DO ALTERNATIVE OPPORTUNITIES MATTER?

THE ROLE OF FEMALE LABOR MARKETS IN THE DECLINE OF TEACHER QUALITY

by

Marigee P. Bacolod *
University of California - Irvine

CES 06-22 July, 2006

Abstract

This paper documents the widely perceived but little investigated notion that teachers today are less qualified than they once were. Using standardized test scores, undergraduate institution selectivity, and positive assortative mating characteristics as measures of quality, evidence of a marked decline in the quality of young women going into teaching between 1960 and 1990 is presented. In contrast, the quality of young women becoming professionals increased. The Roy model of selfselection is used to highlight how occupation differences in the returns to skill determine average teacher quality. Estimates suggest the significance of increasing professional opportunities for women in affecting the decline in teacher quality.

JEL Classifications: I20, J16, J31, J48

* This paper is part of my Ph.D. dissertation. I gratefully acknowledge the generous advice and guidance of Joe Hotz and Ken Sokoloff. I also benefitted from discussions with Paul Devereux and Meredith Phillips, and helpful comments from Sandra Black, Janet Currie, Dean Jamison, Jean-Laurent Rosenthal, Seth Sanders, and seminar participants at UCLA, RAND, UC Irvine, University of Texas-Dallas, Amherst College, and the Federal Reserve Board. I also thank the Higher Education Research Institute at UCLA and the UCLA Census Regional Data Center. Financial support from a UCLA Dissertation Year Fellowship and the Edwin Pauley Fellowship is gratefully acknowledged. All errors and views expressed are my own, and do not represent the opinions of the Census Bureau or of HERI.

I. Introduction

In this paper, I use three alternative indicators of teacher quality to provide evidence of a marked decline in teacher quality over the recent decades. In addition, these declines are linked to the expansion in labor market opportunities for women and minorities that began in the 1960s.

Teaching has traditionally been the primary occupation for educated women. Economists have hypothesized that expanded female labor market opportunities, particularly for high ability educated women, should lead to a decline in teacher quality.[1] However, despite the popular perception that teachers today are less qualified than they once were because of the greater professional opportunities available to women, there has been relatively little investigation of the decline in teacher quality.[2] Part of the reason is the lack of data and time-series measures of teacher quality to test this hypothesis. For this purpose, I bring together several sources of data: the National Longitudinal Surveys of Young Men, Young Women, and Youth-79; the Cooperative Institutional Research Program's Freshman Surveys from 1971-1995; and the Integrated Public Use Microdata Series of 1940-1990. Using geographic and time-series variation, I also test to see if the decline in relative teacher wages and relative wage growth can help to explain the decline in the quality of those employed in teaching.

Using standardized test scores, undergraduate institution selectivity, and positive assortative mating characteristics from these data as indicators of teacher quality, I document a clear decline in the quality of young women going into teaching between 1960 and 1990. For instance, among those that scored in the highest quintile on standardized exams, the fraction that became teachers declined by 21 percentage points, while the fraction that became professionals increased by 22 percentage points.

Furthermore, I find that the more teachers were paid relative to professionals, the more likely highly able educated young women chose to teach. Moreover, as wage opportunities in teaching became relatively less attractive, the ability of teachers and prospective teachers declined. These

---

1. See for instance Temin (2002). Using a lemons model, Temin argues that because educated women initially constituted a captive labor pool for schools, a consequence of the gender desegregation of the labor market in the 1960s is today's low teacher pay, low teacher quality equilibrium.

2. Notable exceptions discussed further below include Corcoran, Evans, and Schwab (2004a, 2004b), Flyer and Rosen (1997), Hoxby and Leigh (2004), Lakdawalla (2001), Murnane et.al. (1991), Stoddard (2003).

findings are consistent with the interpretation that the availability of outside opportunities determined the quality of those who chose to teach. Despite the overall growth in real wages paid to teachers over this period, the real wage increases have not kept up with the growth in alternative professional occupations.[3] While there potentially remain additional explanations for the decline in teacher quality, the results in this paper suggest that as outside opportunities improved for women and blacks in the recent decades, fewer chose to teach, and those who did teach tended to be less skilled.

Section II briefly reviews the related literature. Section III proceeds to describe the various data sources used, followed by a statistical analysis of that data in Section IV. In Section V, the patterns are examined in the context of the Roy model, which predicts that individuals choose an occupation that gives the highest payoff to their skill. The link between wage opportunities and the decline in teacher quality is further explored in Section VI. Finally, Section VII concludes.

II. Background and Related Literature

Over the last century and particularly since World War II, labor market opportunities for educated women in the United States expanded substantially. While real wages conditional on education and experience have grown for all women, wage increases were notably higher among college-educated women (Goldin 1997; Pencavel 1998; Smith and Ward 1984, 1989). Within professional occupations, women's wages also rose relative to those of men (Black and Juhn 2000). These wage gains produced not only increased labor force participation among women (Goldin 1990; Mincer 1962; Smith and Ward 1989), but also led to a rising share of women in traditionally male professional occupations (Black and Juhn 2000).

Nevertheless, few economists have studied the role of changes in alternative female wage opportunities on the quality of teachers, which is traditionally a female-dominated sector. Using individual performance on standardized tests, Corcoran et al. (2004a, 2004b) and Murnane et al. (1991) find similar patterns of a decline in teacher quality as documented below. This paper expands

3. For an excellent survey of the growth in teacher real wages over the 20th century, see Hanushek and

on these studies' analyses of changes in teacher quality over time by examining three alternative measures of quality and by explicitly relating these to changes in relative teacher wages.

Meanwhile, the decline in teacher quality has also been linked to changes in the demand for skills associated with technological change in the U.S. labor market (Lakdawalla 2001) and to unionization (Hoxby and Leigh 2004, in addition to increased female labor market opportunities). Lakdawalla (2001) and Stoddard (2003) use relative wages as proxies for teacher quality, while Hoxby and Leigh (2004) use undergraduate institution-level SAT scores. However, the decline in teacher quality demonstrated below occurred particularly among women and blacks, regardless of the data source and measure. While skill-biased technical change and unionization—generally considered race and gender neutral—could also have contributed to the decline in teacher quality, race and gender specific factors such as the desegregation of labor markets must have dominated.

Understanding the impact of changes in the female labor market on teaching is important not only for establishing what happened, but also for its potential relevance in accounting for changes in school quality. Because teachers constitute a major input in education production in terms of their factor share, the erosion of teacher quality shown below could have had a big effect on school quality.[4] In addition, policymakers and researchers continue to debate whether paying teachers more would induce more highly skilled women to enter the profession.[5] Variation in female labor opportunities may account for some of the differences in these findings.[6]

III. Data Sources

A. Data from the IPUMS 1960-1990

Rivkin (1997). For a review of increases in teacher salaries since the 1980s, see Ballou and Podgursky (1997).

4. It is not clear whether the decline in school quality is just a perception or whether schools have actually gotten worse. For example, declines in the average student performance on the SAT were observed in the late 1960s and early 1970s (Koretz 1986). Some claim the decline is purely due to the changing mix of SAT takers.

5. For example, studies by Ballou and Podgursky (1997) find that raising teacher wages have little to no effect on teacher quality, while Figlio (1997) finds that they do.

6. In a study linking student dropout rates and teacher wages, Loeb and Page (2000) find that controlling for alternative opportunities matters a lot; teacher wage effects are insignificant when alternative wages are not controlled for.

The data used for calculating changes in occupational employment and wage opportunities come from the Integrated Public Use Microdata Series (IPUMS) 1960-1990. The huge sample sizes of the Census is its primary advantage and is particularly useful for obtaining statistics in local labor markets. The IPUMS samples include all black and white individuals aged 21 to 60 not currently attending school and with at least 14 years of schooling. Because they have wildly differing patterns, cohorts born before 1900 are not included in these samples. I use the upper cut-off of age 60 to avoid retirement issues, and note that including ages 60 to 65 lead to qualitatively similar results. Excluding ages 21 to 25 to eliminate problems associated with joint schooling and work activities lead to the same patterns as when these age groups are included. Given that a number of teachers particularly from the early census years attended normal or teaching colleges (about 2 years of college and hence were teaching by age 21), the samples for analyses include ages 21 to 25 and those with less than 4 years of college for ease of comparison over time. The category "teachers" includes all pre-college teachers.[7] The category "professionals" includes accountants, engineers, college professors, doctors, other health technicians, managers, officials, and proprietors, excluding nurses and teachers.

In addition, for the figures below reflecting wage opportunities, IPUMS samples are further restricted to include only those who had been employed in the prior calendar year, not self-employed, not worked without pay, and earned at least the effective minimum wage for 13 weeks.[8] The wage income for workers top-coded at the census maximum was also imputed as 1.5 times the top-code value. All wage earnings are deflated using the CPI with 1967 as the base year. For the most part the qualitative results are not sensitive to these exclusions and imputation.[9] The trends discussed below are also similar to those reported by other researchers using administrative data or surveys such as the CPS. All reported statistics are weighted to add up to the U.S. population using sampling weights.

B. Three Cohorts from the National Longitudinal Surveys

7. Pre-school teachers cannot be separated within this category prior to 1970. In 1970, 1980 and 1990, about 97 percent are elementary or secondary teachers of this category.

8. The effective minimum wage used for the 1960 sample is $1; $1.30 in 1970; $2.90 in 1980; and $3.80 in 1990 (Source: Employment Standards Administration).

To document trends in teacher quality, I turn to the geocode versions of the National Longitudinal Surveys of Young Men (NLS-YM), Young Women (NLS-YW), and Youth-79 (NLS-Y79).[10] The NLS-YM and NLS-YW are two of the NLS Original Cohorts, nationally representative surveys conducted by the U.S. Bureau of the Census Demographic Surveys Division that began in the mid-1960s and were followed over time. NLS-YM respondents were initially interviewed in 1966, when young men were aged 14 to 24, while the first interview of the NLS-YW was in 1968, when young women were aged 14 to 24. Finally, the NLS-Y79 is a sample of young men and women aged 14 to 22 in 1979 who were also followed over time.[11]

An advantage of these data is the availability of measures of standardized test scores as a potential measure of teacher quality. IQ scores of NLS-YM and NLS-YW respondents and scores of NLS-Y79 respondents on the Armed Forces Qualifying Test (AFQT) are provided by these surveys. NLS analyses samples include only black and white respondents who were not in the military, with at least 14 years of schooling, and with non-missing test scores. Demographic and employment data for the survey years respondents were aged 21 to 30 were used to determine their occupation and location.[12] A teacher is identified as having ever taught between ages 21 to 30, while a professional is one who was ever a professional but not a teacher at those ages. This definition will tend to underestimate a decline in teacher quality, given that previous studies find attrition from teaching is higher at younger ages and high-ability teachers are more likely to attrit than those with less talent.[13]

C. CIRP Freshman Surveys

---

9. For instance enforcing more labor force attachment by including only workers who earned at least the minimum wage for 6 months only magnifies the results reported below.

