The Rising Share of Nonmarital Births: Fertility Choices or Marriage Behavior?

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Abstract

Much of the sharp rise in the share of nonmarital births in the United States has been attributed to changes in the fertility choices of unmarried and married women – in response, it is often argued, to various public policies. In contrast, we develop and test a model that attributes the rise to changes in marriage behavior, with no changes in fertility. A variety of empirical tests strongly supports this conclusion and invites focused attention to issues related to marriage behavior, as well as the interactions between marriage and fertility.

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I. Introduction.

Over the past half century, total birth rates in the United States have fluctuated widely, rising dramatically after World War II and then falling from the late 1950s to the mid-1970s, when they dropped below pre-war rates. In the period since the mid-1970s, total birth rates have changed very little, increasing only modestly for whites and barely at all for blacks. At the same time, however, birth rates for unmarried women have soared. Birth rates for married women have also increased substantially, but proportionately less than for unmarried women. Simultaneously, the share of unmarried women has risen sharply. Collectively, these trends yield a particularly striking increase in the ratio of births to unmarried women to total births, sometimes termed the illegitimacy ratio, but referred to here as the nonmarital fertility ratio (NFR). Indeed, NFR for black women aged 20-39 nearly doubled between 1974 and 2000, while NFR for white women aged 20-39 more than quadrupled. Well over half of all births to black women and roughly a fifth of all births to white women are now nonmarital births.

Increases in NFR have for some time been a central focus of a vast literature, particularly with respect to the effects of public policy, such as the now displaced federal Aid to Families with Dependent Children (AFDC), the newer Temporary Assistance for Needy Families (TANF), and the Earned Income Tax Credit. In addition, the 1996 Federal Welfare Reform Act requires states to prevent and reduce the incidence of out-of-wedlock pregnancies and to establish annual numerical goals for doing so. However, changes in NFR do not necessarily indicate changes in the underlying childbearing decisions that are often the real (though perhaps implicit) target of public policy. NFR can be decomposed into three component factors – the nonmarital birth rate, the marital birth rate, and the fraction of women who are married. NFR will vary positively with the first factor and negatively with the two other factors. Demographic studies of NFR (e.g., Smith et al., 1996) typically focus on measuring the contributions of these component factors and on exploring their determinants, implicitly assuming that each factor independently influences NFR. Finding an effect of a policy change on marital or nonmarital birth rates, and therefore NFR, is taken as evidence that the policy change has affected childbearing behavior.[1]

In contrast to previous studies, we hypothesize that (i) changes in marriage behaviors are *causally* related to changes in measured nonmarital and marital birth rates, and therefore (ii) changes in nonmarital and marital birth rates do not necessarily reflect changes in child-bearing behavior. Thus, a distinctive feature of the theory we develop is that marriage behavior has both direct and, through birth rates, indirect effects on NFR. Our empirical findings support the theory and suggest that the effects of marriage behavior on birth rates are quantitatively, as well as statistically, significant. If so, the dramatic changes in NFR of the past several decades may be due less to changes in fertility behavior than to changes in marriage behavior. Thus, we address one of the key questions posed by Smith et al.: "Are the continued increases in the proportion of children in the population who are born out of wedlock now a function primarily of fertility changes among unmarried women?" (p. 142). Our work suggests that increases in the nonmarital fertility ratio have arisen primarily from changes in marriage behavior with little or no change in individual fertility behavior.

II. Background and overview.

The model described in section III is motivated by the distinct trends in birth rates, marriage rates, and NFR evident over the period 1974-2000. Trends in birth rates by marital status are illustrated in Figures 1 and 2 for white and black women, respectively, in the prime

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[1] See, for example, Baughman and Dickert-Conlin (2003), discussed further in section II.

child-bearing years 20-39. Trends in the share of women who are unmarried are plotted in Figure 3 for both white and black women.[2] For white women, Figure 1 shows that the nonmarital birth rate (measured as births per thousand unmarried women) more than triples over the period, rising from 13 in 1974 to 46 in 2000. The marital birth rate rises by nearly half, from 94 to 135. But the total birth rate for white women increases by less than a fifth, from 78 to 92. Similar patterns are seen for black women in Figure 2. The nonmarital birth rate increases from 55 to 74, roughly a third. The marital birth rate also increases, from 108 to 132, a smaller increase of roughly a fifth. But the total birth rate for black women barely rises at all, from 86 to 87. Figure 3 illustrates a pronounced shift away from marriage between 1974 and 2000, with the share of unmarried white women rising from .25 to .45, an 80% increase, and the share of unmarried black women rising from .52 to .73, a 40% increase. Finally, as noted earlier, the trends in birth and marriage rates illustrated in Figures 1 through 3 yield dramatic increases in the nonmarital fertility ratio, or NFR, as confirmed in Figure 4 for both black and white women.

[Figures 1, 2, 3, and 4 here]

To the extent that empirical and policy studies of nonmarital births are grounded in theory, the underlying theory should be able to account for the trends evident in Figures 1 through 4. The fact that both marital and nonmarital birth rates have risen dramatically over the past quarter-century, despite little or no change in total birth rates, presents a particular challenge. The model we propose meets this challenge. The idea is simple. Increases in the population share of unmarried women are produced by changes in the marital status of women who have a low probability of giving birth when compared to the average married woman, but a

[2] The data plotted are constructed aggregates. For current purposes, married women are those women categorized by the U.S. Bureau of Census as "married, spouse present." See section IV for details.

high probability of giving birth when compared to the average single woman. Accordingly, when the proportion of women who are married declines, and the share of unmarried women correspondingly increases, the average birth rates of *both* groups rise. In our model this occurs even though child-bearing behavior, and therefore the total birth rate, is unaffected by changes in marriage behavior. Thus, an important implication of our model is that changes in marital and nonmarital birth rates, and hence in NFR, arise not necessarily from changes in child-bearing behavior, but from changes in marriage behavior.

The model further predicts that a rise in the share of unmarried women will increase the nonmarital birth rate proportionately more than the marital birth rate – that is, the ratio of the two birth rates will rise – a prediction consistent with the data presented in Figures 1 and 2. As we show in Section III, the effect of changes in marriage behavior on the *relative* size of marital and nonmarital birth rates produces a *magnified* effect on NFR and thus provides an explanation for the extraordinary increases in NFR in recent decades. Again, we emphasize that the explanation does not rely on changes in fertility behavior.

Section IV explores the extent to which our model can account for observed changes in NFR. The evidence includes casual empiricism in the form of figures and simple calculations that allow a straightforward comparison of the model's predictions with actual experience over the period 1974-2000, the same time period chosen for Figures 1 through 4. We also perform formal statistical tests of the model using pooled time-series data for women grouped by 5-year age intervals over the longest time periods for which we were able to obtain data in the form required –1969-2000 for blacks and 1957-2000 for most whites. Both individually and collectively, the empirical exercises reported in this section provide remarkably strong support for our model of NFR.

In the context of public policy, our findings suggest that some of the current focus on changes in the fertility behavior of unmarried women could be productively redirected toward changes in marriage behaviors. Examples of pertinent recent studies include Baughman and Dickert-Conlin (2003), who separate women into married and unmarried and then look at the effects of AFDC/TANF and earned income tax programs on the birth rates of the two groups separately. Our work raises the possibility that the effects they and others find are due to the influence of policy on marriage decisions, which is then reflected in changes in measured birth rates – rather than the influence of policy on the fertility choices of individual women or on total fertility.

