A Birth-Cohort Test of the Wilson-Willis Model of Out-of-Wedlock Childbearing

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Abstract

This paper offers the first birth-cohort test of the Wilson-Willis model of black-white differences in nonmarital childbearing. Cohort data are uniquely suited to the model, and unlike prior evidence, support the power of the model's predictions: For blacks, the nonmarital birth share *rises, as predicted,* with the ratio of female to male resources, but decreases for whites. Similarly, the nonmarital birth share for blacks decreases with the ratio of eligible men to women for blacks, as predicted, yet *increases* for whites. The model explains a majority of the racial difference in nonmarital birth shares.

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I. **Overview.**

Out-of-wedlock fertility in the United States is sharply higher for blacks than for whites, but has increased for both groups over recent decades: In 1970, 38% of births among blacks were out of wedlock, and only 6% of births among whites, but by 2004, the nonmarital birth share (NBS) had risen to 69% for blacks and to 32% for whites.[1] The increased mental and physical hazards for children born and raised out of wedlock are well documented, and many factors – economic, political, legal, religious, and cultural have been proposed to explain both the racial differentials in nonmarital childbearing and the increases for both groups. Even so, a robust explanation has yet to emerge. In an effort to provide one, Willis (1999) develops a model of out-of-wedlock childbearing with a focus on marriage markets,[2] one that yields behavior described by William J. Wilson (1987).

Summarized briefly, the model predicts that when women's incomes are sufficiently low relative to men's, and the numbers of men and women are evenly balanced, men and women marry in order to bear and raise children efficiently in cooperation. However, if women outnumber men, and if their incomes are sufficiently high, both absolutely and relative to men's, men prefer to father children with multiple women, children more likely raised outside the cooperative efficiency of marriage. Willis argues that in the United States, this type of marriage market and childbearing is most appropriate to blacks, where eligible women are in excess supply: in recent decades the ratio of men to women in the resident, non-institutionalized population has been well

[1] U.S. Census Bureau (2005).

[2] Related work is found in Willis and Haaga (1996), Neal (2001), and Gray *et. al.,(2009), who emphasize selection into marital status, conditional on desired fertility as a factor in higher birth rates for both married and unmarried women.*

below unity for blacks, but roughly equal to unity for whites –a divergence due primarily to higher death and incarceration rates for black men. For the former, for whom women outnumber eligible men and men's incomes are not as markedly higher, the nonmarital birth share, Willis argues, falls with increases in the ratio of men to women and rises with increases in the ratio of women's to men's incomes. Alternatively, for whites, for whom women do not outnumber eligible men, and men's incomes are markedly higher than women's, Willis argues that children are more likely to be born within marriage to higher income parents, who exhibit positive assortative mating, so that increases in the ratio of women's to men's resources or in the ratio of women to men in the marriage market do *not* increase the nonmarital birth share. Of course, nonmarital childbearing has now become prominent among whites, as well, if not yet the norm: Willis notes that nonmarital childbearing may arise even when men are in excess supply if some women value their independence.

The Willis model offers a coherent cohort-based explanation for the sharp differences we observe in the nonmarital birth shares for blacks and whites, yet prior evidence based on data for individuals tends to reject any significant power for the model's explanation. Indeed, examining the influence of marriage market factors, South and Lloyd (1992, p. 247) find that "only a small proportion of the racial difference in nonmarital fertility appears to be attributable to differences in marriage markets. ..."

Unlike prior studies, however, we test the Wilson-Willis predictions using data for five-year birth cohorts of men and women, data uniquely suited both theoretically and empirically to testing the Willis model of marriage markets. Applying this approach to data for the United States from 1972 to 2002 for women 20-44 years old, we find substantial support for the predictions of the model. Specifically: for black women, for whom the ratio of eligible men to women is less than unity, the nonmarital birth share *rises, as predicted,* with a measure of the ratio of female to male resources, and *declines, as predicted*, with increases in the ratio of eligible men to women. However, for whites, for whom the ratio of eligible men to women is greater than or equal to unity: the nonmarital birth share *declines* with the ratio of female to male resources, and *increases* with the ratio of eligible men to women. With only two variables, the Willis model explains a majority of the racial difference in nonmarital birth shares.