10. The NLS Original Cohort (YM, YW) geocode data may only be accessed at a Census Regional Data Center, and thus subject to the Census Bureau's procedures for access to Title 13 data. The Bureau of Labor Statistics handles applications for access to the NLSY79 geocode data.

11. Three subsamples comprise the NLS-Y79: a cross-sectional nationally-representative sample; supplemental samples designed to oversample Hispanics, blacks, and economically disadvantaged youths; and a military sample. Analyses samples include the regular cross-section samples and black oversamples. Since the focus of this paper is in the early careers of these cohorts, attrition is not a major issue.

12. Additional details on the construction of the NLS samples are provided in Appendix A. Descriptive statistics of relevant variables are also reported in Appendix Table I.

13. See Murnane et. al. (1991) and Podgursky, Monroe, and Watson (2004).

As additional evidence, I use the selectivity of the undergraduate institution of potential teachers as an alternative measure of teacher quality. Data for this come from the Cooperative Institutional Research Program's (CIRP) Freshman Surveys of 1971, 1975, 1980, 1985, 1990, and 1995.[14] The UCLA Higher Education Research Institute (HERI) administers the Freshman Surveys annually to all incoming freshmen at more than 1,700 colleges and universities. Each freshman cohort included in this study is a nationally representative sample of first-time full-time college freshmen enrolled at four-year institutions. Institution selectivity is provided by HERI and is measured at one point in time, 1983. This measure is based mainly on the average SAT of the entering freshman class. The measure is also highly related to college rankings such as those generated by Barron's. For instance, Princeton, Harvard, the University of California and University of Chicago are considered highly-selective; Fordham, Southern Methodist, and University of Pittsburgh are medium-selective; while Idaho State, and Fort Lewis College are among some of the low-selective institutions.

A potential issue in using college selectivity as a measure of teacher quality from this data is that a number of highly selective institutions curtailed undergraduate education programs during the time period under study. To deal with this, a potential teacher is indicated in two ways: whether a freshman intends to major in education or whether she declares teaching as her career plan. Since the two indicators are very highly correlated, I find similar results using either indicator.

A more important limitation to this data is that not all prospective education majors and prospective teachers end up actually teaching. Neither do all teachers major in education in college. This limitation has to do with our uncertainty as to when students acquire information and form expectations about relative wages. One would expect the marginal value of this information to be greatest as a freshman, before sunk costs are created that make it costly to switch fields. On the other hand one might expect learning to occur as students progress through college, making college seniors or new graduates the more ideal cohort to study. This issue is only important for the inference below if we believe the way wage expectations are formed across the ability distribution is changing over time.

---

[14] Although the surveys have been collected annually since 1967, data prior to 1971 were unavailable in

IV. Trends: A Descriptive Analysis

This section provides a statistical description of the data. First, trends in employment in teaching and the professions are examined, followed by a description of the decline in teacher quality using three alternative indicators. These changes in quality and employment are then contrasted with national wage trends to illustrate how relative wages may be a significant contributor in accounting for the declining quality of teachers.

A. Decline in the Employment of Women in Teaching and Rise of Women Professionals

With the rise of women professionals relatively fewer college-educated women were teaching. Among college graduate women in 1960, more than 30% of whites and more than 50% of blacks were teachers (see Figure I). By 1990 only about 20% of young college graduate black and white women were schoolteachers.[15] The early figures reflect the intensive hiring of teachers during the 1950s and 1960s as school systems moved towards smaller class sizes and the baby boom cohorts had to be accommodated. The exit of these cohorts undoubtedly contributed to the dramatic decline after 1970.

Table I focuses on flows of new labor market entrants and reports the fraction of 21 to 30 year olds within education groups who were teachers by region and race. Four findings are particularly noteworthy. The decline between 1970 and 1990 occurred everywhere and across all groups, but was especially pronounced for women in general and among blacks in the South. College-educated blacks (women and men) were more likely to be in teaching than their white counterparts in 1960. Regional differences in those who teach are also highlighted in Table I—women in the South and Midwest were more likely to be teaching. Finally, black men's patterns were more similar to those of white and black women than to those of white men. All these trends suggest that in areas and periods when outside opportunities were less available, more college educated individuals end up teaching.

While the decline in the fractions of college-educated women and blacks in teaching may be largely explained by their increasing college attendance (the denominator), these figures nonetheless

---

electronic form. I was also granted access only to these particular cohorts by HERI.

15. A cohort-based analysis shows the decline in the proportion of women teaching occurred within as well as across cohorts. As each cohort got older, fewer among them were teaching.

illustrate that conditional on having at least two years of college, fewer women and blacks today end up teaching.[16] This, however, has not resulted in a dramatic defeminization of the teaching workforce over this period. Using administrative data from public schools, the percentage of all teachers that are female has remained fairly stable—at 69% in 1960-61 to 72% in 1990-91.[17]

The decline in the employment of college-educated women in teaching is striking not only when compared to the slight decline for white men, but particularly in the context of rising female employment in traditionally male professions. The share of women entering professions such as engineering, medicine and law grew rapidly after 1960. As seen in Table II, between 1960 and 1990 the proportion of young college-graduate women in these occupations increased by 33 percentage points among whites, and by 29 percentage points among black women, compared to the slight increase of 9 points among white males. There is also geographic variation in the rise of women professionals. States in the Northeast observed more rapid changes and higher fractions of women in the professions than did other regions of the country. This may be related to regional differences in the structure of the economies, in the attitudes toward women entering these occupations, as well as in the access of women to institutions where the appropriate human capital could be acquired.[18]

B. Three Indicators of Teacher Quality

Given that relatively fewer college-educated women chose to go into teaching, did the skill or ability of teachers change over time? What occupations did high quality women choose? Using three alternative indicators of quality, this section presents some evidence of the decline in teacher quality and the increasing propensity of high quality women to choose other professions.

---

16. Furthermore, the declines in Table I are not only the result of the increase in college attendance. For one, the college attendance rates did not rise uniformly across these groups. Between 1960 and 1990, the largest increases in those with 2+ years of college are white males while the fraction of white male teachers declined only very slightly. The rate of increase in those with college is also higher among white females than black females, but the decline in teaching participation rates is steeper among black females.

17. Figures from Status of the American Public School Teacher, NEA.

18. The rising share of women professionals reflects increasing numbers of previously all-male universities that opened up to be co-educational and the professional programs that admitted women in increasing numbers. There were 23.4 men for every woman enrolled in professional schools in 1960; this ratio was 1.66 by 1988. (U.S. Dept of Education Digest 1988 and U.S. Dept of Health Education & Welfare 1960)

Measurement of teacher quality is an ongoing research issue. While personal qualities such as dedication and a compassionate nature certainly contribute to a teacher's effectiveness, most studies focus on observable and measurable attributes—such as teacher experience, level of education, test scores, or proxies such as relative wages—to measure quality. The measures presented below may be interpreted as indicators of (pre-market or innate) skill, or accumulated human capital, or academic proficiency. While these measures capture only *some* aspects of teacher quality, it is difficult to argue that they are either uninformative with respect to intelligence and skills or unrelated to teacher quality.

1. Standardized Test Scores

Of input-based measures—such as class-size, expenditure per pupil, and measures of teacher quality such as teacher education and experience—teacher test scores have the most robust positive relationship with student performance (Hanushek 1997).[19] Since improving school quality may be the most important reason for caring about teacher quality, I first examine test scores.

Few national surveys collected test scores particularly for the cohorts in the early period of this study. As discussed in Section III standardized test scores to investigate changes over time in teacher quality are available for cohorts in the NLS-YM, NLS-YW, and NLS-Y79. I compare the performance of teachers and professionals across birth cohorts on standardized examinations such as the Armed Forces Qualifying Test (AFQT) and IQ tests. Figure II plots the fraction of test takers that scored above the 80th percentile that were professionals and teachers by birth cohort. The figures are calculated separately for white males versus all females. Overall, the fractions that were professionals increased over this time frame while the fractions that were teachers declined. But the decrease in the share of high quality teachers and increase in the share of high quality professionals were much larger for females than for white males. Among the early 1940s cohort (cohorts who were in their late 20's in 1970), 30% of those who scored above the 80th percentile were teachers; among the cohorts who were in their late 20's in 1990, only 8 to 9 percent were teachers. Meanwhile, 49% of the early 1940s cohort

[19] In a review of 377 education production function estimates, Hanushek finds more than 70 percent report class-size, expenditure per pupil, and teacher education and experience have negative to insignificant effects.

who scored above the 80th percentile were professionals, and the proportion increased to 70% of the cohort who were in their late 20's in 1990.

Furthermore, teachers were increasingly being drawn from the lower end of the distribution. Table III shows that the fraction of teachers who scored below the 20th percentile increased from 8% of female teachers born in the 1940's to 19% of female teachers born in the early 1960's. The fraction of female teachers who scored above the 80th percentile fell as well, from 41% of cohorts born in the early 1940's to 19% of cohorts born in the early 1960's.

2. Selectivity of Undergraduate Institution

An alternative measure of teacher quality shown to also be significant in determining student performance is a measure of the selectivity of a teacher's undergraduate institution (Ehrenberg and Brewer 1994). As described in Section III, these measures are available from the CIRP Freshman Surveys of 1971 to 1995. Depicted on Figure III, the data show the fraction of all prospective education majors enrolled in highly selective institutions declined from 21 to 10 percent over the 1970s, remaining at about 10% through 1995. Prospective teachers and education majors were increasingly being drawn from low to middle selective institutions. The fraction of education majors from low-selective institutions steadily increased from 34% in 1971 to 57% by 1985, declining slightly to 50% by 1995.

The data also show that the fraction of those from highly selective institutions who declared teaching as their career plan declined over the same period. The decline was greatest for white females, followed by black females and only a very slight decline for black males. Similar to previous figures, the fraction of white females who declared teaching as their career plan converged to that of white males by 1995. On the other hand, freshmen from highly selective institutions were increasingly intending to pursue professional and/or business careers. In 1971 among white female freshmen from highly selective institutions, 28% were potential teachers, 11% were planning to be doctors/engineers/ lawyers/college professors, and 2% were planning to have business careers. By 1980 only 6.5% were potential teachers, while 25% intended to be doctors/engineers/etc, and 15% planned to pursue careers

in business. The fraction planning to teach increased slightly to 9% by 1995, but still 27% plan to be doctors/engineers/etc and 9% planned to have business careers.

