The Evolution of the U.S. Gender Earnings Gap, 1969-1999:

A Cohort-Based Analysis

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April 22, 2004

Very preliminary: please do not quote!

1. Introduction

It common knowledge that the gender earnings gap is smaller today than it was in the past (Blau and Kahn 2000; O'Neill 2003). It is also widely recognized that, in any recent cross-section of workers, the gender earnings gap is larger among older workers than among the young. One well known explanation of both these facts is based on differences across successive cohorts of women in the accumulation of labor market experience with age (e.g. O'Neill 2003). Simply put, this hypothesis argues that because earlier generations of women experienced more frequent labor market interruptions, their earnings grew much less rapidly with age than those of the men in their birth cohort. Among later generations of women who accumulate experience at almost the same rate as men, this "falling behind" should be much less severe. Other explanations of the two above facts include declines in discrimination (in particular discrimination of a form that is cumulative over the course of a woman's career, (e.g. Ferber & Kordick 1978, Wood, Corcoran and Courant 1993) and improvements in the labor market value of human capital women bring into the labor market from the educational system (Blau and Ferber 1986, Brown and Corcoran 1997, Weinberger 1998, 1999, 2001).

In this paper we use four cross-sections from the 1970 through 2000 censuses, combined with detailed panel data on college-educated workers from 1989 to 1999 to understand the nature of changes over time in the age-earnings profiles of men and women. Clearly, the census data provide information on long-term trends for a nationally representative sample of workers. Complementing this, our panel data analysis focuses on college-educated workers, in part because it is precisely among well-educated workers that gender differences in experience and career development are likely to have the largest effects.[1] This panel, incorporating the Survey

[1] For example, Wood et al. (1993) show that differences in age-related wage growth play a dominant role in accounting for the gender-wage gap amon lawyers. Card (1994) shows that among college-educated men, earnings

of College Graduates and generated by the NSF as part of its SESTAT system, covers the period 1989-1999.

A key feature that distinguishes this paper from previous research is a more explicit attempt to track the evolution of the gender earnings gap within successive cohorts over time. While a number of authors (e.g. O'Neill and Polachek 1993, Table 2; Blau and Kahn 2000, Table 1) have presented descriptive statistics that follow cohorts of men and women over time, in this paper we conduct a more detailed analysis of within-cohort wage growth, paying particular attention to the issue of identifying changes across cohorts in the rate of age-related earnings growth in the presence of confounding factors such as cohort and/or year effects. Compared to studies based on changes over time in the experience (or age) coefficient in *cross-section* regressions (e.g. O'Neill 2003, Table 1), our within-cohort results lead to dramatically different conclusions about whether changes in women's labor market attachment can explain time trends in the gender wage gap.

Other unique features of our analysis include incorporating data from the 1990s, (by using the 2000 Census, plus NSF's SESTAT panel from the 1990's), the focus in some of our analysis on college-educated workers, and the unique advantage of the SESTAT data that allows us to follow older women over time while controlling for college major. These data allow us to sort out the effects of between-cohort changes in pre-labor market investments and to confirm that, except for the very early career, labor force attachment is not an important determinant of earnings growth at the individual level.

In more detail, our main results are as follows. First, contrary to what one would gather by looking at repeated cross sections, and in contrast to Wood et al.'s (1993) findings for lawyers,

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grow with potential experience at about twice the rate of men with a high school education, and four times that of men with less than high school.

we find that the gender earnings disadvantage associated with a given cohort of workers tends (with one qualification, noted immediately below) to be fairly constant if that cohort is followed over time. We also find that younger cohorts of women face a smaller disadvantage, relative to men, than did older cohorts of women at the same age. In sum, there is little evidence that, in *any* generation, American women began their careers with similar earnings to men and then fell behind as they aged.

Second, while a constant gender-wage gap for each cohort over its entire lifespan fits our data remarkably well, closer examination reveals that a slightly nonmonotonic pattern fits even better. In particular, when we follow individual cohorts (or individuals) over time, we see that the gender gap does tend to widen during the earliest years of the career, but then actually *narrows* substantially during most of the life cycle. Both this and the previous result characterize the data for both a representative sample of all full-time workers and for the sample of college graduates, where women are compared to men with the same college major. In fact, in the college-graduate panel, we find that the narrowing earnings differential is particularly pronounced among women with lower prior and current labor force attachment.