II. Empirical specification.

Our empirical specification includes controls for age and period fixed effects in order to isolate the role of the cohort-specific factors in the Willis model from such influences as age differences in the timing of marriage and fertility, and time-varying changes in cultural and legal norms, economic conditions, earnings, and other cohort invariant, but age- or period-varying factors not otherwise accounted for, including in particular, the prominent role of changes in public assistance programs.[3] Thus, we estimate the following empirical specification of the Willis model separately for blacks and whites:

$$NBS_{int} = \alpha + \beta_n \, Age_{it} + \delta_t \, Period_{in} + \lambda_i \, \$(F/M)_{it} + \gamma_i \, \#(M/F)_{it} + \eta_i + \varepsilon_{int} \qquad (1)$$

Where NBS is the nonmarital birth share, the ratio of births to unmarried women to total births, for cohort i, age n, and period t. $(F/M) is a measure of the ratio of resources available to women relative to men, and #(M/F) is a measure of the sex ratio, the number of eligible men relative to women in a specific marriage market.The parameters η_{it} and ε_{int} are respectively, random cohort and residual error terms, and we invoke the usual assumptions regarding the error structure, including that the cohort and residual errors are uncorrelated. With Age and Period

[3] Moffitt (2000), for example, examines effects of welfare programs on female headship.

included in the model, it is not possible to identify the cohort-specific effects associated with the random error component (η_i), since the age, period and cohort triad are perfectly collinear. However, it is possible to identify the *variance* of the cohort-related error (η_{it}), which permits a comparison of the cohort-related error variance in models with and without explicit cohort variables in order to assess the extent to which explicit cohort variables account for the total cohort-related error variance.

Model Predictions.

λ_i, the coefficient for $(F/M), the resource ratio, is positive for blacks in the Willis model. The positive sign arises both from the positive effect of increasing resources available to women on their decisions to bear children, and from the positive effect of fewer relative resources available to men, making both men and women less likely to marry. By contrast, γ_i, the coefficient for #(M/F), the sex ratio in the cohort's marriage pool, is negative for blacks: incentives for men to marry increase in the model as the ratio of men to women rises if women are in excess supply.

For whites, children are more likely born within marriage in the Willis model, because the ratio of men to women is greater than or equal to unity, and men's resources are substantially greater than women's. Hence, there is no role similar to that for blacks for relative resources or the sex ratio, so we expect λ_i and γ_i for whites to differ from those for blacks—that is, be respectively, nonpositive, and nonnegative.

Data and Variables.

Data for fertility and population are from U. S. Bureau of Census (various years), and we limit our analysis to cohorts for which full data are available for whites and blacks. The cohorts used in the analysis, their birth years, and the years at which they reached ages 20-24 and 40-44 are given in Table 1. Consistent with other birth-cohort studies, we use five-year birth cohorts—wide enough to provide reliable statistical measures, but narrow enough to limit time-and age-varying heterogeneity within the cohort. Also, by averaging fertility over among women in a five-year birth cohort we avert the necessity of identifying all the idiosyncrasies and stock-flow fertility dynamics so intractable in individual panel data.[4] The oldest cohort in the analysis was born between 1928 and 1932; the youngest, between 1978 and 1982. Table 2 illustrates the structure of the data using the nonmarital birth share (NBS) for blacks and whites.

In Table 2, data for each age group are portrayed in rows and data for each year in columns. The nonmarital birth share for a given age and period for whites and blacks, respectively, are the first two elements of each cell. The third element is the number assigned to the birth cohort, corresponding to those listed in Table 1. For whites, values of NBS vary from 2.7, for 25-29 year-olds in 1972, the first year for which we have data, to 44.6, for 20-24 year-olds in 2002. As expected, values for blacks are consistently higher than those for whites. As summarized in Table 4, the minimum NBS for black women is 23.1, for 30-34 and 35-39 year-olds in 1972. The maximum is 81.3, which occurs for the same cohort and period as the maximum for whites: 20-24 year olds in 2002.