3. Positive Assortative Mating

The decline in the quality of female teachers is further illustrated using a third alternative measure of quality: their husbands' position in the male wage distribution and their husband's education. I use this measure because traditional quality measures are not available in census data, and because under the assumption of positive assortative mating, these should proxy for married female teacher's quality.[20] Although certainly not "standard" measures of teacher quality, these are highly correlated with accepted quality measures. The IPUMS samples are further restricted to married women between ages 21 to 30 from 1960 and 1990.[21] Table IV reports the occupation distribution of young married women whose husbands earned above the 75th percentile on the male wage distribution or whose husbands attained more than a college education. The fraction of married female teachers with top-earning husbands clearly fell over time, while the fraction of professionals married to top-earners increased over time. Similarly, the fraction of married female teachers whose husbands attained more than college fell over time, while the fraction of such professionals increased over time.

In summary, using three alternative indicators of quality, the trends suggest that the decline in teacher quality was primarily driven by exit from the top of the distribution, among individuals who potentially faced higher returns to their ability. The above figures and tables necessarily condition on college attendance, however. If the selectivity of females entering college has changed over the period, these figures may not reflect that the overall quality of females entering teaching has declined. That is, if prior to the widening of opportunities it was the brightest women who did not attend college, their recent entry into college and into non-teaching occupations would actually have no

---

20. There is some evidence that assortative mating was not as positive in earlier years. That is, low-wage women were disproportionately married to high-wage husbands as these women specialized in home production. Over time, as women's market work has increased, assortative mating has probably become more positive. This should favor against finding any decline in teacher quality measured by using husband's characteristics.

21. Marriage bars were prevalent before 1960. By 1940, 87 percent of all school districts would not hire a married woman and 70 percent would not retain a single woman who married. Most of such bars went away with the War. By 1951, 18 percent still had the hire bar and 10 percent the retain bar. (Goldin 1990)

impact on overall teacher quality. This selectivity does not seem to be the likely story, however. In fact, Corcoran et al. (2004a) show that low ability females of the early 1990s were more likely to complete college than their counterparts in the 1960s.

C. Relative Teacher Earnings

The above discussion examined trends in the employment of the educated population in teaching relative to other professions and changes in relative teacher quality. One of the striking trends was that the relative decline in employment and quality was most pronounced for women and blacks. An explanation for this differential decline is that alternative labor market opportunities for women and blacks converged closer to those of white males. This hypothesis is, however, difficult to test directly because job opportunities or job offers are not in the data. Instead I use wages as an indicator of opportunities to evaluate the hypothesis. Using data from the IPUMS, I next calculate teacher earnings relative to workers of similar skill by race and gender group. The earnings refer to wage income from the calendar year preceding the census from *all* occupations, i.e. not just the primary occupation. As Hanushek and Rivkin (1997) point out, overall earnings may better reflect the benefits of being a teacher as opposed to having a different primary occupation since teachers enjoy other non-pecuniary benefits such as longer vacations than other workers.

Mean teacher earnings relative to that of workers of similar background are plotted in Figure IV.[22] This figure shows the major decline in relative teacher earnings for women and blacks that occurred as their alternative wage opportunities improved. The decline in relative teacher earnings for women and blacks is especially noteworthy when compared to the only slight decline for white males.

[22.] Alternative earnings for each teacher *i* is calculated as the mean among college-educated non-teachers of the same background as teacher *i* – i.e., the same state of residence and metropolitan status (SMSA), gender, race, education and age group. If the mean non-teacher earnings cannot be formed for teacher *i* using these observables, a mean is formed using a wider geographic category–from non-teachers residing in the same census region and metro status. If there are still no matching cells to form the mean non-teacher earnings, the mean is calculated among non-teachers over all ages in the same census region and metro status and of the same gender, race, and education background. Finally, the remaining unmatched teacher observations are assigned mean non-teacher earnings averaged over all ages and education groups in the same census region and metro status and of the same gender and race. For each teacher *i*, a ratio of teacher *i*'s earnings relative to her group's non-teacher earnings is formed. The figure plots the weighted average of these relative earnings across all teacher *i*'s.

This suggests that the expansion in opportunities for women and blacks is a major source of explanation for changes in teacher quality.

V. Theoretical Framework

In light of the above statistical evidence of declining relative teacher wages, particularly for females and blacks, the natural question to ask is to what extent these declines in wages and declines in teacher quality are related. Economic theory tells us that observed wages and employment may be due to either supply or demand factors, or a combination of both. The typical supply side explanation for why women tend to choose occupations such as teaching is that since women anticipate shorter and less continuous work lives than men, they choose occupations where their human capital depreciates less from labor market exits (Flyer and Rosen 1997; Blau et. al. 1998). One interpretation of Becker's (1985) sexual division of labor model is that women select teaching because its tasks are more compatible with home production. Since women are socialized to enter traditionally female pursuits or perceive barriers in certain occupations, discrimination can also lead to supply-side effects. To the extent that these supply-side factors led women to segregate into occupations such as teaching, an expansion in alternative opportunities should actually increase the supply of workers in alternative sectors, shifting the relative supply curve in teaching inward, raising relative teacher wages.[23] Yet we observe the opposite effect in equilibrium: relative wages of teachers actually decline, suggesting any such changes in relative supply must be more than offset by changes in relative demand.[24]

To illustrate how (primarily demand-driven) changes in relative wages affect teacher quality, I use Roy's model (1951) as a framework for thinking about the occupational choice decision of a

23. One can think of this supply curve as a quality-adjusted supply curve, so this shift is not a parallel shift.

24. Declines over time in fertility and technical improvements in home production also allowed women to pursue occupations that are not as complementary to child-rearing. Other potential sources of shifts in female labor supply include changes in marriage rates, divorce laws or day care arrangements. There seems to be no intuitive story that any one of these supply-side events should disproportionately increase female labor supply in teaching relative to alternatives, particularly at the top of the quality distribution.

potential teacher. Let *0* denote the non-teaching sector and *1* the teaching sector. The following earnings distributions characterize the earnings facing an individual who is considering teaching:[25]

$$(1) \qquad \ln w_0 = \mu_0 + \varepsilon_0, \quad \text{where } \varepsilon_0 \sim N(0, \sigma_0^2)$$
$$(2) \qquad \ln w_1 = \mu_1 + \varepsilon_1, \quad \text{where } \varepsilon_1 \sim N(0, \sigma_1^2)$$

and ρ gives the correlation between ε_0 and ε_1. One can think of ε_0 and ε_1 as the value of an individual's draw of talent or ability in each sector. This may vary across sectors because an individual's skills are a better match for the tasks in one sector over another. Assuming that individuals are income maximizing, the probability of choosing teaching, *P*, is given by:

$$(3) \qquad \begin{aligned} P &\equiv \Pr(\ln w_1 - \ln w_0 > 0) = \Pr[\nu > -(\mu_1 - \mu_0)] \\ &= 1 - \Phi(z) \end{aligned}$$

where $\nu \equiv \varepsilon_1 - \varepsilon_0$, $z \equiv \dfrac{-(\mu_1 - \mu_0)}{\sigma_\nu}$ and Φ is the standard normal cumulative distribution function. The proportion of the population in teaching is then a negative function of μ_0, income earned in the non-teaching sector, and a positive function of μ_1, earnings as a teacher.

Let us consider what happens to average teacher quality as changes in sector *0* occur. In particular, consider the effects of an exogenous increase in μ_0, mean earnings in the non-teaching sector. A change in earnings is exogenous in the sense that it is unrelated to shifts in the skill level of the population. Consider for instance a positive price shock in the non-teaching product market, raising the marginal product and wages of workers in sector *0*.[26] This model tells us that teacher quality *may not necessarily decline* when alternative female wage opportunities increase. What happens to average teacher quality depends on the distribution of ability in each sector and the nature of self-selection. For example, suppose skills are unique to each sector so that individuals pursue their

---

25. The model presented here is formally identical to that in Borjas (1985). For simplicity, I do not include a parameter Borjas incorporated—the cost of immigration—which in this case would be the cost of switching from the non-teaching to teaching sector. Since I am thinking of an individual at the beginning of her or his career, it is more useful to abstract from switches that may occur later in the lifecycle. This parameter can also easily be included and enters as a positive term in *z* in equation (3). Various applications of the Roy model include Willis and Rosen (1979), Heckman and Sedlacek (1985), among several others.

26. The lifting of employment-based discrimination barriers affecting women and blacks would also lead to an exogenous change in earnings faced by these groups in the alternative sector.

comparative advantage in that those who are relatively better at teaching chose teaching, while those with relatively higher productivity in alternative occupations are in non-teaching.[27] In this case, average teacher quality could actually *increase* with a rise in mean earnings in the non-teaching sector. The story is this: as μ_0 increases and shifts the non-teaching distribution upward, those who would have chosen non-teaching before the change would see their earnings increase so they would still choose non-teaching. Other workers who would have chosen teaching before the change now see their relative productivity and earnings across sectors change. In particular, the group that gains most from switching to non-teaching is those from the lower end of the teaching skill distribution, because their skills are now relatively more productive in non-teaching. This leaves more of the highly skilled in teaching, whose teaching skills are still relatively more productive, *raising* average teacher quality.

Average teacher quality will decline with an increase in μ_0 when skills are sufficiently positively correlated across sectors and the distribution of ability in the non-teaching sector is more dispersed relative to the teaching sector, resulting in a non-teaching earnings distribution that is more unequal than in teaching.[28] This gives rise to negative self-selection—low ability individuals face higher earnings in teaching while high ability individuals earn more in non-teaching. An exogenous increase in μ_0 means better opportunities in the non-teaching sector for some marginal individual so that she chooses not to teach. But this marginal individual is actually more talented than the average teacher prior to the shock. In this case, an increase in μ_0 decreases average teacher quality.

