resource, and men manipulate kinship terms in ways that make more women available for mates, and powerful men as coalition partners (Chagnon 1979, 1982), so that reproductive success is uneven Among the Yanomamo, not only being a member of a numerous and therefore powerful kin group works as a method of gaining wives, but also gaining recognition as a revenge-killer (Chagnon 1988) In none of these cases was there a correlation between children's survival and father's resources; the correlation existed between wealth/status and number of wives, and wives with their children were frequently relatively independent economic units

Our results have the clear implication that fertility declines, even today, are likely to be local, and locally reversible, rather than singular events with singular causes The extent to which we can predict fertility shifts as a result of economic conditions or purchasing power will depend on a number of factors, but especially how much parental investment assists individual children. Perhaps the relative costs and benefits of children themselves are influential (e g., Easterlin 1978, Becker and Barro 1988, Turke 1988) resource differentials, opportunities for better-educated children, and migration opportunities As resources begin to decrease, the risks of migration will be perceived as less onerous, we expect migration to increase if it can offer reproductively less successful individuals an alternative

Even the richest family's wealth could be dissipated through continued even investment in large numbers of children, thus unequal investment (even in the face of legal mandates for equal inheritance) are unsurprisingly common (e g , Hartung 1982, Low 1990a, Low et al. 1991) 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 children (education, savings, health insurance, resource gifts, etc); unless there is a net increase in total resources, the allocation of available resources must be into fewer children (e.g , Rogers 1990, 1991) 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

This ecological approach echoes some classic demographic models centered on "individual decision" and "proximate variables" (e.g , Becker 1981, Becker and Lewis 1974, Easterlin 1978, Tilly 1978, Bongaarts 1978, 1982, Lindert 1978, Simon 1974, Lesthaeghe and Wilson 1986), as well as Mosk's (1983) "leveraging" approach to fertility, and Easterlin and Crimmins' (Crimmins and Easterlin 1984; Easterlin and Crimmins 1985) models of the factors favoring a shift to conscious control of fertility. All of these

models have two important characteristics individuals are not assumed to be uniform, and there is an explicit trade-off between quantity and "quality" (probable success) of children Such models have had a varied fate in the literature

The conceptual advance of a behavioral ecological approach is this if we consider not only monetary but reproductive, currencies, previously perplexing fertility patterns of some societies may become understandable The perceived non-generality of some of the 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 work) Behavioral ecological models may, in fact, be very general, affecting all sexually-reproducing organisms, and not particular to one or another society, or one or another currency

There is a wealth of supporting evidence from many biological studies, that, while of course simplistic, may by useful in establishing generality MacArthur and Wilson (1967 145–150) argued that, when the density of conspecific competitors (in any species) 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

Following this logic, across human societies *complexities in either the ecological or social environment which result in increased effectiveness of parental investment should result in more investment, at the expense of fertility itself* (see review by Low et al 1992) Thus, it is not surprising that wealth differentials promote fertility differentials, even in Western societies which are monogamous and attempt to be egalitarian As we noted above, this is true at the "high" end of the socioeconomic scale Rank (1989) found that at "low" socioeconomic levels, women on welfare have fewer children (age-specific fertility is lower at all ages) than women not on welfare, and that these welfare recipients specifically cited the need for resources to invest in their existing children as the reason for avoiding further pregnancies

In human populations, male fertility typically increases with income within socioeconomic groups (above). For women, the conflict between investment capability and fertility is sharper than for men, even in traditional societies (e g , the !Kung women above) When monetary resources become central to children's success, women's shift from traditional maternal investment patterns to market employment typically has negative impact on fertility (e g , Farooq and DeGraff 1988, below) The link to industrialization may simply 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 we noted above, typically the largest family sizes) Further, as Turke (1989) has noted, increased investment to enhance competitiveness by even a few families will raise the stakes for all competing families in the population Finally, Turke (1989) has argued that, as family and kinship networks are weakened (e.g , by spatial disruption), fertility will fall Older children and non-descendant relatives initially comprise a resource—nepotistic effort When that resource declines, children pose an increased cost to their parents, a cost no longer defrayed by kin help Thus, fertility will decline