Our findings also underscore the importance of empirical studies that look simultaneously at fertility and marriage (e.g., Grogger and Bronars 2001 and Upchurch et al. 2002), as well as those that focus directly on the determinants of marriage and other forms of union formation (e.g., Bitler et al. 2004, Carlson et al. 2004, Fitzgerald and Riber 2004, Moffitt 2000 and Sigle-Rushton and McLanahan 2002). Finally, our results suggest that at least some of the divergence in published results concerning the effects of public welfare and related policies on fertility may be reconciled by accounting for differences in the treatment of marital status.

III. The Idea

This section describes a simple, but joint, theory of child-bearing and marriage. The model is intentionally stylized, as its purpose is to isolate and illustrate a particular effect of changes in marriage rates on nonmarital and marital birth rates and, hence, NFR. The effect we isolate occurs even in the absence of changes in individual childbearing behavior, and can therefore reconcile the observation of simultaneous *increases* in nonmarital and marital birth rates with a *constant* total birth rate. It also predicts a disproportionately large effect of changes in marriage behavior on NFR. Indeed, as we show in section IV, a remarkably high proportion of actual changes in NFR can be attributed to changes in marriage behavior alone, once one accounts for the causal relationship between marriage behavior and birth rates.[3]

The key theoretical results follow directly from a few simple definitions and a small number of deliberately strong assumptions.

A. Definitions

The nonmarital fertility ratio, NFR, is defined as

$$\text{NFR} = \text{UB}/(\text{MB}+\text{UB}),$$

where
MB = number of births to married women, and
UB = number of births to unmarried women.

Simple algebraic manipulation allows us express NFR in terms of the nonmarital birth rate, the total birth rate, and the fraction of women who are not married (hereafter termed the unmarried share):

$$\begin{aligned}\text{NFR} &= [\text{U}/(\text{M}+\text{U})]\bullet[\text{UB}/(\text{MB}+\text{UB})]\bullet[(\text{M}+\text{U})/\text{U}] \\ &= [\text{U}/(\text{M}+\text{U})]\bullet(\text{UB}/\text{U})\bullet[(\text{M}+\text{U})/(\text{MB}+\text{UB})] \\ &= \text{Su}\bullet(\text{UBR}/\text{TBR}) \qquad \text{Eq. (1)}\end{aligned}$$

where
M = number of married women,
U = number of unmarried women.
UBR = UB/U = the birth rate of unmarried women, or the nonmarital birth rate,
TBR = (MB+UB)/(M+U) = the total birth rate,
Su = U/(M+U) = the fraction of women not married, or the unmarried share.

As expressed in eq. (1), NFR depends only on the *ratio* of the nonmarital to the total birth rate and on the unmarried share. It follows that NFR differs from Su only to the extent that the

[3] The design of the model assumes a traditional definition of marriage, but could be adapted to account for other types of unions such as cohabitation.

childbearing behavior of unmarried women deviates from that of the rest of the population. This observation is a common basis for demographic decompositions of NFR.

B. Assumptions

Variation across women in the desire for children is captured by a parameter, γ, which measures the probability that a particular woman will give birth to a child during the observation period (e.g. a year). We assume that γ is exogenous with respect to the model (in particular, it is independent of marital status) and that it is distributed uniformly across women on the interval [0,P], where $0 \leq P \leq 1$.[4] Hence, if women are indexed and ordered by γ, then

(i) the γ associated with the n^{th} ordered woman in a total population of z women is (n/z)P,
(ii) the expected birth rate of the first n ordered women is (1/2)(n/z)P,
(iii) the birth rate of the remainder of the population is (1/2)[(n/z)P + P] = (1/2)[(n/z)+1]P,
(iv) the birth rate of the population taken as a whole is (1/2)P.

This information is recorded in Figure 5, which orders women along the horizontal axis according to their preference for children and records the corresponding values of γ along the vertical axis.

[Figure 5 here]

The net benefits to marriage are assumed to be increasing in γ and decreasing in a fixed cost, C, that is common to all women. Hence, there exists a critical value of γ, denoted γ_c, for which it is true that women with $\gamma > \gamma_c$ marry and women with $\gamma < \gamma_c$ do not marry. The critical value γ_c is increasing in C. Since women are ordered by γ, then the first U ordered women will be unmarried and the remaining M women will be married, as depicted in Figure 6. It follows

[4] While strong, this assumption finds support in other recent studies of fertility behavior. It parallels, for example, Udry's (1994, 2000) model of within-sex differences, and relates to recent work (e.g. Kohler et al. 1999 and Rodgers et al. 2001) suggesting that fertility arises in substantial part from deep genetic influences.

that the birth rate of unmarried women (UBR), the birth rate of married women (MBR), and the total birth rate (TBR) are found by replacing n/z with [U/(U+M)] in (i) through (iv) above.

$$\text{UBR} = (1/2)(\text{Su})\text{P}, \quad \text{where Su} = [\text{U}/(\text{M+U})]. \qquad \text{Eq. (2)}$$

$$\text{MBR} = (1/2)(\text{Su}+1)\text{P}, \qquad \text{Eq. (3)}$$

$$\text{TBR} = (1/2)\text{P}. \qquad \text{Eq. (4)}$$

[Figure 6 here]

C. Key predictions.

From eqs. (2) and (3) above it follows that the ratio of the nonmarital birth rate to the total birth rate can be written simply as Su. That is,

$$(\text{UBR}/\text{TBR}) = \text{Su}. \qquad \text{Eq. (5)}$$

Substituting eq. (5) into eq. (1) produces the theoretical result that forms of the cornerstone of the paper's empirical contribution -- the nonmarital fertility ratio can be expressed simply as the square of the proportion of women who are unmarried:

$$\text{NFR} = \text{Su}^2. \qquad \text{Eq. (6)}$$

NFR is a power function of Su because the direct effect of Su on NFR, captured in the first term on the right-hand-side of eq. (1), is magnified by Su's effect on the ratio (UBR/TBR), the second term on the right-hand-side of eq. (1). Because (UBR/TBR) *is* Su in our model, the expression for NFR reduces to the square of Su.

An implication of eq. (6) is that the size of the *change* in NFR induced by a *change* in Su depends on the *level* of Su. Depending on the value of Su, the change in NFR may exceed or fall short of the change in Su – that is, changes in Su may either "underpredict" or overpredict" the resulting changes in NFR. Both points follow from the differentiated form of eq. (6):

$$dNFR/dSu = 2Su. \qquad \text{Eq. (7)}$$

Eq. (7) implies that changes in Su exceed changes in NFR (dNFR/dSu < 1) when Su is less than 0.5, and fall short of changes in NFR (dNFR/dSu > 1) when Su is greater than 0.5.

The key predictions of the model are summarized as follows:

(P1) Increases in Su cause increases in both the nonmarital and marital birth rates, with a proportionately larger increase in the nonmarital birth rate – and no necessary change in the total birth rate – consistent with the patterns in Figures 1 and 2.

(P2) Increases in Su produce a magnified increase in NFR (NFR = Su^2), because the direct effect of a shift away from marriage is magnified by its effect on the ratio of the nonmarital birth rate to the total birth rate.

(P3) NFR, unlike its component birth rates, does not depend on P, the upper limit of the uniform distribution describing γ. Thus, NFR is independent of many factors that might plausibly be expected to influence child-bearing behavior.