Thus, changes in average relative wages not only affect the decision to enter teaching but also the average quality of teachers. The descriptive analysis above showed that higher quality individuals are the ones increasingly choosing not to teach as their opportunities expanded. A shock that expands labor market opportunities can also be considered as an exogenous increase in σ_0; as the number and types of jobs for women and blacks in the non-teaching sector increase, variation in the value of skill and productivity in the non-teaching sector are likely to increase as well. Changes in inequality across

27. Formally both ratios σ_1/σ_0 and σ_0/σ_1 are greater than ρ.
28. Formally $\sigma_1/\sigma_0 < 1$, σ_1/σ_0 is less than ρ, ρ is less than σ_0/σ_1, and ρ is sufficiently positive.

the non-teaching earnings distribution can also be thought of as an exogenous change in σ_0 as long as the change in inequality is unrelated to changes in skill levels.[29] An increase in σ_0 improves the position of the more able on the non-teaching earnings distribution relative to teaching, drawing more of the talented into non-teaching. Meanwhile, more teachers are being drawn from the lower tail of the skill distribution, decreasing average teacher quality. Because relative earnings in alternative occupations (particularly the professions) increased more for women and blacks, teacher quality would be expected to decline more for women and blacks with an expansion in non-teaching opportunities.[30]

VI. Increased Opportunities and the Decline in Teacher Quality

A. Empirical specification

To explore these implications, I explicitly relate the rise in alternative opportunities with teacher quality, using wages as an indicator of opportunities. I first relate earnings in teaching relative to alternatives with occupational choice, and then see if this estimate varies across the ability distribution. I estimate the following multinomial logit model over pooled NLS cohorts:

$$(4) \qquad \Pr(Y_{ijkt} = c) = f(\beta_0 + \sum_q \sum_c \beta_q^c w_{jkt}^c + \sum_q \sum_c \gamma_q^c g_{jkt}^c + \theta' X_{ijkt} + \delta_k + \delta_t)$$

where c indicates the occupation choice of person i of birth cohort t residing in area k: teaching, professional, non-professional or not in the labor force. Each race and gender group j's entry earnings for each alternative c are denoted by w_{jkt}^c, while g_{jkt}^c capture the lifetime profile of earnings in teaching and in alternatives.[31] To allow for wage effects to vary across four quintiles q of the ability

---

29. If for example changes in inequality are mainly due to technological change, it is likely that the skill levels of the population are increasing with changes in inequality.

30. The fitted parameters from estimating the Roy Model using the IPUMS samples suggest an absolute selection story (relative mean and variance in non-teaching increased more for these groups post-1970). The estimation used only normality for identification—in part because any candidate exclusionary restrictions such as school age population and lagged industrial mix were insignificant in the probability equation. Results of this estimation are available from the author on request.

31. More specifically, j=white male, white female, black male, or black female. What constitutes labor market area k is discussed further below. To calculate wage growth g^c, I assume that individuals making an occupation entry decision use today's wage profile in projecting their lifetime wages. This is the cross-section earnings profile, calculated as the growth in market earnings between age groups 21-30, 31-40, 41-50, and 51-60

distribution, $(\beta^c_{1-25}, \beta^c_{26-50}, \beta^c_{51-75}, \beta^c_{76-100})$ and $(\gamma^c_{1-25}, \gamma^c_{26-50}, \gamma^c_{51-75}, \gamma^c_{76-100})$ are estimated for each choice *c*. Finally, X_{ijkt} is a vector of other individual characteristics, while δ_k and δ_t are labor market area and birth cohort fixed effects, respectively. Of primary interest are estimates of β^c_q, the relationship between wage opportunities and occupational choice conditional on ability.

To examine the relationship between wage opportunities and the quality of respondents who identify themselves as teachers in the NLS, I also estimate the following using quantile regressions:

$$(5) \qquad Q_{ijkt} = h(\lambda_0 + \lambda_1 \ln\left(\frac{w^T_{jkt}}{w^p_{jkt}}\right) + \lambda_3 \ln\left(\frac{g^T_{jkt}}{g^p_{jkt}}\right) + X_{ijkt}'\theta + \delta_k + \delta_t).$$

Q_{ijkt} is a measure of teacher *i*'s quality, while *w*, *g*, and the vector *X* are defined as before.

While none of these estimated relationships can be claimed to be causal, it is worth noting observed market earnings may be endogenous. Because location is a choice variable, individuals sort themselves across these labor markets such that areas that pay teachers more are observed to draw more high-quality teachers. To alleviate these concerns, I employ cohort and labor market area fixed effects. It is also possible that more high quality individuals are drawn to areas for reasons unrelated to the teacher market, such as a husband's occupation. Women are generally less mobile than men.[32]

As already noted, the databases and measures of teacher quality necessarily condition on college attendance. The fixed effects included in the regressions alleviate some of these selectivity biases, as long as rising college attendance did not vary differentially across the quality distribution. For instance, if it was mostly high ability women who did not attend college prior to the expansion in non-teaching opportunities, then estimates of the relationships of both the likelihood of becoming a teacher and teacher quality with relative teacher wages will be biased upward. However, as previously

---

at each census year. As a sensitivity check, alternative time-series calculations assume perfect foresight. The wage profiles faced by 21 to 30 year olds in 1960 are then wages of 31-40 year olds in 1970, and so on. There are no significant differences in using either wage profile; results below use the cross-section profile.

32. An inspection of national trends, with the labor market at the national level, is less likely to suffer from this source of bias. Estimates of (4) and (5) using national or regional averages for market earnings in teaching and the professions are actually greater in magnitude. Other sensitivity analyses are reported in Appendix B.

discussed, there is evidence for the selectivity going in the opposite direction, suggesting that the estimates reported below may in fact be biased downward.

B. Definition of Local Labor Markets

A natural definition of a local labor market for teachers might be the school district. In this study, however, wages at the school district level may not be appropriate when considering the wages of teachers *relative* to what could be earned in alternative occupations. School districts across the nation vary in size and concentration, such that the school district of one's residence does not necessarily constitute one's labor market. Moreover, the unavailability of school district identifiers in the data and potentially very small sample sizes do not allow for calculations at this level.

Instead I define two labor market areas within each state: one labor market for all of the state's metropolitan areas and another one for all its non-metropolitan areas. This is equivalent to assuming urban and rural residents have different tastes or form wage expectations differently. As a sensitivity check the same analyses are carried out with labor markets defined at the state level. The results are very similar in both the magnitude and direction. Market earnings of teachers and professionals in the IPUMS 1970-90 calculated within the following cells—birth cohort, race, gender, state and SMSA status of residence—are then merged onto observations in the NLS's with the same characteristics.[33]

C. Results

Estimates of Equation (4) using the NLS cohorts are reported in Table V.[34] This table suggests the significance of changes in professional wage opportunities in driving the relationship between relative teacher wages and the likelihood of teaching. Among the most able, notably those who scored in the 75th -100th percentile, lower professional wages (holding the teaching wage constant) are associated with increased likelihood to teach. This is true across various specifications controlling for either state or birth cohort effects or both (cols. 1, 3, 5, and 7). Similarly, higher teacher wages are

33. Details are discussed in the Appendix A. Almost all observations that could not be merged with wage data reside in unidentified states. The multivariate results below are based on the matched sample. Very similar results were obtained when the unmatched observations were included with missing dummies.

34. Due to the cell sizes of some variables in these regressions, Census regulations forbid me from reporting them. Only the sign and significance of such estimates are reported.

significantly associated with decreasing likelihood to enter the professions among the most able. This is also true across various specifications controlling for either state or birth cohort effects or both (cols. 2, 4, 6, and 8).[35]

To more easily interpret the magnitude of these relationships, I next calculate the probability each cohort enters teaching and the professions based on estimates from the full model in cols. (7)-(8) of Table V. Mean predicted probabilities and their standard errors are reported in Table VI by birth cohort and percentile in the ability distribution. The calculated wage elasticity—the marginal effect divided by average probability—indicates that a 10% increase in professional wages is associated with a 6.4% decline in the probability of teaching among the most able.[36] This is greater than the 3.7% decline in the probability of teaching among those in the 25^{th}-50^{th} percentile for the same 10% increase in professional wages. Table VI shows the predicted probability that college-educated individuals enter teaching has fallen over time, across the ability distribution. More striking is that particularly among the most able, the predicted probability they enter the professions has dramatically increased. With an expansion in opportunities, high-quality women, who presumably face better alternatives than those less able, are increasingly less likely to teach, consistent with the predictions of the Roy model.

To see whether the relationship between relative teacher earnings and teacher quality varied across the quality distribution, quantile regressions are estimated on the teacher sub-sample.[37] Results are reported in Table VII. The relationship between relative teacher wages and quality are robust and positive particularly across the upper tail of the conditional distribution, with state fixed effects (cols. 4-6), and both state and cohort fixed effects (cols. 10-12).[38] That high-quality teachers are more

---

35. To see if these relationships have changed over time, equation (4) is also estimated separately by birth cohort. The relationship between wage opportunities and the likelihood to teach, conditional on high quality, is more robust for the more recent cohorts. As outside opportunities improved, not only did educated women increasingly choose not to teach, it was especially high quality individuals increasingly choosing not to teach.

36. Elasticity=(.003-.086)/.13=-0.64 using estimates from column (7) of Table V.

37. These estimates have the following interpretation: conditional on teaching, how do differences in local labor market areas' relative teacher earnings relate to teacher quality.

38. These findings are further confirmed by estimates of the same relationship with institution selectivity and husband's traits as measures of quality. Across college freshmen cohorts in 1971 to 1995, students from highly selective institutions were significantly less likely to teach, particularly among later cohorts. Estimates of

sensitive to changes in relative teacher wages is consistent with the hypothesis that the availability of opportunities affects the quality of those who teach.

VII. Summary and Concluding Remarks

This paper brought together several data sources to document a clear change in the composition of women who chose to teach between 1960 and 1990. Teacher performance on standardized exams declined, markedly so among women, relative to previous cohorts of teachers and to professionals in their own cohort. Female prospective teachers were also increasingly being drawn from less selective institutions. Measures of quality using positive assortative mating traits further illustrate the decline in teacher quality. While declining proportions of high quality women did not choose teaching, increasing proportions joined the professions.

Changes in alternative labor market opportunities for females and blacks are linked to the marked decline in teacher quality. Results show that the lower teachers were paid relative to professionals, the less likely high-quality educated women were to choose to teach. High-quality teachers are particularly more sensitive to changes in relative teacher wages. These findings suggest that as alternative opportunities improved for women and blacks over this period, fewer chose to teach, and fewer among those who taught were of high quality.

While changes in female labor markets appear to be the major source of the decline in teacher quality, additional explanations are also likely. Other potential explanations not explored here include women's admittance to professional programs, their increased access to credit markets for loans to pursue skill acquisition and even access to the pill, as well as unionization in teaching and de-unionization in non-teaching, and the general rise in skill returns. It is more likely that an interaction of overall economic, demographic, and institutional factors account for the decline in teacher quality.