Wealth Among Nations, Men, and Women

It seems to us important to ask, in each case, whether a child's eventual effectiveness in obtaining resources requires more (especially monetary) investment by parents in individual children, when it does, we predict fertility decline, but when it does not (many proto-industrialized and other labor markets using unskilled labor), we do not Thus, even though the general pattern reported is that across countries, as resources (measured as GNP) increase, fertility declines (Birdsall 1980), we suggest that within such societies or social groups, when men's fertility is considered, as resources increase, fertility should increase (Hughes 1988, Low and Clarke in press) That is, increasing GNP is in fact a correlate of cultural/technological/economic changes which result in a competitive requirement for increasing investment in individual children to ensure their success (Fig 4a) When considering women's earned income and their individual fertilities, a conflict exists, and women richer through their own efforts may have lower fertility than women married to wealthy men

Because families of different status, and even of different background (do current resources represent an increase or a decrease?), may be differentially able to get and use resources equally, we may not always see well-tuned responses that agree with external assessment of resources Sometimes, for example, a superficial examination suggests that men's fertility decreases with wealth, even within a society However, even when greater societal resources correlate with increased importance of investment in each child, and correlate with lowered fertility,we should not be surprised if men with relatively more resources within each stratum of society have more children than men with fewer resources (Fig 4b, see also Hughes 1988) In fact, Johnson and Lean (1985) review relevant studies, which suggest that couples assess their income relative both to their parents income in the pervious generation and to others in their social economic group (Low and Clarke in press) Similarly, Freedman and Thornton (1982) have shown that

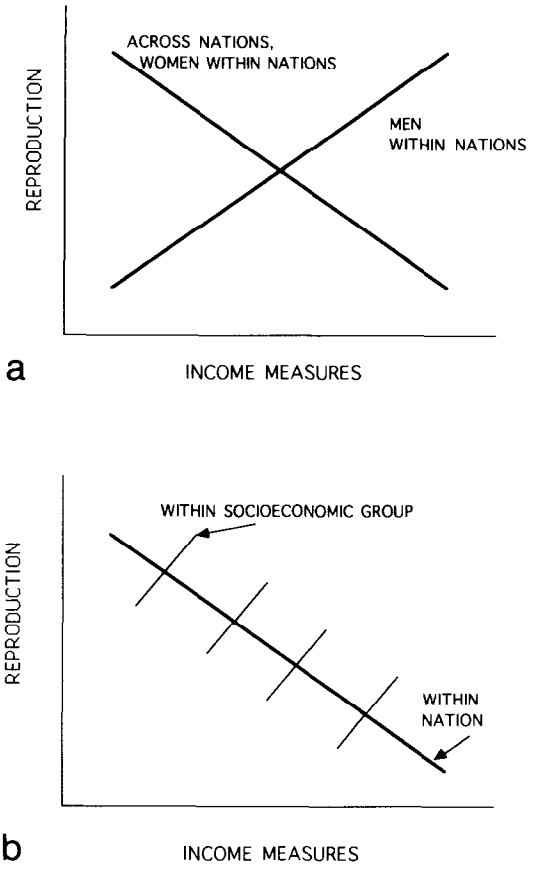


FIGURE 4 (a) As resources due to own work increases, we expect different fertility patterns for men (increasing) versus women (decreasing) within a society. Cross-national comparisons of aggregate fertility versus GNP typically look like the women's curve, and women's work and education may be important proximate fertility determinants. (b) These patterns are further complicated by patterns within socioeconomic groups in some modern societies. See text for further explanation.

in the United States, families make deliberate decisions about family size in response to their judgment of available resources, and that, when deliberately chosen family sizes are considered, there is a correlation between income and family size. When accidental pregnancies are considered, the picture becomes less clear. Studies suggest that when income is judged as favorable relative to others, fertility is increased (e.g., Turke 1990).