(P4) dNFR/dSu is linear in Su, with changes in Su overpredicting changes in NFR when Su is small (less then 0.5) and underpredicting changes in NFR when Su is large (greater than 0.5).

D. Discussion.

We have described a simple model in which a woman's marital status depends on her childbearing propensity, γ. Married women occupy the upper end of the uniform distribution that describes childbearing propensities, and unmarried women the lower end. The portions of the distribution occupied by married and unmarried women are adjacent and non-overlapping. Accordingly, increases in the population share of unmarried women are produced by changes in the marital status of women who have a lower probability of giving birth than the remaining married women, but a higher probability of giving birth than the unmarried women they join. Thus, the average birth rates of both groups rise with Su, as noted in (P1). Yet, since the propensity to bear children is independent of marriage behavior in our simple model, the number of children born and the total birth rate do not necessarily change.

Less intuitive, perhaps, is the implication that as Su rises, the nonmarital birth rate increases by proportionately more than the marital birth rate. The assumption that γ is uniformly distributed means that as women shift from married to unmarried, the absolute increases in the birth rates of the two groups are the same. This result follows directly from the linearity of the functions depicted in Figures 5 and 6, which in turn follows from the assumption that γ is uniformly distributed. However, because the nonmarital birth rate is always less than the marital birth rate, the same absolute increase in the two birth rates produces a larger percentage increase in the nonmarital birth rate. The importance of this result lies in its implication for the ratio (UBR/TBR), as discussed next.

The magnified effect of marriage behavior on NFR described in (P2) follows directly from (P1) and eq. (2). From (P1) we know that increases in Su cause UBR to rise relative to MBR. Since the total birth rate is a weighted average of UBR and MBR, it follows that UBR also rises relative to TBR. Turning to eq. (2), we can now see that an increase in Su raises NFR both because Su appears directly in the expression for NFR, and also because it raises the ratio (UBR/TBR). A corollary to (P2) is that the impact of an increase in Su on NFR is larger than a typical calculation – one that accounted for only the direct effect of Su on NFR – would suggest.

The third prediction (P3) is that NFR is independent of P, the upper limit of the distribution from which γ is drawn. This is important because it allows us to set aside in our study of NFR many factors that might be expected to influence child-bearing behavior. The implication follows from the fact that P enters the expressions for each of the three birth rates given in equations (2) through (4) as a multiplicative factor. Since each of the three birth rates is proportional to P, the ratio of any two of the birth rates is independent of P. Intuitively, our assumption of a uniform distribution means that changes in P have the same proportional effect on child-bearing for all women and so do not affect birth rate *ratios*. Because NFR is the product of Su and the birth rate ratio (UBR/TBR), NFR is independent of P.

Together, the three predictions discussed above produce the paper's central thesis: The dramatic increases in NFR observed over the past several decades have been produced primarily by changes in marriage behavior rather than by significant changes in fertility choices. The predictions also provide a direct empirical test of the model in the form NFR = Su^2.

The result that NFR is equal to Su^2, rather than a more general non-linear function of Su (e.g. quadratic), produces the corollary (P4): The size of the response of NFR to a change in Su is linear in Su itself. Furthermore, dNFR/dSu will equal one – that is, changes in NFR will be equal to changes in Su – if Su is equal to 0.5. If Su is less (greater) than 0.5, then changes in Su will exceed (fall short of) the resulting changes in NFR – a strong prediction. Since both Su and dNFR/dSu are observed in our data, the prediction (P4) provides an additional, particularly strong, empirical check of the theory.

IV. Empirical Applications & Tests.

A. Does Su "explain" NFR?

To answer the question of how well our model performs in explaining NFR, we examine several forms of empirical evidence. The annual U.S. data employed in these exercises are constructed from information on the numbers of, and births to, married and unmarried women in the prime childbearing years of 20-39 over various post-WWII time periods.[5] We focus on the prime adult child-bearing years of 20-39, and thus set aside the particular idiosyncrasies of both

[5] Data for births by marital status are from National Vital Statistics Reports (2000, 48:16 and 2002, 50:10). Data for total births are from Vital Statistics of the United States (www.cdc.gov/nchs/births.htm). Data for the number of married and unmarried women are from U.S. Bureau of Census, Current Population Reports, Series P-20, various dates.

births to teenage mothers and births to women 40 and older. In order to avoid the complications created by the large shifts in the age distribution of the population over the post-war period, we group women into five-year age intervals – i.e. ages 20-24, 25-29, 30-34, and 35-39.

We begin with the central theoretical prediction that NFR is equal to the squared value of Su. Figures 7 and 8 compare the model's prediction of NFR with actual experience over the time period emphasized in sections I and II of the paper. The figures plot the values of NFR, Su, and Su^2 separately for white and black women aged 20-39 over the period 1974-2000.[6] Overall, the match between historically observed values of NFR and the model's prediction, Su^2, is strikingly close. In Figure 7, for whites, both the level and rate of increase of NFR over time correspond closely to the level and rate of increase of Su^2. Although the measure of Su is noisier for black women, the same general correspondence is evident in Figure 8.[7] Thus, the much higher levels of Su^2 for blacks than for whites produce correspondingly higher levels of NFR. The values of NFR range from a low of .04 in Figure 7 to a high of .58 in Figure 8, over half the total possible variation in NFR. That Su^2 appears to explain NFR well over such a wide range of observed values suggests a robust relationship.

[Figures 7 and 8 here]

We turn next to the ability of the model to explain changes in NFR for the individual five-year age groups. Table 1 presents the results of simple numerical calculations for how well changes in Su^2 explain changes in NFR between 1974 and 2000. Columns (1) and (4) of Table 1

[6] The series plotted in Figures 7 and 8 are weighted averages of the series available by five-year age group, with each age group's weight fixed at the average value of its population share over the period 1974-2000.
[7] Broader definitions of marriage (i.e. ones including separated and/or spouse absent) yield similarly close correspondences in the trends of NFR and Su^2 but not quite as close a match of the levels. Fortunately, the other evidence presented is affected very little by the choice of definition since the correlations between alternative measures of marriage are near unity. The definition of marriage employed here – married, spouse present – is arguably the best match to the married status self-reported by women in the birth data, given that welfare eligibility is restricted to female heads of household throughout most of our sample period.

report actual changes in NFR between 1974 and 2000 by race for each five-year age group; columns (2) and (5) report changes in Su^2; columns (3) and (6) report the ratios of the model's predictions for changes in NFR (i.e., the changes in Su^2) to actual changes in NFR.[8]

[Table 1 here]

For each age group and for both white and black women, Table 1 shows that changes in Su^2 correspond quite closely to the change in NFR. The ratio of the predicted NFR to the actual NFR deviates from one by just 6 percent on average, and in only one case does the ratio fall more than 7 percentage points away from unity. The one exception is for black women aged 30-34, where the ratio of 1.19 may be, at least in part, a consequence of small sample size and associated problems of data reliability. Overall, the calculations presented in Table 1 are consistent with the hypothesis that observed changes in NFR have been caused primarily by changes in marriage behavior rather than by changes in fertility behavior *per se*.

While Table 1 focuses on the model prediction (P2) that NFR is equal to the square of Su, Figure 9 examines evidence for the prediction (P4), that dNFR/dSu increases linearly in Su, with changes in Su overpredicting changes in NFR (dNFR/dSu < 1) when Su is less than 0.5, and underpredicting changes in NFR (dNFR/dSu > 1) when Su is greater than 0.5. Figure 9 plots the ratio dNFR/dSu against Su for blacks and whites in each of the four age groups in our study. The ratio dNFR/dSu is calculated by dividing the change in NFR between 1974 and 2000 by the change in Su over the same time period. For the level of Su, which appears on the horizontal axis, we use the average of its values in 1974 and 2000.