---

the relationship between wages and the probability of becoming a teacher were also greater among those from highly selective institutions. A similar result holds in relating wages with married female teachers' quality.

REFERENCES

American Federation of Teachers, AFL-CIO, "Survey & Analysis of Teacher Salary Trends 1999," *Research & Information Services Department Research Report* (2000).

Bacolod, Marigee, "The Impact of Expanding Opportunities for Women on the Decline in U.S. Teacher Supply and Quality, 1940-1990," UCLA, dissertation (2002).

Ballou, Dale, "Do Public Schools Hire the Best Applicants?" *Quarterly Journal of Economics*, 111, 1 (1996), 97-134.

—— and Michael Podgursky, "Recruiting Smarter Teachers," *Journal of Human Resources*, 30, 2 (1995), 326-338.

—— and Michael Podgursky, *Teacher Pay and Teacher Quality* (Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 1997).

Becker, Gary "Human Capital, Effort, and Sexual Division of Labor," *Journal of Labor Economics*, 3, 1, Pt 2 (1985), S33-S58.

Black, Sandra E. and Chinhui Juhn, "The Rise of Female Professionals: Are Women Responding to Skill Demand?" *American Economic Review: Papers and Proceedings*, 90 (2000), 450-55.

Blanchard, Olivier Jean and Lawrence F. Katz, "Regional Evolutions," *Brookings Papers on Economic Activity* (1992), 1-61.

Blau, Francine and Lawrence Kahn, "Swimming Upstream: Trends in the Gender Wage Differential in the 1980s," *Journal of Labor Economics, Part 1,* 15 (1997), 1-42.

Blau, Francine, Patricia Simpson, and Deborah Anderson, "Continuing Progress? Trends in Occupational Segregation in the United States Over the 1970's and 1980's," *Feminist Economics*, 4, 3 (1998), 29-71.

Boe, Erling and Dorothy Gilford, eds. *Teacher Supply, Demand, and Quality: Policy Issues, Models, and Data Bases* (Washington, D.C.: National Academy Press, 1992).

Borjas, George J, "Self-Selection and the Earnings of Immigrants," *American Economic Review*, 77 (1987), 531-53.

Burtless, Gary, ed., *Does Money Matter? The Effect of School Resources on Student Achievement and Adult Success*, (Washington, D.C.: Brookings Institution Press, 1996).

Cain, Glen G. and Ross E. Finnie, "The Black-White Difference in Youth Employment: Evidence for Demand-Side Factors," *Journal of Labor Economics, Part 2*, 8 (1990), S364-95.

Corcoran, Sean, William Evans, and Robert Schwab, "Women, the Labor Market, and the Declining Relative Quality of Teachers," *Journal of Policy Analysis and Management*, 23, 3 (2004a), 449-470.

——, "Changing Labor Market Opportunities for Women and the Quality of Teachers 1957-1992," *American Economic Review: Papers and Proceedings of the Annual Meeting of the American Economic Association*, 94, 2 (2004b), 230-235. (Also, *NBER Working Paper No. 9180*.)

Dolton, Peter and G. H. Makepeace, "Female Labour Force Participation and the Choice of Occupation: The Supply of Teachers," *European Economic Review*, 37 (1993), 1393-1411.

Ehrenberg, R. and D. Brewer, "Do School and Teacher Characteristics Matter?" *Economics of Education Review*, 13 (1994), 1-17.

Figlio, David, "Teacher Salaries and Teacher Quality," *Economics Letters*, 55 (1997), 267-71.

Flyer, Frederick and Sherwin Rosen, "The New Economics of Teachers and Education," *Journal of Labor Economics*, 15 (1997), supplement, S104-S139.

Goldin, Claudia, *Understanding the Gender Gap: An Economic History of American Women* (New York, NY: Oxford University Press, 1990).

——, "Career and Family: College Women Look to the Past," *Gender and Family Issues in the Workplace*, Francine Blau and Ronald Ehrenberg, eds. (New York, NY: Russell Sage Foundation, 1997).

Grogger, Jeff, and Eric Eide, "Changes in College Skills and the Rise in the College Wage Premium," *Journal of Human Resources*, 30 (1995), 280-310.

Hanushek, Eric, "The Economics of Schooling: Production and Efficiency in Public Schools," *Journal of Economic Literature*, 24 (1986), 1141-77.

——, "Assessing the Effects of School Resources on Student Performance: An Update," *Educational Evaluation and Policy Analysis*, 19 (1997), 141-164.

—— and Steven G. Rivkin, "Understanding the 20th Century Growth in U.S. School Spending," *Journal of Human Resources*, 32, 1 (1997), 35-68. (Also, *NBER Working Paper No. 5547.*)

Heckman, James J., "What Has Been Learned About Labor Supply in the Past Twenty Years?," *American Economic Review: Papers and Proceedings*, 83 (1993), 116-21.

—— and Guilherme Sedlacek, "Heterogeneity, Aggregation, and Market Wage Functions: An Empirical Model of Self-Selection in the Labor Market," *Journal of Political Economy*, 93 (1985), 1077-1125.

Hoxby, Caroline Minter, "How Teachers' Unions Affect Education Production," *Quarterly Journal of Economics*, 111 (1996), 671-718.

—— and Andrew Leigh, "Pulled Away or Pushed Out? Explaining the Decline of Teacher Aptitude in the United States," *American Economic Review: Papers and Proceedings of the Annual Meeting of the American Economic Association*, 94, 2 (2004), 236-240.

Koretz, Daniel, *Trends in Educational Achievement*, Congressional Budget Office, 1986.

Lakdawalla, Darius N., "The Declining Quality of Teachers," *NBER Working Paper No. 8263*, 2001.

Loeb, Susanna and Marianne Page, "Examining the Link Between Teacher Wages and Student Outcomes: The Importance of Alternative Labor Market Opportunities and Non-Pecuniary Variation," *The Review of Economics and Statistics*, 82 (2000), 393-408.

Manski, Charles F., "Academic Ability, Earnings, and the Decision to Become a Teacher: Evidence from the National Longitudinal study of the High School Class of 1972," *NBER Working Paper 1539*, 1985.

Mincer, Jacob, "Labor Force Participation of Married Women," *Aspects of Labor Economics*, H.G. Lewis, ed. (Princeton, N.J.: Princeton University Press, 1962).

Murnane, Richard J., Judith D. Singer, John B. Willet, James J. Kemple, and Randall J. Olsen, *Who Will Teach? Policies That Matter* (Cambridge, MA: Harvard University Press, 1991).

National Center for Education Statistics, U.S. Department of Education, "Teacher Quality: A Report on the Preparation and Qualifications of Public School Teachers," *NCES 1999-080*, 1999.

Pencavel, John, "The Market Work Behavior and Wages of Women: 1975-94," *Journal of Human Resources*, 33 (1998), 771-804.

Podgursky, Michael, Ryan Monroe, Donald Watson, "The Academic Quality of Public School Teachers: An Analysis of Entry and Exit Behavior," *Economics of Education Review*, 23, 5, (2004), 507-518.

Roy, A.D., "Some Thoughts on the Distribution of Earnings," *Oxford Economic Papers*, 3 (1951), 135-46.

Smith, James P. and Michael Ward, "Women's Wages and Work in the Twentieth Century," *RAND Document No. R-3119-NICHD*, 1984.

——, "Women in the Labor Market and in the Family," *Journal of Economic Perspectives*, 3 (1989), 9-23.

Smith, James P. and Finis Welch, "Affirmative Action and Labor Markets," *Journal of Labor Economics*, 2 (1984), 269-301.

Stoddard, Christiana. "Why Has the Number of Teachers Per Student Risen While Teacher Quality has Declined?" *Journal of Urban Economics*, 53 (2003), 458-481.

Temin, Peter, "Teacher Quality and the Future of America," *Eastern Economics Journal*, 28 (2002), 285-300.

Willis, Robert J and Sherwin Rosen, "Education and Self-Selection," *Journal of Political Economy, Part 2*, 87 (1979), S7-36.

Appendix A. Construction of the NLS Samples

For each NLS cohort under study, I first extract the test scores of all respondents. A special school survey mailed directly to each school of the NLS-YM and NLS-YW respondents in 1968 recorded from individual respondents' transcripts test scores on instruments such as the Otis/Beta/Gamma, California Test of Mental Maturity, Lorge-Thorndike Intelligence and SAT. An IQ score was created from these data. To norm the IQ scores, percentile IQ scores were generated from the raw IQ score of NLS-YW and NLS-YM respondents. Percentile rank was generated within 1-year and 5-year date of birth intervals, and results were largely equivalent using either measures. For the NLS-Y79 respondents, I used the revised percentile scores on the AFQT as reported by the Survey. Although the generated IQ score and AFQT are not the same exams, because the scores are normed within cohort the analyses in the paper (particularly using cohort fixed effects) should be fine.

For the multivariate analyses portion, I also extract employment and location data for the survey years respondents were aged 21-30 and defined the following variables: (1) SMSA=mode SMSA value between ages 21-30; (2) State of residence=mode state of residence between ages 21-30; (3) Teacher=1 if ever a pre-kindergarten, elementary or secondary teacher at ages 21-30; (4) Professional =1 if ever a professional or technical worker at ages 21-30 but not a teacher and not a nurse. Summary statistics are reported in Appendix Table I. Market earnings of professionals and teachers were next calculated from the IPUMS 1970-90 within the following cells—birth cohort (1940-49, 1950-59, 1960-69), race, gender, state and SMSA status of residence—and merged onto observations in the NLS's with the same characteristics.

Appendix B. Sensitivity Analyses

To further address the endogeneity issues raised in the second half of the text, I also use the state-level industrial structure and demographics as instruments for relative teacher earnings in equations (4) and (5). This framework suggests that changes affecting relative teacher demand operate on teacher quality through its effect on relative wages. As noted in the text, new teacher demand increased as the baby boom cohorts entered the school system and subsequently declined as the boomer cohorts left. I also use lagged industrial composition as an indicator of demand conditions in alternative sectors. This measure is calculated as the proportion of the employed population in the services, manufacturing, and federal government sectors by state.

The estimated relative wage effects on the likelihood of teaching when using these instruments are further magnified, lending more empirical support to the conclusions in the text. This strategy in effect identifies responses off of wage changes generated by changes in relative teacher demand across areas and over time, that is, it attempts to identify the supply of quality curve. The greater magnitudes of the 2SLS estimates also suggest that the fixed effects regressions discussed in the text identified equilibrium points arising from both supply and demand shifts.[39]

These IV estimates are, however, difficult to interpret as causal, as other changes (such as unionization, wage inequality, and others mentioned in the text) could also drive changes in relative wages. Since these merely reinforce the finding that changes in female labor opportunities are related to the decline in teacher quality, the IV estimates are not discussed in the text.