In sum, our cohort-based analysis of the evolution of the gender wage gap provides little support for an "experience"-based explanation of the decline in the gender wage gap over time. For that matter it is also inconsistent with those models of discrimination that are based on factors, such as lack of access to promotions, that have a cumulative negative effect over a woman's careers. Instead, our results suggest that an understanding of why each successive cohort of women entering the U.S. labor market began its career at a higher wage relative to men is likely to hold the key to why the gender gap has fallen. One possible model, in which women's entry level wages depend on anticipated future labor force attachment, is described in

Kuhn (1993). Another possible explanation is that the effect of discrimination on entry-level opportunities has fallen over time.

The remainder of the paper is organized as follows. Section 2 reviews existing research on the evolution of the US gender wage gap, and describes an identification problem that arises when attempting to use returns to experience (or potential experience) in a cross-section to make inferences about trends across cohorts in women's rate of relative, age-related earnings growth. Section 3 describes the data and empirical results in light of this identification problem. We argue that four decades of U.S. Census data and panel data on college graduates during the 1990's are much more consistent with a pure "cohort effects" model than a pure "experience" model of the gender wage gap. Our main conclusions are that–after allowing for a modest amount of "falling behind" early in the career followed by a modest recovery later on—the best description of women's lifetime wage growth paths is one where each cohort's (or individual's) path is roughly parallel to men's, maintaining a roughly constant gender wage gap throughout the life cycle. Section 4 then analysis the four decades of Census data in greater detail, carefully testing the predictions of alternative models against empirical observations over the period 1969-1999.

2. An Identification Problem

As noted, most existing studies of the effect of experience differentials on the gender wage gap base their results on changes over time in the experience (or age) coefficient in a series of cross-section regressions. As O'Neill (2003, Table 1) shows, the potential experience coefficients have risen dramatically for women, relative to men, over the last couple of decades. This finding is consistent with a model in which changes in the quality of women's experience, as well as in the rate of accumulation of *actual* experience with age, play a major role in explaining time trends in the gender wage gap.[2] As Figures 1 and 2 show, however, these empirical observations are also consistent with an alternative model.

Figure 1 plots hypothetical time profiles of the female-to-male earnings ratio in a model where the only factor causing an increase in this ratio over time is changes across cohorts in women's rate of earnings growth with age (driven, for example, by a decline in the number of career interruptions). In particular, we assume that every cohort of women earns 80 percent of the male wage on labor market entry, but that the gender gap in the effect of potential experience on wages falls smoothly across cohorts.[3] As one would expect, under the assumptions of this model the cross-sectional age profile of the female-male earnings ratio (given by the vertical array of points in each year) becomes flatter between 1969 and 1999.

Figure 2 plots hypothetical time profiles of the female-to-male earnings ratio in a very different polar-case model: one in which the gender-wage gap is invariant to age within every cohort. In this model, the only factor giving rise to changes over time in the gender-wage gap is a change in "entry" wages across cohorts. Notably, in Figure 2 we assume for the sake of argument that the rate of decline in the gender wage gap is *decelerating* across cohorts: the female-to-male earnings ratio is assumed to be .40 for the oldest cohort, .55 for the next oldest, .66 for the next, and so on, with the remaining gap assumed to shrink at a rate of 25 percent per cohort.

[2] For brevity, the discussion focuses on gender differences in experience, but the same argument can easily incorporate other types of human capital investments such as job search, migration or on the job training.

[3] In this example, returns to potential experience fall from 2.4 percentage points per year for women who entered the labor market in 1939 to zero for women entering in 1999. For convenience the structure of these profiles is designed to mirror exactly our Census data, which follow a total of seven ten-year birth cohorts ranging from 1897-1906 to 1957-1966 over the four census years 1969 through 1999. Cohorts in Figure 1 and subsequent figures are labeled by the year in which a person in the "middle" of the cohort turned 27; thus for example persons in cohort 1, born 1907-1916, would be aged between 23 and 32 in 1939).