[8] This exercise is similar in spirit, though not in detail, to the demographic decompositions reported in Table 3 of Smith et al. (p. 147) for the period 1982-1992. Whereas our calculations assign to Su both its direct effect and its indirect effects (through birth rates) on NFR, Smith et al. assign to Su only its direct effect on NFR.

As Figure 9 shows, the eight observations provided by the two races and four age groups in our sample deviate very little from the linear relationship predicted by the theory, with the observation for black women aged 30-34 lying furthest from the reference line included in the figure.[9] Furthermore, with only one exception (again, blacks aged 30-34), changes in Su overpredict (underpredict) changes in NFR when Su is less (greater) than 0.5. In the three cases in which Su is less than 0.5, the corresponding values of dNFR/dSu are less than one, and in all but one of the five cases in which Su is greater than 0.5, dNFR/dSu is greater than one. The one exception is black women aged 30-34, for whom Su is close to the critical value of 0.5. Overall, Figure 9 illustrates a remarkable consistency between actual experience over the period 1974-2000 and the predictions of our simple model.

B. Statistical tests

The close correspondence between the (squared) share of unmarried women and the nonmarital fertility ratio apparent in both Figures 7 and 8, as well as between *changes* in the two variables between 1974 and 2000, is also supported by formal statistical tests. For these tests, we turn to standard regression techniques that exploit both the cross section and time series dimensions of our data over the longer period for which data on both NFR and Su are available.[10] Data are pooled across five-year groups over the years 1957-2000 for white women aged 20-34, 1968-2000 for white women aged 35-39, and 1969-2000 for black women aged 20-39. Table 2 presents estimates of the relationship between NFR and Su^2 for the full, unbalanced panel, pooled by race and age group. The estimates are corrected for first-order autocorrelation specific to race and age group. For white women, the autocorrelation coefficients range from 0.70 to 0.90, while for black women they range from 0.20 to 0.55.

[9] The reference line, which plots eq. (7), has an intercept of zero and a slope of two.
[10] The range of NFR, which is limited to the closed interval [0,1], does not pose a problem for estimating the model since all the predicted values of NFR lie within the range.

[Table 2 here]

The estimated effect of Su^2 on NFR reported in column (1) of Table 2 is 0.985, significantly different from zero at the five percent level, but not significantly different from the predicted value of 1.00.[11] The fit of the equation – as measured by the adjusted R-square for the transformed data – is extraordinarily high at 0.980, as one might expect given the time series component of the data.[12] Column (2) reports the results of including controls (fixed effects) for the five-year age groups and for race. While the addition of these controls raises the adjusted R^2 from 0.980 to 0.986, the estimate of the coefficient on Su^2 is virtually unchanged, at 0.973. Additional controls for age group and race interaction, reported in column (3), do not increase the adjusted R^2, and the coefficient on Su^2 is again virtually unchanged at 0.965. Hence, the overall explanatory power of the model is remarkably strong, and its prediction that the coefficient on Su^2 be 1.00 is supported in the data, regardless of whether age group and race specific controls are included.[13]

Finally, we conclude this section by extending the exercises reported in Table 1 and Figure 9 for the period 1974-2000 to the longer periods used in the regression analysis. These calculations are presented in Table 3 and Figure 10. In Table 1, changes in Su^2 explain changes in NFR quite well over the longer samples, though overall, as one might expect, not quite as closely as in the shorter period. The average deviation from unity, calculated as the absolute difference from 1.00, is slightly larger at 9 percent for the longer periods. However, the largest deviation from unity is actually slightly smaller – about 18 percent – in this case for the oldest

[11] The five-percent confidence interval is presented in brackets in Table 2.

[12] Including a time trend in the model has little effect on the results reported here. In the preferred specification in column (2), for example, the estimated coefficient on Su^2 declines only slightly in magnitude (from .973 to .951) and remains highly significant.

[13] Introduction of a linear term for Su in the preferred specification of column (2) produces a coefficient on Su that is not significantly different from zero at the 5% level. Also, the null hypothesis that the coefficient on Su^2 is the same for black and white women is not rejected at the 5% level.

age group of black women. Interestingly, black women aged 30-34, who evidence the largest deviation from unity over the shorter period 1974-2000, show a deviation of only about 4 percent over the longer period 1969-2000.

In Figure 10, the ratio dNFR/dSu is calculated from changes between 1957 and 2000 for whites 20-24, 25-29, and 30-34, between 1968 and 2000 for whites 35-39, and between 1969 and 2000 for blacks in all four age groups. The value of Su that appears on the horizontal axis is in each case the average of its values in the first and last years of the period covered. The eight observations recorded in Figure 10 closely approximate the linear relationship predicted by the theory. The observation for black women aged 35-39 lies furthest from the reference line included in the figure. In all cases, changes in Su overpredict (underpredict) changes in NFR when Su is less (greater) than 0.5, as predicted by the theory. Overall, then, we find substantial predictive power for the model even over these longer periods.

V. Concluding Remarks

The rising share of births to unmarried women has for some time been a focus of concern in the United States and elsewhere. In this paper we propose a model that suggests that this phenomenon may be due less to changes in the underlying fertility of individual women than to changes in their marital status. The model is motivated by the fact that for the period 1974-2000 in the United States, birth rates for unmarried women have soared, birth rates for married women have also tended to increase, and yet total birth rates have either remained flat or increased only slightly for specific age groups. If the primary origins of these trends were fundamental changes in underlying fertility, then why has the total birth rate risen so much less, proportionately, than either the nonmarital birth rate or the marital birth rate?

Our explanation relies on the effects that marriage behavior has on the composition of married and unmarried women. We develop a model in which child-bearing behavior at the level of the individual is characterized by a single preference parameter that varies across women. A woman's decision to marry depends on her preference for children, but the decision to bear children does not depend on martial status. This simple framework allows us to isolate the effects of changes in marriage behavior on nonmarital birth rates and shares, holding constant underlying fertility decisions. The model predicts outcomes consistent with U.S. experience since the mid-1970s: A decline in marriage will cause increases in the nonmarital birth rate, the marital birth rate, and the nonmarital birth rate *relative* to the marital birth rate, even though the total birth rate does not change. Thus, in addition to the direct effect of marriage behavior on the nonmarital fertility ratio standard to other demographic models, we predict an indirect effect that operates through relative birth rates. Indeed, our model predicts that the nonmarital fertility ratio is a power function – the square – of the share of unmarried women.

While the simplicity of our model reflects some strong assumptions, its predictions have substantial empirical power. Aggregated U.S. data from the post-WWII period are remarkably consistent with the various predictions of the model, as are demographic projections performed for each 5-year age group for both blacks and whites. Regression estimates fail to reject the model, regardless of whether controls for specific age groups and race (or their interactions) are included in the regressions. Our findings lend support to the view that the soaring ratio of nonmarital to total births has arisen primarily from changes in marriage behavior rather than changes in underlying fertility choices, and provide insights into the dual relationship between fertility and marriage behaviors. A number of recent studies seek to identify factors, including public policies, that affect the fertility of unmarried women. As this paper shows, factors that *appear* to affect fertility decisions – because they affect birth rates or shares – may actually exert no influence at all on fertility behavior. Instead, their influence may be on marriage decisions, which in turn affect measured birth rates and shares, with no accompanying change in fertility choices.