Thus, investment level required to produce successful offspring may vary with environment, and specifically with the threshold level of investment 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 concept (r- and K-selection, see review by Low et al. 1992). If poorer parents cannot substantially enhance their children's success, then we might

expect larger families, 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. Within sub-groups, however, those with more than sufficient resources may be able to support additional children and still have all be adequately invested

Measuring "resources" is, of course, a difficult task. Important resources can differ significantly between and within regions These differences result not only from physical differences in the environment, but also from the social structure of the population Here we have used a simple combination of information about best status and landownership We have suggested that relationships between resources and reproductive patterns can be easily clouded by aggregate data and inadequate measures of total resources, and predictive analysis of population/environment interactions will depend on careful evaluation of variation in both physical and social environments

CONCLUSIONS

In summary, we suggest that resources positively influence lifetime reproductive success both through production of and investment in children This relationship appears to hold, then, not only for traditional societies, but through the demographic transition in19th-century Sweden External conditions which influence competitiveness influence the relative potency of investment versus production Perhaps a re-examination of existing data in this broader, behavioral ecological, perspective would be useful For example, industrialization may not be, of itself, a force driving toward lower fertility, unless success in an industrial environment requires greater training or monetary investment by parents, resulting in later marriage ages, and often, fewer children marrying (e g , the "European" marriage pattern, Hajnal 1965) We also suggest that, if high fertility is not a response to infant loss (see Low et al 1991, Low 1991), medical and public health measures leading to increased infant survivorship, though warranted in their own right, will not, in themselves, lead to lowered fertility *What we should look for is* ***any*** *force enhancing the effectiveness for net reproduction of increased investment in individual children* ability to purchase medical services, ability to will reproductively useful resources such as land or status (e.g , the heritable status of the British peerage, Hollingsworth 1957), investment in education, etc As parents' ability to influence their children's eventual success by *investment* increases, we expect *fertility* to decline, and resources to be routed into *investment*, decreasing mortality and increasing success

of children Thus, rather than "the" demographic transition with a singular cause, we expect fertility trends with local, reversible, patterns In our data, as well in the work of others, we find that the primary components of population change (fertility, mortality, and migration) respond to ecological conditions at the individual family level in ways that are predictable, and familiar to students of nonhuman populations In our 19th-century Swedish population, even during the demographic transition, resources are positively correlated with family size and lifetime reproductive success Resources make certain life-paths far more likely than others

We need not postulate a conscious decision on the actors' parts to predict these patterns True, our human consciousness offers us additional, perhaps less painful, options for responding, but it does not entirely free us of the constraints and opportunities which our environment provides Human complexity and conscious decision can (as many demographers and economists have subtly appreciated) add special dimensions For instance, we find that not just the 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 Then land, usually a valuable resource, may limit migration options (Clarke and Low in press)

In sum, we suggest that certain predictable ecological rules underlie patterns of fertility, mortality, and migration, although these may be constrained by a variety of cultural complexities and interactions For example, men's reproductive patterns vary in concert with resource control to a much greater extent than women's patterns, this variance between the sexes is greatest when resources are abundant When resources become constricted, reproductive responses are uneven among families, and even within families In a resource-constriction period, we might find very unequal investment in children within a family, with heightened investment in older (closer to successful reproduction) sons (whose success we predict to be more dependent on resources than daughters) We have published these findings previously (Low 1989, 1990a, 1991, Low and Clarke 1991 in press, Low et al 1992) Our 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 Different predictions arise, and can be tested, indeed, e g , Boone (1986), Turke (1989, 1990), Borgerhoff Mulder (1988), Mueller (1991), Voland (1984, 1989, 1990), and Voland and Engel (1990) have begun just such tests

What happens to populations, we argue, 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 various kinds of families respond differently to external shifts in resources (perhaps because they have differential access to those resources, or because the shifts profit some while

costing others), then what happens to population numbers, and ultimately how the environment in its turn is affected by the population, depend on what proportion of the population comprise different kinds of families If we fail to measure the appropriate resources, or if we look simply at aggregate measures or only for conscious decisions as mediators, we may make the wrong predictions and set inappropriate policies

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