Clearly, while Figures 1 and 2 differ in many of their implications, both these models share the feature that the cross-sectional age profile of the female-male earnings ratio (given by the vertical array of points in each year) becomes flatter over time. Caution is therefore required in drawing conclusions from time trends in such profiles alone. Further analysis is required to distinguish whether changes in age-earnings profiles fit the model described in Figure 2 (with an increase over time in women's relative wages on labor market entry and no within-cohort changes over time) rather than the model depicted in Figure 1.

3. Data

Our cross-sectional sample comprises U.S. born, full-time, full-year white workers aged 23-62 in the four census years 1969, 1979, 1989 and 1999. Gender earnings differentials are estimated for four birth cohorts in any given year, for workers who attain the age ranges 23-32, 33-42, 43-52 and 53-62 in that year. Altogether, the analysis includes at least one observation for each of seven ten-year birth cohorts ranging from birth dates between 1897-1906 for the oldest cohort to 1957-1966 for the youngest. In different parts of the analysis these cohorts are described either by age at the time of observation, by age in 1989, or by the year in which the median member of the cohort was 27 years old.

The panel sample comes from the 1993 National Survey of College Graduates, conducted by the U.S. Census Bureau for the National Science Foundation. Matched with 1990 census responses from the same individuals and with followup surveys in 1995, 1997 and 1999 as part of NSF's SESTAT system, this data set generates a representative sample of Americans of all ages holding college degrees in a large number of selected majors. While covering a shorter time period and smaller sample, these data allow us to directly observe the dynamics of individual workers' wage growth, including its dependence on labor market experience and choices during the preceding and intervening years.

The SESTAT panel used in our analysis comprises U.S. born, full-time, full-year white workers aged 23-52 in 1989 (33-62 in 1999) who were sampled on college major (rather than occupation) and who still held no degree higher than a bachelors and worked full-time in 1999. Cross-sectional regressions allow us to compare 1989 gender earnings differentials in this panel to those in the full representative sample of all U.S. college graduates included in the 1993 survey.

In the panel analysis, gender differentials in earnings levels and earnings growth are estimated for three birth cohorts, for workers who were in the age ranges 23-32, 33-42 and 43-52 in 1989.[4] The cohorts are described by age in 1989. A 1993 question about full-time, professional labor market experience allows us to create a good proxy for pre-1989 labor force attachment.[5] Information from the 1993, 1995 and 1997 surveys allows us to learn something about labor force attachment between the 1989 and 1999 earnings observations.

4. A cohort analysis of gender wage differentials

Cross-sectional earnings regressions using Census data on full-time, full-year workers from the past four decades are described in Table 1. Estimates are reported first with and then without controls for hours worked per week. In each year, gender coefficients are estimated separately for each of four ten-year cohorts. Gender coefficients along the diagonal of Table 1 describe a given cohort followed over time. The patterns in Table 1 are almost too clear to require further

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[4] Earnings growth is measured as the difference between 1989 and 1999 log annual earnings. The 1989 earnings measure is the exact measure used in the Census analysis, taken from 1990 Census responses. The 1999 earnings measure is the response to a question about annual salary in the 1999 follow-up survey.

[5] Our proxy for pre-1989 labor force attachment is the ratio of full-time, professional work experience since college graduation to potential experience.

description: Gender coefficients tend to be larger among older cohorts than among younger cohorts observed in the same year (vertical), gender coefficients fall if a given age group is followed over time (horizontal), but are fairly constant when a given cohort is followed over time (diagonal). One deviation from either of the two models is a consistent reduction in the gender gap as a given cohort reaches the age of 55. This pattern can be seen for each of the three cohorts followed to this age. Aside from this minor deviation, the within-cohort gender gap is surprisingly constant over time.

Consistent with the model described in Figure 2, gender differences in earnings are smaller among more recent cohorts (even at labor market entry) than among older cohorts, and the age-earnings profiles of cohorts of women followed along the diagonals of Table 1 appear to closely track men's in every cohort observed, so that the gender earnings ratio is virtually unchanged over time within a given cohort.

In Section 5 of the paper, we will return to the results of Table 1, analyzing in much greater detail how well the estimated gender coefficients fit alternative models. But first, we turn to the detailed panel data on bachelor's level college graduates to present evidence that neither gender differences in pre labor-market investments nor changes in labor force attachment hold the key to explaining changes in the gender earnings gap over time.