Of course, our model is stark, and the evidence limited in some important dimensions. We hope this paper stimulates interest in developing and testing more fully articulated models – models designed to tease out the life-cycle dynamics of the timing of fertility, to better understand the sequential interactions of marriage (or other union formations) and fertility, and to explore the relevance of this approach to other periods or contexts. All that said, the evidence presented here suggests that we have identified a relatively unexplored and potentially powerful effect of marriage behavior on birth rates and birth shares.

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Table 1. Ratio of Changes in Su^2 to Changes in NFR from 1974 to 2000[a]

Age group	White women			Black women		
	NFR change (1)	Su^2 change (2)	Ratio of (2) to (1) (3)	NFR change (4)	Su^2 change (5)	Ratio of (2) to (1) (6)
20-24	0.357	0.348	0.976	0.401	0.421	1.050
25-29	0.158	0.152	0.965	0.301	0.284	0.945
30-34	0.077	0.072	0.931	0.180	0.215	1.192
35-39	0.066	0.062	0.937	0.145	0.148	1.016

a. The model predicts that the ratios in columns (3) and (6) will be 1.000.

Table 2. Regression estimates of the link between NFR and Su^2 [a]

Specification	(1)	(2)	(3)
Constant	-0.005**	0.013**	0.006
	(0.002)	(0.003)	(0.009)
Su^2	0.985**	0.973**	0.965**
	(0.008)	(0.014)	(0.022)
5% confidence interval	[0.968 – 1.001]	[0.945 – 1.000]	[0.923 – 1.008]
$AR(1)_i$ [b]	yes	yes	yes
Fixed effects: [c]			
Age group	no	yes	yes
Race	no	yes	yes
Race x Age group	no	no	yes
R^2 (transformed data)	0.984	0.986	0.987
Adj R^2 (transformed data)	0.980	0.986	0.986
degrees of freedom	283	279	276

** Significant at the five percent level.

a. Standard errors are in parenthesis. Data are pooled across five-year groups over the years 1957-2000 for white women aged 20-34, 1968-2000 for white women aged 35-39, and 1969-2000 for black women aged 20-39.

b. Estimates are corrected for first-order (AR1) autocorrelation specific to age group by race..

c. Fixed effects are introduced, respectively, for age group, race , and for the interaction between age group and race. The latter interactions do not improve the adjusted R^2.

Table 3. Changes in Su^2 and in NFR – Longer Sample[a]

Age group	White women			Black women		
	ΔNFR	ΔSu^2	Ratio $\Delta Su^2/\Delta NFR$[b]	ΔNFR	ΔSu^2	Ratio $\Delta Su^2/\Delta NFR$[b]
	(1)	(2)	(3)	(4)	(5)	(6)
20-24	0.395	0.425	1.074	0.513	0.490	0.955
25-29	0.174	0.177	1.020	0.374	0.356	0.953
30-34	0.096	0.081	0.846	0.243	0.252	1.038
35-39[a]	0.080	0.070	0.870	0.217	0.177	0.815

a. 1957-2000 for white women aged 20-34, 1968-2000 for white women aged 35-39, and 1969-2000 for black women aged 20-39.

b. The model predicts that this ratio will be 1.000.