[39] Another potential reason for the greater magnitude of IV estimates is measurement error, as measurement error in wages is not going to be related with error in measuring the school-age population (i.e. sampling error). Extra instruments are also valid in tests of overidentifying restrictions.

Appendix Table I. Descriptive Statistics of the NLS samples

	white male	white female	black male	black female
NLS-YM				
n	1302		176	
Birth cohort range	1940-52		1941-52	
Teacher	12.44%		14.20%	
Professional	62.60%		38.07%	
Mean IQ (std error)	68.28 (23.2)		37.79 (25.2)	
Education:				
Some college	31.95%		53.98%	
College	51.84%		37.50%	
Greater than college	16.21%		8.52%	
NLS-YW				
n		893		180
Birth cohort range		1942-53		1942-53
Teacher		36.28%		37.22%
Professional		28.56%		23.89%
Mean IQ (std error)		72.25 (21.57)		37.34 (26.09)
Education:				
Some college		32.59%		40.00%
College		52.41%		47.22%
Greater than college		15.01%		12.78%
NLS-Y79				
n	1513	1583	564	594
Birth cohort range	1957-64	1957-64	1957-64	1957-64
Teacher	3.64%	11.62%	1.60%	8.42%
Professional	57.24%	47.13%	36.17%	35.19%
Mean AFQT (std error)	55.89 (33.38)	55.75 (29.8)	24.24 (25.76)	25.84 (23.33)
Education:				
Some college	54.00%	53.57%	76.95%	70.54%
College	34.24%	36.13%	18.97%	25.59%
Greater than college	11.76%	10.30%	4.08%	3.87%

NOTE: Sample includes NLS respondents with at least 2 years of college education and currently not in school and with non-missing test scores. For NLSYW, YM, mean IQ refers to the mean percentile score generated from raw IQ test scores. For more discussion, see details in text and Appendix A.

Table I. New Entrants to Teaching, by Education Background
First row: Fraction in Teaching, With Some College
Second row: Fraction in Teaching, College+

WHITE FEMALE

	Census year			
Region	1960	1970	1980	1990
NEast	0.01	0.01	0.01	0.01
	0.21	0.29	0.16	0.08
NCentral	0.04	0.01	0.00	0.01
	0.23	0.34	0.21	0.11
South	0.01	0.01	0.01	0.01
	0.24	0.31	0.22	0.14
West	0.01	0.00	0.00	0.01
	0.22	0.26	0.14	0.09
Total	0.02	0.01	0.00	0.01
	0.22	0.30	0.18	0.11

BLACK FEMALE

	Census year			
Region	1960	1970	1980	1990
NEast	0.01	0.02	0	0
	0.23	0.21	0.16	0.06
NCentral	0.01	0	0.01	0
	0.26	0.41	0.2	0.09
South	0.01	0.02	0.01	0.01
	0.52	0.46	0.21	0.09
West	0	0.01	0	0.01
	0.21	0.26	0.11	0.02
Total	0.01	0.01	0.01	0.01
	0.31	0.34	0.17	0.06

WHITE MALE

	Census year			
Region	1960	1970	1980	1990
NEast	0.00	0.00	0.00	0.00
	0.09	0.14	0.06	0.02
NCentral	0.01	0.00	0.00	0.00
	0.13	0.18	0.08	0.03
South	0.01	0.00	0.00	0.00
	0.08	0.10	0.05	0.03
West	0.00	0.00	0.00	0.00
	0.10	0.08	0.05	0.03
Total	0.00	0.00	0.00	0.00
	0.10	0.13	0.06	0.03

BLACK MALE

	Census year			
Region	1960	1970	1980	1990
NEast	0.02	0.01	0.01	0.00
	0.08	0.08	0.03	0.02
NCentral	0.01	0.00	0.00	0.00
	0.20	0.17	0.06	0.05
South	0.01	0.00	0.00	0.00
	0.39	0.29	0.10	0.03
West	0.00	0.00	0.00	0.00
	0.17	0.08	0.04	0.04
Total	0.01	0.00	0.00	0.00
	0.21	0.16	0.06	0.04

SOURCE: IPUMS. Sample for this table includes individuals aged 21 to 30 with at least two years of college, whether or not they are working.

Table II. Increase in Professionals: Fraction Professionals, Age 21-30 With College

WHITE FEMALE

	Census year			
Region	1960	1970	1980	1990
NEast	0.14	0.19	0.31	0.46
NCentral	0.13	0.17	0.28	0.42
South	0.12	0.17	0.28	0.41
West	0.10	0.16	0.28	0.41
Total	0.12	0.17	0.29	0.43

BLACK FEMALE

	Census year			
Region	1960	1970	1980	1990
NEast	0.17	0.32	0.25	0.39
NCentral	0.17	0.17	0.33	0.40
South	0.07	0.17	0.25	0.35
West	0.00	0.20	0.24	0.41
Total	0.10	0.22	0.27	0.39

WHITE MALE

	Census year			
Region	1960	1970	1980	1990
NEast	0.49	0.51	0.49	0.54
NCentral	0.47	0.47	0.48	0.57
South	0.40	0.42	0.48	0.54
West	0.46	0.44	0.45	0.51
Total	0.45	0.46	0.48	0.54

BLACK MALE

	Census year			
Region	1960	1970	1980	1990
NEast	0.32	0.47	0.37	0.45
NCentral	0.18	0.43	0.38	0.48
South	0.18	0.28	0.37	0.42
West	0.17	0.39	0.34	0.40
Total	0.21	0.39	0.36	0.44

SOURCE: IPUMS. Sample for this table includes individuals aged 21 to 30 with at least two years of college, whether or not they are working.

Table III. Decline in Teacher Quality As Evidenced by Test Scores:
Fraction Scoring Lower or Upper 20 % On IQ, AFQT Among Female Teachers

Birth Cohort	*Above 80th percentile*	*Below 20th percentile*
1941-45	0.41	0.08
1946-49	0.40	0.05
1951-53	0.34	0.06
1957-59	0.44	0.06
1960-62	0.20	0.12
1963-64	0.19	0.19

SOURCE: NLSYW,YM,Y79. Samples for this table includes black and white female respondents with at least two years of college who ever taught when they were aged 21 to 30. Sample selection is further described in the text and Appendix A.

Table IV. Decline in Teacher Quality As Evidenced by Positive Assortative Mating: Occupation Distribution of Married Women

Women Whose Husbands Are On Upper 25th Wage Percentile On The Male Wage Distn

	OCCUPATION		
Year	*UNEMP, NILF*	*TEACHER*	*PROFSNL*
1960	61.99	22.24	15.78
1970	51.81	29.63	18.55
1980	62.06	15.79	22.15
1990	70.39	6.00	23.61
Total	62.40	16.88	20.72

Women Whose Husbands Attained Greater Than College

	OCCUPATION		
Year	*UNEMP, NILF*	*TEACHER*	*PROFSNL*
1960	49.78	29.88	20.34
1970	41.38	36.01	22.61
1980	52.50	20.73	26.77
1990	53.88	10.33	35.79
Total	48.95	24.95	26.10

SOURCE: IPUMS. Sample for this table includes married women aged 21 to 30 with at least two years of college, whether or not they are working, and with matched spouses from the 1960-1990 IPUMS.

TABLE V. Multinomial Logit Estimates: Marginal Effects

	(1) teacher	(2) profsnl	(3) teacher	(4) profsnl	(5) teacher	(6) profsnl	(7) teacher	(8) profsnl
white female	0.079	-0.145	0.071	-0.120	0.071	-0.106	0.058	-0.061
	(0.018)**	(0.032)**	(0.016)**	(0.031)**	(0.011)**	(0.031)**	(0.010)**	(0.032)
black male	+	- *	+	-	+	-	+	-
black female	0.099	-0.231	0.087	-0.189	0.093	-0.201	0.074	-0.135
	(0.034)**	(0.069)**	(0.030)**	(0.063)**	(0.026)**	(0.062)**	(0.024)**	(0.059)*
metro	-0.031	0.094	-0.031	0.088	-0.022	0.077	-0.021	0.065
	(0.011)**	(0.024)**	(0.010)**	(0.022)**	(0.008)**	(0.022)**	(0.007)**	(0.021)**
metro*black	-0.030	0.095	-0.024	0.088	-0.025	0.086	-0.017	0.075
	(0.028)	(0.051)	(0.025)	(0.048)	(0.024)	(0.048)	(0.023)	(0.046)
college	0.177	0.230	0.161	0.245	0.158	0.252	0.143	0.267
	(0.012)**	(0.018)**	(0.010)**	(0.018)**	(0.009)**	(0.017)**	(0.008)**	(0.018)**
greater than college	0.260	0.468	0.238	0.489	0.233	0.499	0.211	0.522
	(0.018)**	(0.043)**	(0.015)**	(0.045)**	(0.014)**	(0.046)**	(0.013)**	(0.048)**
log w^T	0.008	-0.005	0.005	-0.001	0.004	0.001	0.002	0.004
	(0.009)	(0.009)	(0.007)	(0.008)	(0.007)	(0.008)	(0.006)	(0.008)
*25-50th %ile	-0.000	0.004	0.001	0.004	0.000	0.003	-0.000	0.005
	(0.011)	(0.013)	(0.009)	(0.013)	(0.010)	(0.013)	(0.008)	(0.013)
*50-75th %ile	-0.002	0.012	0.002	0.014	-0.004	0.018	-0.001	0.019
	(0.012)	(0.017)	(0.011)	(0.018)	(0.009)	(0.016)	(0.008)	(0.018)
*75-100th %ile	0.052	-0.091	0.047	-0.093	0.014	-0.059	0.013	-0.062
	(0.027)	(0.039)*	(0.024)	(0.035)**	(0.015)	(0.029)*	(0.013)	(0.026)*
log w^P	0.002	-0.018	0.002	-0.016	0.004	-0.026	0.003	-0.023
	(0.012)	(0.025)	(0.011)	(0.025)	(0.010)	(0.026)	(0.009)	(0.026)
*25-50th %ile	-0.034	0.046	-0.037	0.085	-0.048	0.122	-0.051	0.181
	(0.017)*	(0.057)	(0.016)*	(0.061)	(0.018)**	(0.079)	(0.018)**	(0.094)
*50-75th %ile	-0.150	0.135	-0.138	0.192	-0.088	-0.025	-0.069	0.043
	(0.051)**	(0.148)	(0.050)**	(0.147)	(0.047)	(0.142)	(0.044)	(0.152)
*75-100th %ile	-0.158	0.155	-0.156	0.179	-0.091	0.027	-0.086	0.077
	(0.042)**	(0.087)	(0.039)**	(0.088)*	(0.035)**	(0.114)	(0.033)**	(0.075)
1950-59 birth cohort					-0.063	0.105	-0.057	0.114
					(0.010)**	(0.021)**	(0.007)**	(0.019)**
1960-69 birth cohort					-0.083	0.196	-0.076	0.197
					(0.010)**	(0.023)**	(0.008)**	(0.021)**
Constant	-0.109	-0.437	-0.086	-1.012	0.293	-1.671	0.350	-2.638
	(0.300)	(0.534)	(0.258)	(0.487)*	(0.150)	(0.538)**	(0.136)*	(0.576)**
Observations	5958	5958	5958	5958	5958	5958	5958	5958
State FE	No		Yes		No		Yes	