In order to bridge the transition from the Census to the SESTAT panel data, Table 2 describes cross-sectional Census regressions similar to those of Table 1, columns 3 and 4, but comparing bachelor's level college graduates to workers with more or less education. In Table 2, cohorts are followed along rows, rather than diagonally. Here we see that, at all education levels, wage gaps are fairly constant within cohort, and smaller among more recent cohorts. Table 2 also shows the robustness of the "catch up" among women in the oldest cohort. At every education level, the gender gap in earnings grows slightly early in the career and shrinks later in the career.[6]

Table 3 describes how gender gaps estimated from the college graduate samples compare to the Census estimates. Columns 1 and Column 2 present estimates of gender wage gaps using the comparable representative samples of college graduates from the Census and the Survey of College Graduates. The estimates are nearly identical, confirming that these samples are truly comparable. In columns 3 and 4, first broad and then detailed controls for pre-labor market investments including majors, minors, and fields of graduate degrees are introduced. The more detailed controls explain only slightly more of the gender gap than the small number of broad controls, suggesting diminishing returns to incorporating even better controls for unobserved investments. In all four specifications, the gender gap faced by the oldest cohort is three times as large as that faced by the youngest. Clearly, differences in the pre-labor market educational choices of women do not account for the fact that older cohorts of women face larger wage gaps. In columns 5 and 6, the samples are further restricted to include only bachelor's level college graduates, and then only the SESTAT sample that will be used in our panel analysis. In each of these samples, the three estimated gender coefficients are quite similar to those for the full sample of all college-educated full-time full-year workers.

Table 4 describes the evolution of gender wage gaps as a matched SESTAT sample is followed over time, with cohorts followed along rows. Columns 1-3 are repeated cross section regressions of full-time workers in 1989, 1995 and 1999, with the sample restricted to those working full-time in each of the three years. Columns 4-6 are the same regressions, but with

[6] We tested the hypothesis that the apparent shrinking of the gender gap among older workers might be due to large numbers of men reaching the topcoded value of earnings. While this might be a small factor, it does not account for much of the observed effect. For example, even if we make the extreme assumption that all men in 1999 with earnings topcoded at $175,000 actually earned $350,000, the gender gap in row 4, columns 3&4 of Table 2 still shrinks from 0.49 to 0.38 (rather than to 0.34).

detailed educational attainment controls. Here we see that, even when a fixed group of full-time workers is followed over time, the gender gap faced by the oldest women remains 2-3 times as large as that faced by the youngest cohort of women in every year. The youngest women face a gap in log earnings between 0.16 and 0.18 in each year (0.08 to 0.10 after controlling for college major) while the gap faced by the oldest women falls from 0.56 to 0.35 (from 0.43 to 0.23 after controlling for college major). The results shown in Table 4 tell us that the shrinking gender gap among older workers observed in Tables 1 and 2 is not the result of selective attrition or reentry, but is the experience of individual workers followed over time.

Another finding made even more apparent in Table 4 is that differences in educational choices cannot explain why the two older cohorts, aged 33-52 in 1989, face larger wage gaps than the two younger cohorts, aged 33-52 in 1999. For example, the middle cohort of women faces a gender differential of 20 percent in both 1989 and 1999, after including detailed college major controls. The 1999 gap is only half as large as that faced by the older cohort at the same age, and the 1989 gap is more than twice as large as that faced by the younger cohort at the same age. Differences in college major cannot explain why older cohorts of women face larger gaps.

The next portion of the analysis focuses on the relationship between labor force participation and earnings growth. Here individual level measures of earnings growth are regressed on measures of human capital and labor force participation.

Table 5, Column 1 reports estimates of gender differentials in wage growth for each of the three cohorts.[7] As in the cross-section estimates of Table 4, there is no gender differential in