Figure 1: Birth Rates by Marital Status, White Women Aged 20-39

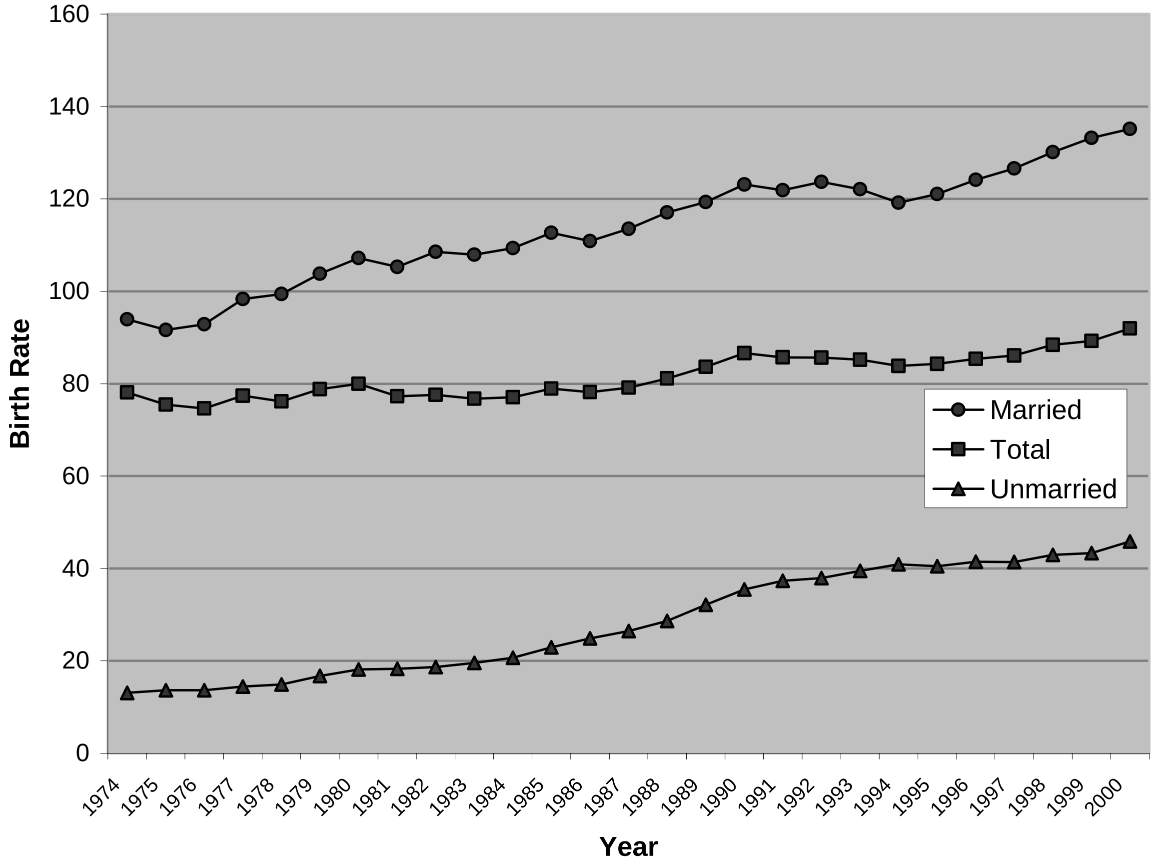


Figure 2: Birth Rates by Marital Status, Black Women Aged 20-39

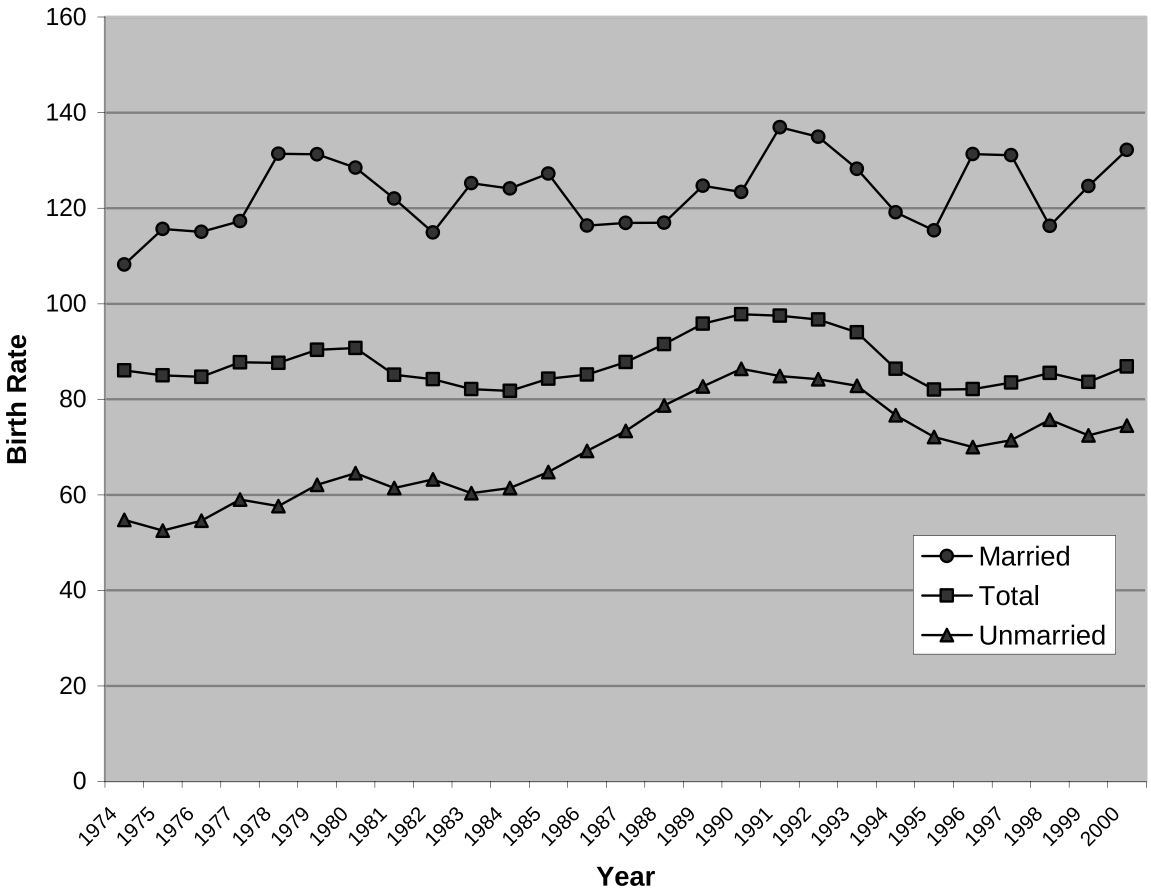


Figure 3: Population Shares of Unmarried Women Aged 20-39

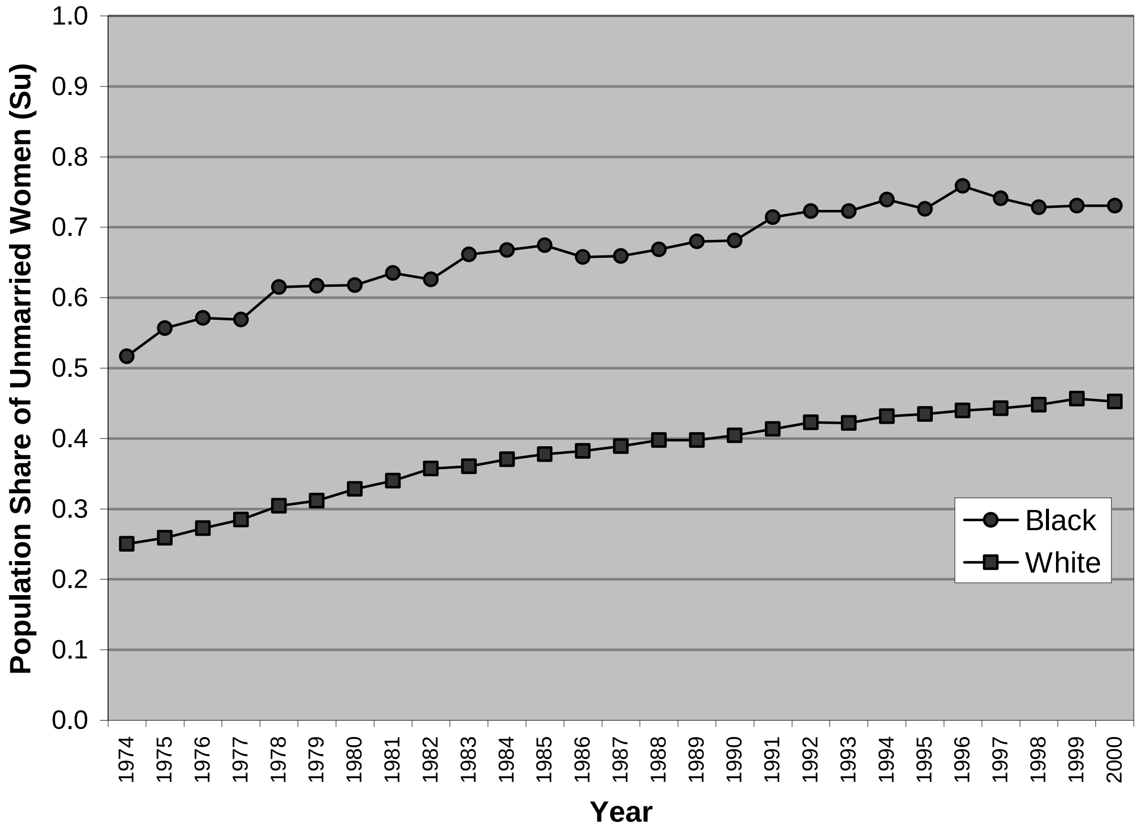
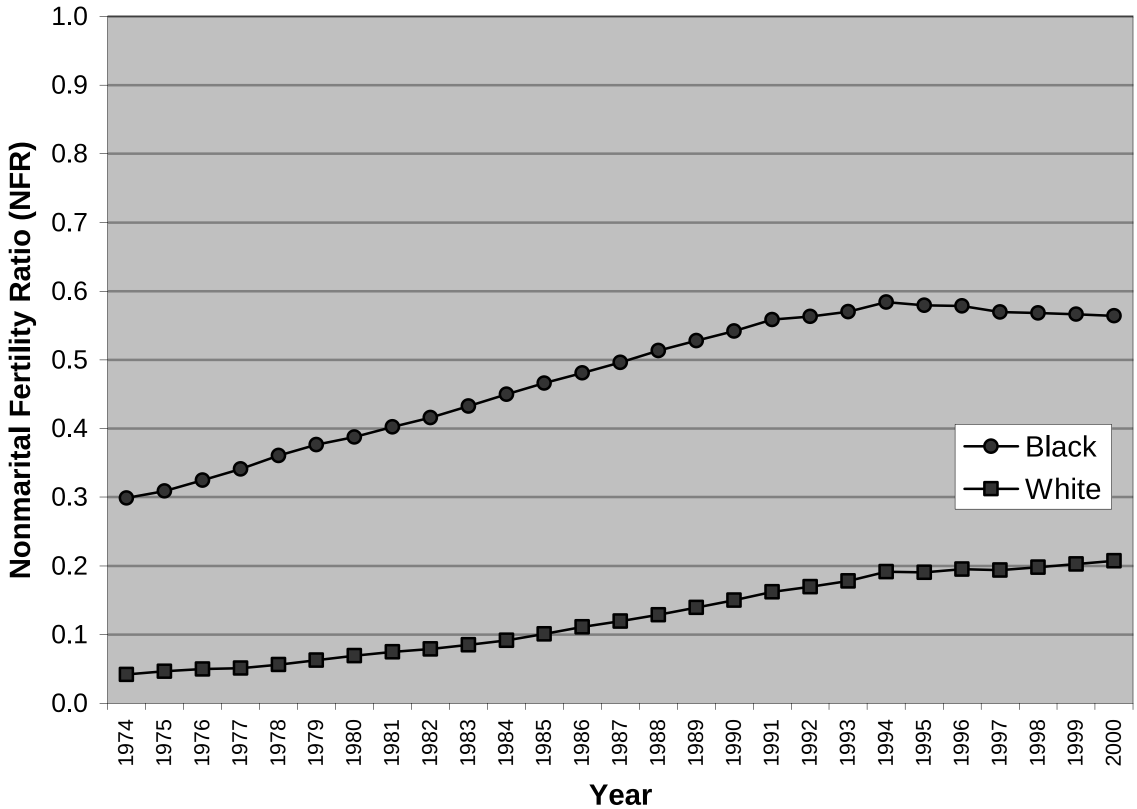