The columns of Table 2 illustrate age-related variations in NBS for each period. For whites, the youngest age group (20-24) has the highest NBS (23.4), averaged across all periods, while the oldest age group has the second highest (11.6). The middle age group (30-34) has the lowest NBS (7.4). The rows of Table 2 illustrate period-related variations in NBS for each age group. Clearly, there is a strong monotonic increase in NBS for each age group over the seven periods in the data.

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[4] Lerman (1989), for example, emphasizes this problem.

The diagonals in Table 2 illustrate cohort-specific changes. The oldest cohort for which full information is available is cohort 5, born in 1948-1952 and age 20-24 in 1972. For whites, along the diagonal for cohort 5 from the upper-left cell, the age-period-specific NBS was 5.7% in 1972, the lowest for all years for that age group. NBS declined when the cohort was in its late twenties and early thirties, but then rose to 8.9% in 1987, when the cohort was 35-39 years of age, and rose again to 15.1% in 1992 when the cohort was 40-44 years of age. Cohort 6, the next diagonal to the right, had an age-period-specific NBS of 8.3% at age 20-24 in 1977, NBS declines over the next ten years, but then rises to a value of 11.4 for 35-39-year-olds in 1992 and then to 14.2% in 1997,when the cohort was 40-44.

Our measure of relative resources available to women and men, $(F/M), is the ratio of the percentage of women to men in a specific cohort enrolled in school at ages 20-24. (x100).[5] The ratio of the percentage of women to men in a cohort enrolled in school at ages 20-24 is likely to be a superior indicator of relative lifetime earnings than the usual age-period-specific wage ratios found to have little influence in other studies, These vary little over the period for blacks or whites, and exhibit little or no *cohort-specific* temporal variation,

Table 3 reports summary statistics for NBS and the other cohort-specific variables separately for whites and blacks. For our dependent variable, the nonmarital birth share (NBS), the average for whites is only 12.3%, but the values range from a minimum of 2.7% for women 40-44 in the oldest cohort to 44.6% for women 20-24 in the most recent cohort. The average NBS for blacks is 43.4%, which ranges from a minimum of 23.1% for women 40-44 in the oldest cohort to 81.3% for women 20-24 in the most recent cohort.

The average value of $(F/M) is 71 for whites, ranging from only 24 for the oldest cohort to 113 for the most recent cohort. The average ratio for blacks is 87, ranging from 56 for the

[5] We find similar results using alternative younger and older ages, e.g., 18-21 and 18-24 years old.

oldest cohort to 140 for the most recent cohort.[6] These ranges reflect major shifts in relative enrollments and exhibit the now-familiar dominance of school enrollments by women at ages 20-24–particularly so for blacks. Data are for the resident, noninstitutionalized, population,

The average sex ratio, #(M/F), is 102.5 for whites, ranging narrowly from 100.9 for the oldest cohort to 107.0 for the most recent cohort. The average ratio is only 93.6 for blacks, ranging from 88.6 for the oldest cohort to 97.5 for the most recent cohort. As expected, the ratios are all above unity for whites and below unity for blacks, so that ranges of values for whites and blacks do not overlap. The lower ratios for blacks reflect in large part, higher incarceration death rates among black men as compared to both women of both races and white men. However, note that the sex ratio for the most recent cohort of blacks is only slightly lower than unity, up from only 88.6 for the oldest cohort.

Estimation Issues.

> Identification and endogeneity bias for the sex-ratio coefficient do not appear to be serious: the sex ratio at ages 20-24 for a particular cohort is predetermined for all other age groups in the cohort, and with both age- and period-specific effects held constant, not particularly susceptible to either spurious correlation from unobserved heterogeneity or endogeneity, especially since the Willis model predicts *differing results* for blacks and whites, so the odds of spurious correlations simultaneously consistent with the differing predictions of the model for blacks and whites appear remote.[7]

[6] The enrollment data are from the U.S. Bureau of the Census). Values for cohorts 1 and 2 are not available, so we impute by regression based on median years of schooling at age 25-29 (R squared = .93).