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[7] The results of Table 5, column 1 are also robust to a large number of other tests. The finding of somewhat faster earnings growth for women than for men was replicated using the 89-93 panel representative of all college graduates, within nearly every subsample broken down by bachelor's level college major, and broken down by level of degree (BA, MA, Ph.D., MBA, Lawyer, Doctor). The sole exception is that the earnings of women computer science graduates grew more slowly than those of men computer science graduates, but more quickly that those of men or women with any other college major, during the 1990's. While these findings, especially those for lawyers,

wage growth within the youngest cohort. There is, however, a substantial female advantage in wage growth within the middle cohort, and an even larger female advantage in growth within the oldest cohort. The remaining columns of Table 5 represent unsuccessful attempts to explain the gender difference in earnings growth with a variety of controls including region of residence, college major, changes in hours worked per week, and changes in childcare responsibilities between 1989 and 1999. Only one of these factors appears to have any influence on gender differences in earnings growth: women who had children at home in 1989 but not in 1999 experienced particularly fast earnings growth over this period. However, the very high rate of earnings growth among older women is robust to inclusion of every one of the tested controls, including the "empty nest" indicator.

Finally, Table 6 examines relationships between earnings levels or growth and labor force participation. Estimates of gender coefficients on earnings levels are reported in columns 1-3, followed by estimates of gender coefficients on earnings growth in columns 4-6. Regressions in Columns 1 are restricted to young men and women aged 23-32 in 1989. Columns 2 and 3 describe different samples aged 33-52 in 1989. In column 2, the sample is restricted to young women with the strongest pre-1989 labor force attachment, compared to all young men. In column 3, the women with lower prior labor market experience are compared to all young men. Descriptive statistics presented on the same page as Table 6 make it clear the group of strongly attached older women have both prior and current labor force attachment similar to, if not stronger than, men the same age.

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seem to contradict previous research findings, they are robust. As a final check that these results are not due to a coding error, regressions similar to those of Table 1 were run for the sample of lawyers in the 1980, 1990 and 2000 census data. Here we found a result similar to Wood, et. al.: For the cohort that was aged 28-37 in 1979, the gender gap grew from -.10 (0.04) to -.30(0.05) between 1979 and 1989. However, for the cohort aged 28-37 in 1989, the gender gap did not grow at all between 1989 and 1999.

As we saw in previous tables the youngest cohort of women enjoyed both earnings and earnings growth similar to men during the 1990's.[8] Not surprisingly, older women with lower prior labor force attachment earn less than other women the same age. However, even women with strong prior attachment face a statistically significant wage penalty relative to men the same age with the same college major. The gap faced by older women with strong labor force attachment is also large relative to that faced by younger women—more evidence of a cohort effect that is clearly not due to low labor force attachment. These data do not allow us to distinguish the direction of causality between labor force attachment and low earnings, but do clarify that strong attachment is no guarantee of earning as much as men the same age with the same educational investments.

Finally, the most surprising result of all is that older women with lower levels of both prior and current labor force attachment have the highest rate of earnings growth of all. This finding is not consistent with any existing model.

To summarize, this empirical analysis demonstrates that, during the 1990's, women experienced wage growth that kept pace with, or even exceeded, men's. Nonetheless, large gender earnings differentials still characterize older cohorts of workers. The larger gender differentials among older cohorts cannot be explained by differences in educational investments, and the evidence presented here suggests they are unlikely to be due to gender differences in labor force attachment.

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[8] In a regression not reported in the table, the small number of women aged 23-32 who did not work full-time continuously between 1989 and 1999 did have substantially lower wage growth than the typical woman in the youngest cohort. Among the older women, there was no penalty for interruptions in full-time employment between 1989 and 1999.

5. Testing Alternative Models of Gender Gap Dynamics

The results described so far are robust within this sample of college graduates who worked full-time in both 1989 and 1999. We now return to the question of how well they generalize to the population of all full-time workers employed at any given point in time, over a longer time period. In Table 1, it appears that in representative samples of U.S. full-time workers, gender earnings differentials are more closely tied to birth cohort than to accumulated labor market experience over the longer period 1969-1999. In this section, we test that hypothesis formally.

Using the 16 age-and-year-specific gender-wage gaps estimated in the top left of Table 1 as data points, we run a series of regressions designed to evaluate various models of the evolution of the gender wage gap across time and between cohorts. For ease of interpretation, the gender-wage gaps of Table 1 have been converted into female/male wage ratios; thus a positive coefficient represents a rise in women's wages relative to men's. Recognizing the general nonidentifiability of secular trends in time versus cohort effects (for example as Deaton and Paxson 1994 point out, any time trend can be reinterpreted as age and cohort effects of equal and opposite sign), we omit year effects from all these regressions, thus forcing all time trends into the cohort coefficients.