Figure 4: Nonmarital Fertility Ratio of Women Aged 20-39



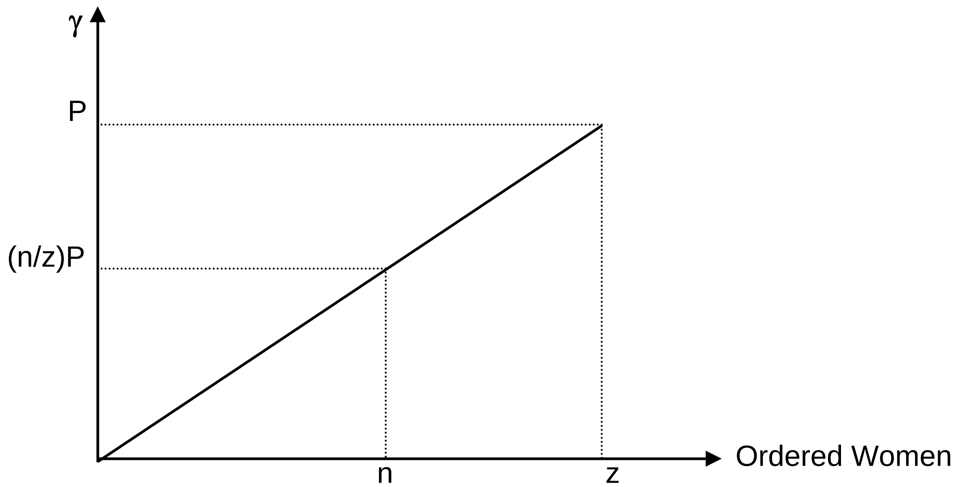


Figure 5. Women ordered by their preference for children (γ)

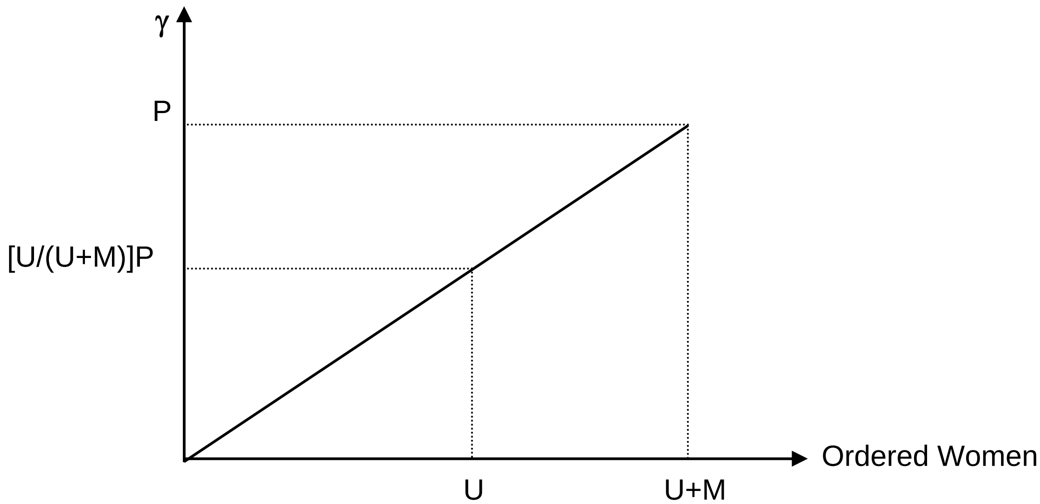


Figure 6. Women ordered by their preference for children (γ)