NOTES:

1. Standard errors are in parentheses, estimated assuming non-zero covariance within birth cohort and labor market area. * denote significant at 5% level; ** denote significant at 1% level. Per Census RDC guidelines, I report only the sign and significance level of coefficients for "black male" because too few observations fell within this cell.
2. Baseline occupation choice in multinomial logit models: non-professional occupations or not in the labor force. Marginal effects are evaluated at the mean of independent variables.
3. Sample includes NLS respondents with at least 2 years of college and currently not in school. Percentiles refer to generated percentile IQ scores in the NLSYW & YM and percentile AFQT in the NLSY79. Earnings are calculated from the IPUMS among teachers and professionals & managers, and merged onto the NLS's by birth cohort, race, gender, state and metropolitan category. Other controls include earnings growth interacted with ability. For discussion, see details in text and Appendix A.

TABLE VI. Predicted Probabilities

A. Predicted Probability of Becoming a Teacher

	Birth Cohort			
Percentile on the Ability Distribution	1940-49	1950-59	1960-69	Total
1-25	0.25 (0.45)	0.05 (0.40)	0.03 (0.40)	0.05 (0.41)
25-50	0.24 (0.37)	0.09 (0.39)	0.08 (0.39)	0.12 (0.39)
50-75	0.26 (0.37)	0.15 (0.38)	0.11 (0.36)	0.17 (0.37)
75-100	0.25 (0.37)	0.14 (0.38)	0.09 (0.41)	0.16 (0.38)
Total	0.25 (0.38)	0.11 (0.38)	0.07 (0.39)	0.13 (0.39)

B. Predicted Probability of Becoming a Professional

	Birth Cohort			
Percentile on the Ability Distribution	1940-49	1950-59	1960-69	Total
1-25	0.23 (0.28)	0.19 (0.22)	0.23 (0.20)	0.22 (0.21)
25-50	0.44 (0.24)	0.42 (0.23)	0.50 (0.22)	0.46 (0.23)
50-75	0.47 (0.23)	0.52 (0.23)	0.60 (0.21)	0.53 (0.22)
75-100	0.56 (0.24)	0.65 (0.24)	0.75 (0.23)	0.65 (0.24)
Total	0.48 (0.24)	0.48 (0.23)	0.47 (0.22)	0.48 (0.23)

NOTES:
1. Predicted probabilities calculated from estimates of model in columns (7)-(8) in Table V.
2. Average of standard errors of predicted probabilities are in parentheses.

Table VII. Teacher Quality and Relative Teacher Earnings: Quantile regression coefficients

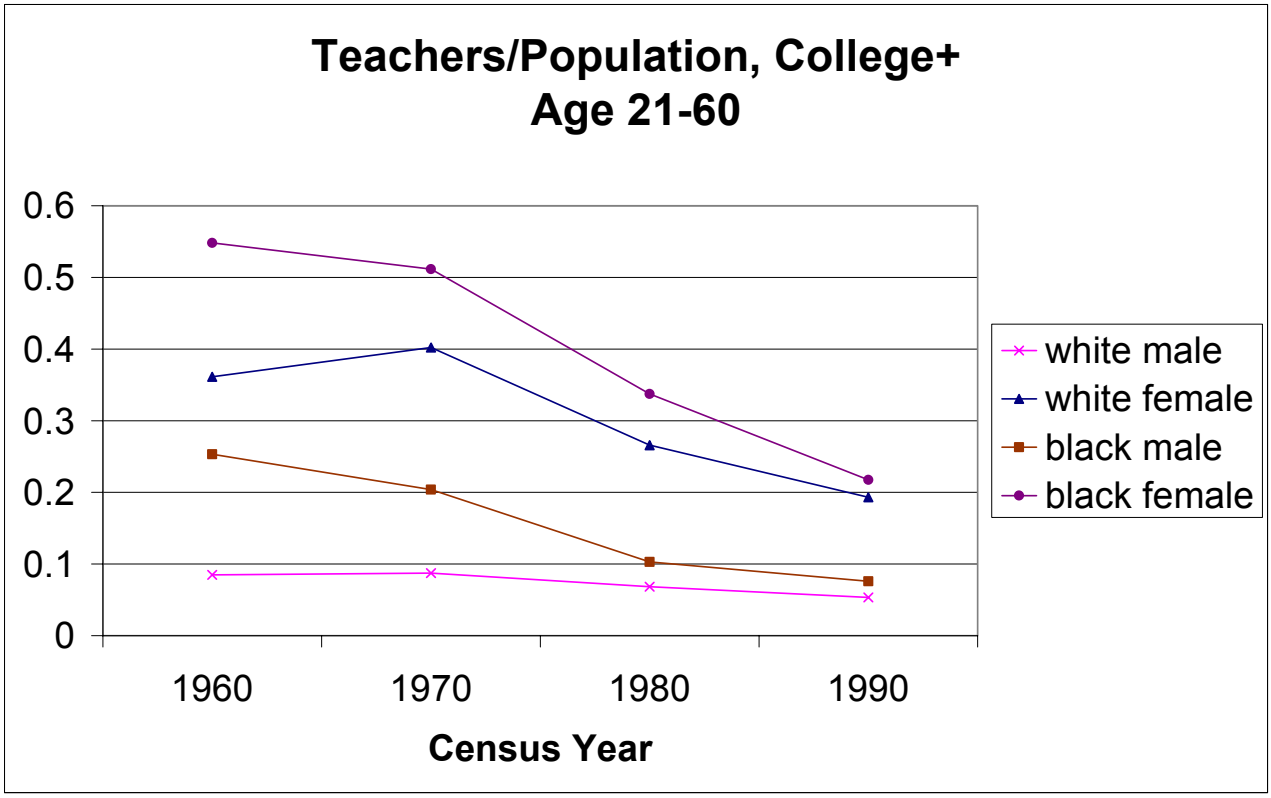
DEPVAR: IQ/AFQT Percentile Score
Sample: Teachers in the NLSYW,YM,Y-79

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Quantile	25	Median	75	25	Median	75	25	Median	75	25	Median	75
white female	4.197	-1.265	-3.470	2.159	-0.167	-3.567	4.103	0.319	-1.695	2.818	-2.213	-1.740
	(4.931)	(2.984)	(3.109)	(3.585)	(2.425)	(2.562)	(3.127)	(2.623)	(2.183)	(3.604)	(3.473)	(2.044)
black male	-	-	-	-	-	-	-	-	-	-	-	-
	**	**	**	**	**	**	**	**	*	**	**	**
black female	-29.985	-40.862	-42.801	-31.437	-34.092	-27.017	-30.305	-39.920	-35.140	-30.780	-32.723	-21.928
	(7.044)**	(10.130)**	(9.175)**	(5.636)**	(9.441)**	(8.630)**	(7.554)**	(11.102)**	(7.328)**	(8.078)**	(10.237)**	(9.834)*
metro area	8.870	8.829	4.963	4.658	6.969	7.659	9.379	8.048	4.787	4.007	6.531	8.188
	(4.071)*	(2.907)**	(1.863)**	(4.963)	(2.559)**	(2.036)**	(2.531)**	(2.232)**	(2.845)	(4.827)	(2.566)*	(1.783)**
metro*black	-12.504	-7.773	2.817	-8.497	-9.268	-10.752	-12.869	-5.982	-1.049	-8.973	-11.727	-13.010
	(5.518)*	(10.903)	(9.789)	(7.596)	(7.837)	(8.122)	(8.014)	(8.839)	(10.383)	(7.451)	(8.269)	(9.735)
ln(teacher/profsnl W)	4.804	10.673	11.565	9.092	15.280	14.253	5.405	7.302	4.116	7.105	12.333	12.083
	(4.077)	(6.234)	(6.497)	(5.780)	(5.121)**	(7.203)*	(4.650)	(5.335)	(5.753)	(6.516)	(5.317)*	(5.898)*
relative wage growth	-0.000	-3.163	-1.576	-3.890	-5.855	-3.702	0.000	-3.184	-0.765	-3.818	-5.832	-1.891
	(3.707)	(4.757)	(3.383)	(5.346)	(4.862)	(4.238)	(3.647)	(4.044)	(2.859)	(5.059)	(3.281)	(4.890)
Constant	39.367	59.852	85.224	43.325	59.236	87.306	38.892	58.989	81.904	41.915	54.870	85.366
	(8.662)**	(5.640)**	(4.923)**	(14.046)**	(13.121)**	(15.033)**	(5.157)**	(5.364)**	(5.485)**	(24.477)	(18.238)**	(23.812)**
Observations	761	761	761	761	761	761	761	761	761	761	761	761
State FE	No			Yes			No			Yes		
Cohort FE	No			No			Yes			Yes		

NOTES:

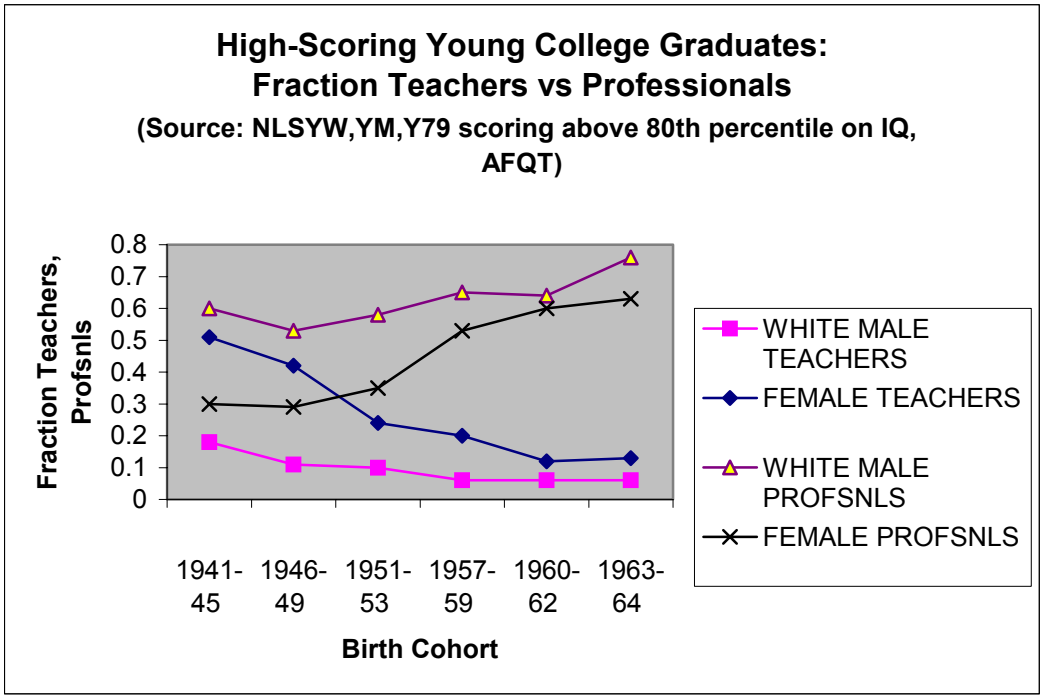
1. Bootstrapped standard errors are in parentheses. * denote significant at 5% level; ** denote significant at 1% level.
2. Sample includes NLS respondents with at least 2 years of college education and currently not in school, who was ever a K-12 teacher between ages 21-30.
3. Percentile test scores are generated from IQ test scores in the NLSYW & YM and AFQT in the NLSY79. Relative earnings are calculated from the IPUMS among teachers and professionals & managers (excluding teachers & nurses), and merged onto the NLS's by birth cohort, race, gender, state and metropolitan category. Relative wage growth controls for lifetime wage profile (difference in market earnings at ages 31-40 and 51-60). For discussion, see details in text and Appendix A.
4. Baseline category: white male teacher with some college.
5. Coefficients for "black male" were not released by the Census RDC because too few observations fell within this cell. Per RDC guidelines, only the sign and significance level of these coefficients are reported here.

Figure I. Decline of Female and Black Employment in Teaching



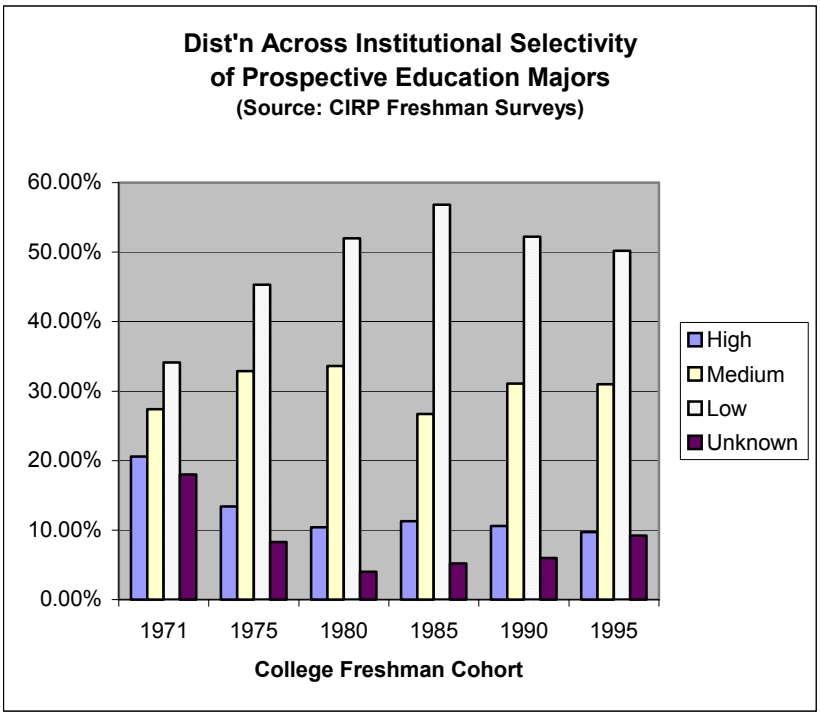
SOURCE: IPUMS. Sample for this figure includes individuals aged 21 to 60 with at least two years of college, whether or not they are working.

Figure II. Decline in Teacher Quality: Evidence from standardized test scores



SOURCE: NLSYW,YM,Y79. Sample for this figure includes black and white respondents with at least two years of college. A teacher is one who ever taught when they were aged 21 to 30. Sample selection and tests further described in the text and Appendix A.

Figure III. Decline in Teacher Quality: Evidence from Undergraduate Institution Selectivity



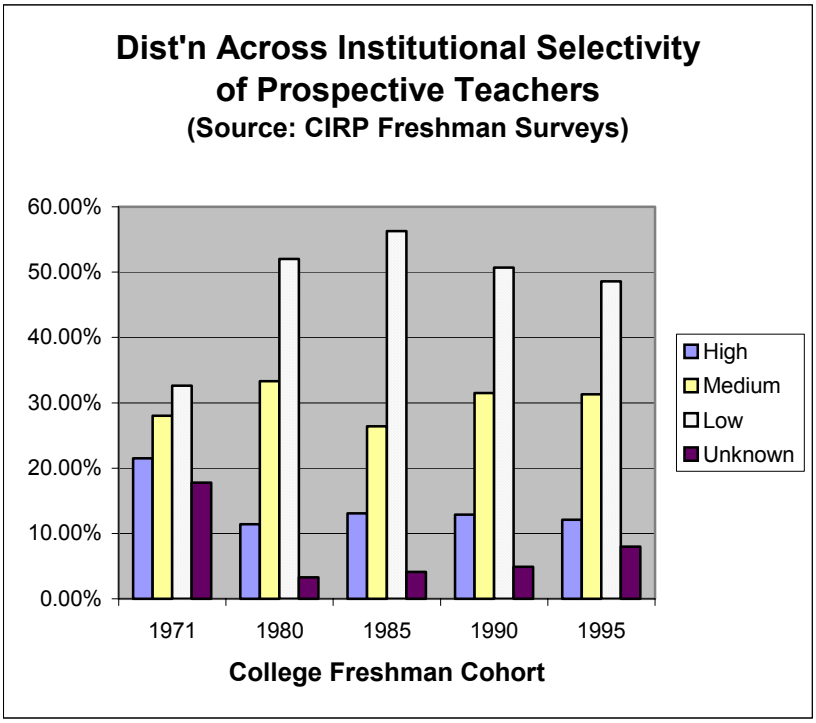
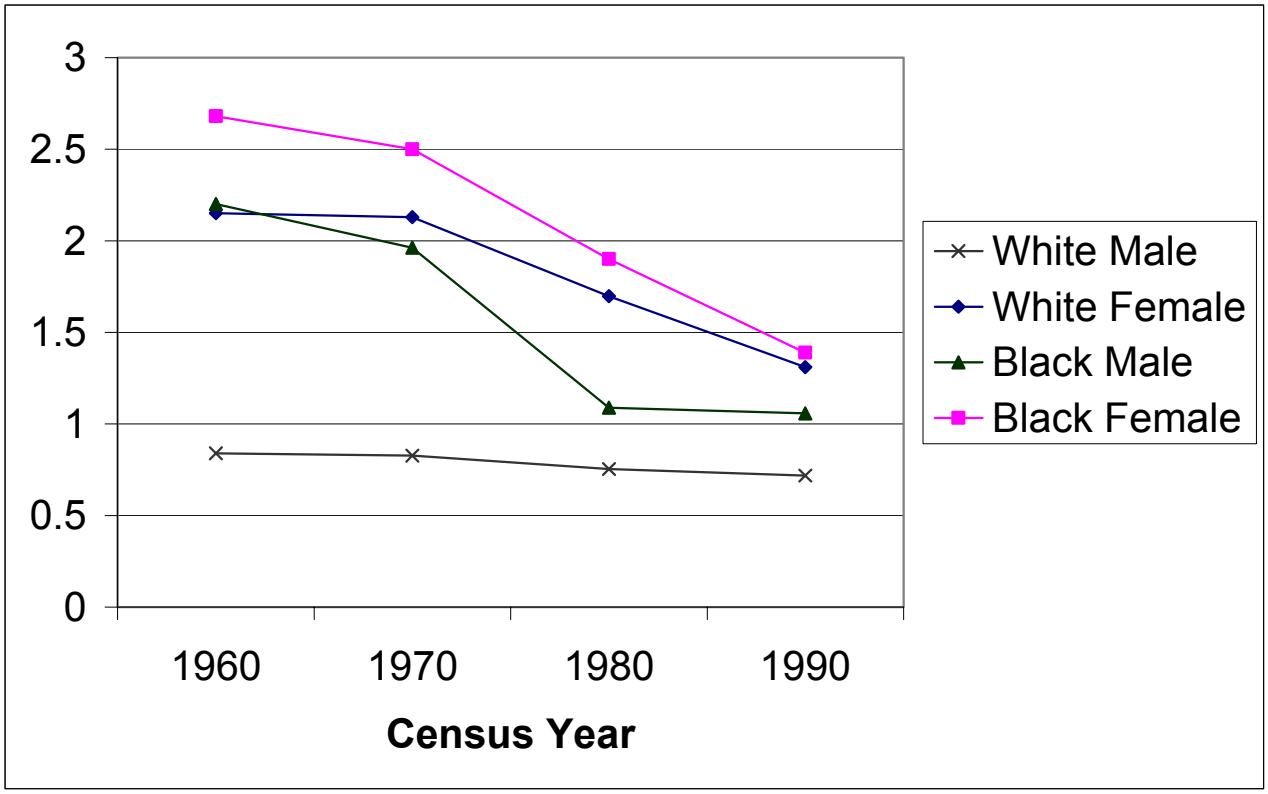


Figure IV. Decline in Teacher Earnings relative to Non-teachers



Note:
Mean relative earnings over all teacher *i*'s relative to non-teacher college-graduate *j*'s are calculated as $\frac{1}{N_i}\sum_i \frac{y_i}{Y_j}$, where $Y_j \equiv \frac{1}{N_j}\sum_j y_j \,|\, X_i = X_j$ and X include state of residence, SMSA status, gender, race, education, and age group. For more details, see discussion in text.