[7] Angrist 2002) notes several possible spurious links between sex ratios and marriage, for example, but none appear to yield differing predictions for blacks and whites.

Identification and endogeneity issues also do not appear overly severe for the resource-ratio coefficient, the resource ratio at ages 20-24 is also predetermined for all other age groups in the cohort. In addition, we find similar results even when we use a variety of alternative younger and older ages, so the identification strategy appears robust. Moreover, we test for the differing predictions for blacks and whites.

Cohort-level Estimation.

We estimate eq.(1) using cohort-, rather than individual-level data, both because the marriage-market factors in the Willis model are most meaningful in terms of birth cohorts and because cohort-level estimation in this context likely yields superior estimates: The underlying parameters for individuals likely exhibit substantial heterogeneity, (introducing greater variance), yet the cohort-level explanatory variables are identical across individuals in each cohort. Hence, with no correlation between the micro parameters and the 'corresponding' variables, there is no aggregation bias. In this environment, cohort-level estimation should yield superior parameter estimates.[8]

IV. III. **Estimates.**

Table 4 presents maximum-likelihood estimates of eq. (1) separately for blacks and whites, consistent with the differing coefficients by race predicted by the Willis model. The estimated Age-and Period-specific coefficients are omitted for simplicity, though we note their inclusion. Both age and period effects enter significantly. Standard errors are presented in parentheses. With only 35 observations, the age and period effects clearly push the data hard, with the possibility of weak power for the estimates. Even so, the

[8] Welsch and Kuh (1976) for example, apply Theil's parametric specification of aggregation to demonstrate that when micro parameters exhibit substantial heterogeneity, aggregation can yield more efficient estimates, and thus, superior estimates if they remain consistent.

standard errors do not appear overly large, and indeed, yield significant estimates, where predicted. The power of the cohort-level estimates contrasts sharply with the weak power found for the Willis model in prior work using data for individuals.

Estimates of eq. (1) for blacks are presented in the first column. As expected, increases in the resource ratio significantly increase NBS for blacks, and estimates for the effect of the sex ratio are significantly negative.

Estimates for whites are presented in the second column of Table 4. The estimated coefficient for our measure of relative resources of females to males indicates that for whites, NBS declines with a relative increase in women's resources, rather than increases, as it does for blacks. The estimated coefficient for the sex ratio is significantly positive, rather than negative, as it is for blacks, and the coefficients for blacks and whites differ significantly, consistent with the Willis model and at odds with spurious correlations affecting both groups in similar ways.

IV. **Explaining the Racial Gap.**

A Blinder-Oaxaca-style exercise, Blinder-(1973), Oaxaca (1973), of changing the means of the sex and resource ratios for one race to those of the other explains a majority of the racial difference in nonmarital birth shares, regardless of whether the black-white differences in means are multiplied by the estimated coefficients for blacks or those for whites—with most of the explanation due to the sex ratio and much less, only about 10%, to the resource ratio.[9] Using the black coefficients for example, explains 61% of the racial difference in NBS, while using the white coefficients slightly 'over explains' the racial difference in NBS by predicting a rise in the white NBS of 112% of the black-white gap in NBS.

[9] The sex ratio and relative school enrollments are linked (inversely) by men and women in a cohort who are institutionalized.

The dominant role for the two cohort-specific variables in the Willis model is also reflected in the fact that these two variables jointly capture roughly half of the cohort-related error variance in the estimates presented in Table 4.

Concluding remarks.

Unlike prior studies, we find substantial evidence in support of the Wilson-Willis model of nonmarital childbearing for both blacks and whites: when women are in excess supply in the marriage market, as is the case for blacks, the nonmarital birth share *rises* with a measure of the ratio of female to male resources (the ratio of female to male school enrollments in each cohort at ages 20-24), but *declines* with increases in the ratio of eligible men to women—results consistent with the model. The largest change over the period for both black and whites has been in the ratio of female to male school enrollments during their early twenties, which increased by more than 100% (from 56 women per 100 men enrolled, to 140 women per 100 men enrolled). Indeed, the sex ratio, the ratio of men to women ages 20-24 has actually increased over the period, from 88.6 to 97.5, remaining below unity.