Figure 7: Su2 as a Predictor of NFR for White Women Aged 20-39

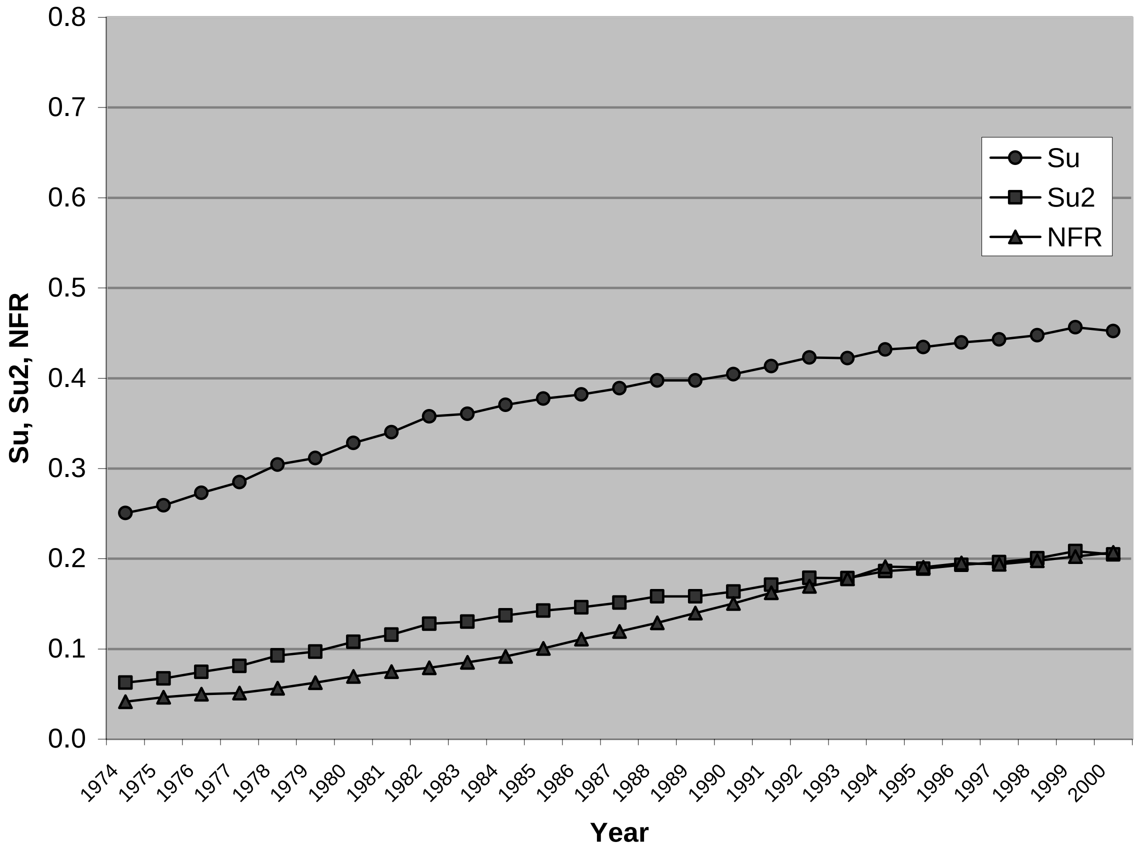


Figure 8: Su2 as a Predictor of NFR for Black Women Aged 20-39

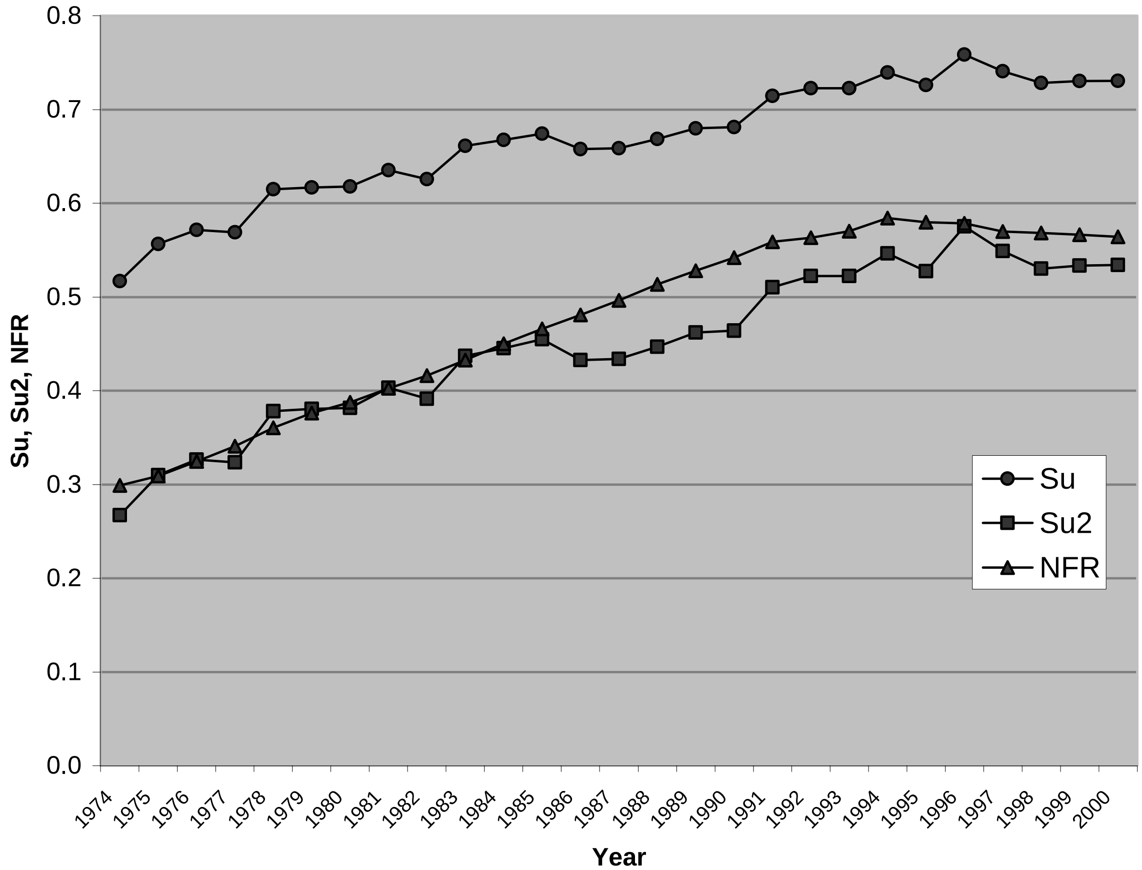


Figure 9: Plot of dNFR/dSu and Su, 1974-2000

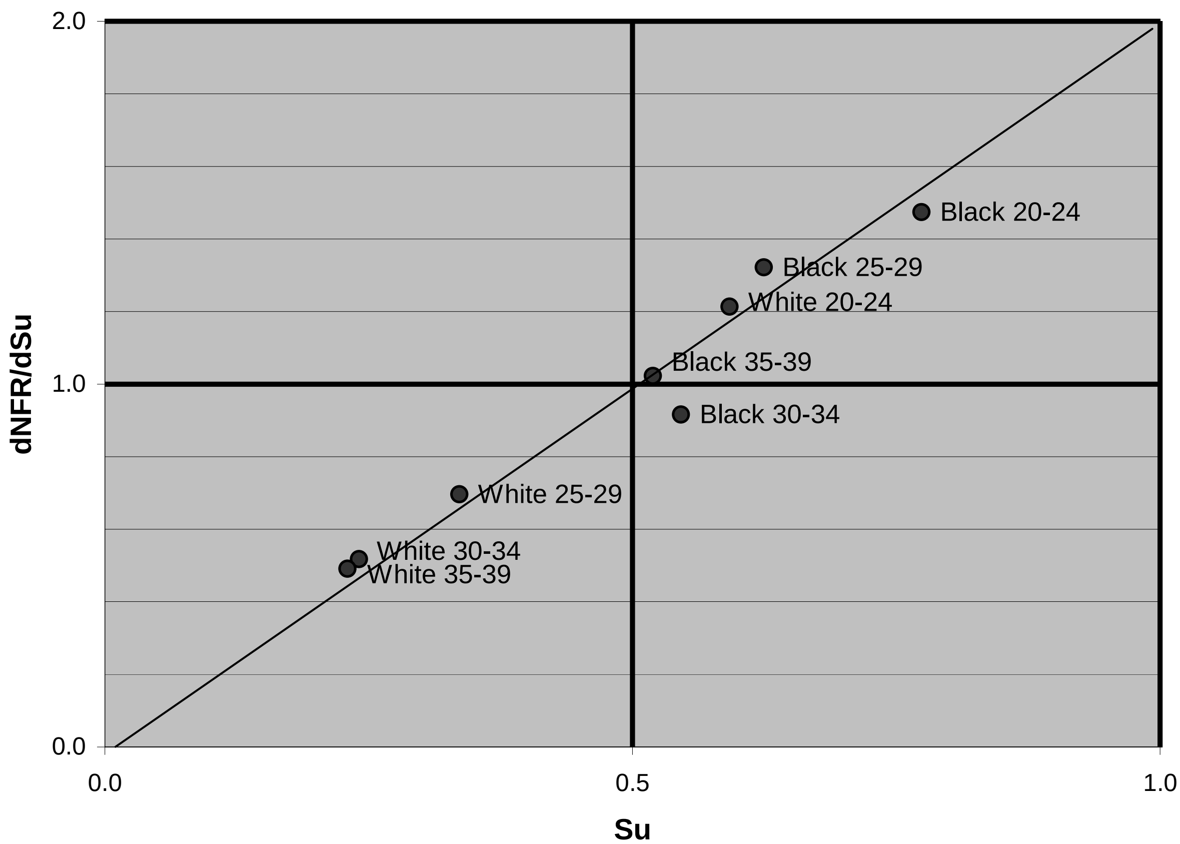


Figure 10: Plot of dNFR/dSu and Su, Longer Sample