For whites, for whom the ratio of eligible men to women is greater than or equal to unity: As expected. The nonmarital birth share *declines* with our measure of the ratio of female to male resources and *increases* with the ratio of eligible men to women, rather than decreases, as for blacks.

In summary, we find substantial power for the Wilson-Willis model: It explains a majority of the black-white difference in nonmarital birth shares. The greater power we find for the Willis model, as compared to prior studies, appears to be due to several factors: the use of cohort-level, rather than individual data, the inclusion of both age- and period-specific effects to control for unobserved heterogeneity, and consistent with the Willis model, separate parameters for blacks and whites, for whom the ratio of marriageable men to women is respectively, less than, and greater than one. Thus, changes in the male-female sex ratio and female-male resource ratio in each cohort appear to be major factors driving the black-white difference in nonmarital birth shares. While the former is more important than the latter, the two are inversely linked by endogenous interactions between schooling, on the one hand and incarceration and other forms of institutionalization on the other, particularly among young black males, a vicious cycle underscoring the importance and concern lent to these issues by William J. Wilson and others.

References

Angrist., Joshua. 2002. “How Do Sex Ratios Affect Marriage and Labor Markets? Evidence from. America's Second Generation,” *Quarterly Journal of Economics* 117:3: 997-301.

Blinder, Alan S. 1973. "Wage Discrimination: Reduced Form and Structural Variables." *Journal of Human Resources*. 8: 436-455.

Gray, Jo A., Stockard, Jean, and Joe A. Stone. 2006. “The Rising Share of Nonmarital Births: Fertility Choice or Marriage Behavior?” *Demography* 43:2:241-253.

Lerman, Robert I. 1989. “Employment opportunities of Young men and Family Formation.” Papers and Proceedings, *American Economic Review* 79:2: 62-66.

Gray, Jo A., Stockard, Jean, and Joe A. Stone. 2008. “Marriage, fertility, and Human Capital Investment” working paper, University of Oregon.

Isen, Adam, and Betsey Stevenson. 2008. "Women’s Education and Family Behavior: Trends in Marriage, Divorce and Fertility." NBER. In *Topics in Demography and the Economy* Cambridge: National Bureau of Economic Research.

Mathews, T. and S. Ventura. 1997. “Birth and Fertility Rates by Educational Attainment: United States, 1994.” *Monthly Vital Statistics Report* 45:10 (Supplement). Washington, D.C.: National Center for Health Statistics.

Moffitt, Robert. 2000. “Welfare Benefits and Female Headship in U.S. Time Series.” *American Economic Review* 90:373-77.

Neal, Derek. 2001. “The Economics of Family Structure.” NBER Working Paper No. 8519, Cambridge, MA: National Bureau of Economic Research.

Neal, Derek. 2004.”The Relationship between Marriage Market Prospects and Never-Married Motherhood.” *Journal of Human Resources*, 39 (4), pp. 938. **...**

Oaxaca, Ronald. 1973. "Male-Female Wage Differentials in Urban Labor Markets," *International Economic Review.*14:3: 693-709.

South, Scott, J, and Lloyd, Kim, M. 1992. “Marriage Markets and Nonmarital Fertility in the United States.” *Demography 29:2:247-247-26.*

Sutton, Gordon F. and Gooloo S. Wunderlich. 1967. “Estimating Marital Fertility Rates by Educational Attainment Using a Survey of New Mothers.” *Demography* 4:1: 135-42.

U.S. Bureau of the Census. (various years). *Vital Statistics of the United States* Upchurch, D., Lillard, L., and C. Panis. 2002. “Nonmarital Childbearing: Influences of Education, Marriage, and Fertility.” *Demography* 39:311-29.

Welsch, Roy E. and Edwin Kuh. (1976).”The Variances of Regression Coefficient Estimates Using Aggregate Data.” *Econometrica* 44:2:353-363

Willis, Robert J. 1999. “A Theory of Out-of-Wedlock Childbearing.” *Journal of Political Economy* 107:6: S33-64.

References continued

Willis, Robert J. and John G. Haaga. 1996. “Economic Approaches to Understanding Nonmarital Fertility.” *Population and Development Review* 22: 67-86.

Wilson, William Julius. 1987. *The Truly Disadvantaged: The Inner City, The Underclass, and Public Policy*. Chicago: University of Chicago Press.

Table 1. Cohorts Used in the Analysis and Birth Years

Cohort #	*Age 20-24 in*	*Age 40-44 in*	*Birth Year*
1	1952	1972	1928-1932
2	1957	1977	1933-1937
3	1962	1982	1938-1942
4	1967	1987	1943-1947
5	1972	1992	1948-1952
6	1977	1997	1953-1957
7	1982	2002	1958-1962
8	1987		1963-1967
9	1992		1968-1972
10	1997		1973-1977
11	2002		1978-1982

Table 2. Nonmarital Birth Shares (NBS) by Age, Period, and Race, (1972-2002)

		Period						
Age		1972	1977	1982	1987	1992	1997	2002
20-24	NBS-Whites	5.65	8.26	13.42	21.58	31.71	38.41	44.6
	NBS-Blacks	37.28	49.93	59.88	68.52	75.24	79.76	81.3
	Cohort	5	6	7	8	9	10	11
25-29	NBS-Whites	2.71	3.57	6.2	9.72	14.27	16.9	20.7
	NBS-Blacks	24.73	30.57	40.01	48.64	54.98	56.8	58.5
	Cohort	4	5	6	7	8	9	10
30-34	NBS-Whites	3.23	3.56	5.13	7.42	10.15	10.54	11.8
	NBS-Blacks	23.08	25.97	32.23	40.25	46.7	44.11	42.5
	Cohort	3	4	5	6	7	8	9
35-39	NBS-Whites	3.99	5.11	6.86	8.91	11.4	11.23	11.8
	NBS-Blacks	23.19	27.29	30.82	37.28	44.7	42.65	39.2
	Cohort	2	3	4	5	6	7	8
40-44	NBS-Whites	4.96	7.79	10.75	12.86	15.12	14.19	15.3
	NBS-Blacks	24.26	28.38	33.23	37.98	43.34	44.75	41.6
	Cohort	1	2	3	4	5	6	7

Table 3. Summary Statistics by Race (x100)

	Whites	Blacks
Age-Period-Specific Nonmarital Birth Share – NBS		
Mean	12.3	43.4
Minimum	2.7	23.1
Maximum	44.6	81.3
Standard Deviation	9.5	15.6
Cohort School Enrollment (20-24) – $(F/M)		
Mean	71.0	87.4
Minimum	24.0	56.4
Maximum	113.0	140.0
Standard Deviation	25.1	25.3
Cohort Sex Ratio (20-24) – #(M/F)		
Mean	102.5	93.6
Minimum	100.9	88.6
Maximum	107.0	97.5
St. deviation	1.4	2.1
Number of observations	35	35

Note: See text for details of data

Table 4. Estimates of Nonmarital Birth Shares (Cohort Ages 20-44 (1972-2002)

Variables	Blacks	Whites
Age effects	Yes*	Yes*
Period effects	Yes*	Yes*
Cohort variables:		
$(F/M) (20-24)	0.227*	-0.361*
	(0.078)	(0.106)
#(M/F) (20-24)	-0.163*	3.254*
	(0.009)	(1.057)
Log-likelihood (-2x)	-176.4*	-152.3*
AIC	-148.4	-122.3
Number of obs	35	35

(*) significant at the five percent level, robust standard errors in parentheses, cohort ar1

Notes: maximum likelihood (Proc Mixed SAS, 9.1) dependent variable is the nonmarital birth share (x 100).
See text for explanation and sources of data and variables.