Table 7, Column 1 presents our most general specification, explaining female relative wages with a full set of cohort fixed effects (cohort 1, born 1897-1906, is the omitted cohort), plus a set of interactions between cohort and potential experience (potential experience is measured as decades elapsed since the cohort was aged 23-32). The rationale for the latter set of interactions is the "experience hypothesis"—that time trends in women's relative accumulation of experience and skills with age explain a significant share of the decline in the gender wage gap in recent years (e.g. O'Neill and Polachek 1993). Note that cohort-specific rates of wage growth with experience cannot be estimated for cohorts 1 and 7, since we observe these cohorts only once.

Not surprisingly, the specification in column 1, with 11 covariates to fit 16 data points, fits those points very well, with an R^2 of .944 and adjusted R^2 of .790. Perhaps more surprisingly, the results show strong support for "cohort effects" model illustrated in Figure 2 but not the "experience model" of Figure 1: the cohort-experience interactions show no strong trend –if there is any trend it is *downward*, contrary to the "experience" hypothesis—and are all insignificant, while the cohort fixed effects show a generally rising pattern that is statistically significant in the later cohorts. Still it is possible that collinearity makes it hard to detect cohort-experience interactions; to examine that possibility we compare the performance of a number of more parsimonious specifications in columns 2-4.

Column 2 asks whether cohort-experience interactions are a necessary feature of a statistical model that fits gender earnings gap trends over the last four decades well. The answer is clearly no: dropping these interaction terms has almost no effect on the ability of the model to fit the data, in fact the adjusted R^2 *rises* from .790 to .846 when the interactions are dropped. *Thus, a parsimonious model that fits recent trends in the gender wage gap extremely well has each successive cohort of women entering the labor market at a higher wage relative to men, with each cohort having the same rate of wage growth, relative to men, as every other cohort.* Column 3 takes this logic a step further: surprisingly little is lost when we force women's age-related wage growth to be the *same* as men's in every cohort. Together, these results suggest that experience-based explanations of *both* the gender-wage gap *and* its evolution over time may be off the mark. Finally, column 4 imposes a pure "experience" model on the data. This model fits the data much worse than any of the previous ones. We conclude that –in contrast to cohort-experience interactions-- cohort fixed effects *are* clearly needed to fit trends in women's relative wages over the past four decades.

Some further insight into why a pure experience model describes recent trends so poorly arises from the simple plot of the data shown in Figure 3. With two relatively minor exceptions, this graph of actual data mirrors Figure 2 –the pure cohort effects model– surprisingly closely. One exception is the fact that, in all cohorts, women's relative wages tend to drop in the early career (between age groups 23-32 and 33-42), then recover later in life. This life cycle pattern of an early lag and later recovery is a robust feature of all our analyses, and is not restricted to the 1990's data described earlier. The second exception is a single data point, giving the end-of-career relative earnings of women in our oldest cohort—cohort 1—in 1969. The median woman in this cohort turned 27 in 1939; thus in some sense these women's "prime" working years coincided with the Second World War. It seems likely that this had a permanent positive effect on their earnings.

To see just where different polar-case models do or do not fit the data in Figure 3, Figures 4-6 plot the Figure 3 values against predicted values from three models. All of these models are slight generalizations of those in Table 1 in one aspect only --they allow for the nonmonotonic effect of age on women's relative earnings noted above (details and coefficients are supplied in Table 8). Figure 4 shows that a pure cohort-effects model with no age-cohort interactions fits the data exceedingly well (R^2 =.988; adjusted R^2=.970). (Small dots connected by lines indicate predicted values; large dots of the corresponding color indicate actual data). Figure 5 shows, as already noted in column 3 of Table 2, that a model in which the gender gap is independent of age for all cohorts also does a surprisingly good job of fitting the data; in essence, smoothing out the U-shaped life cycle profile of women's relative earnings with a straight line does not do great violence to the data (R^2 =.890; adjusted R^2=.816). Finally, Figure 6 shows that relying on age-experience interactions alone to explain the data leads to significantly poorer fit (R^2 =.851; adjusted R^2=.720) than Figure 5's model with cohort fixed effects only. The main reason for this poor fit is obvious: this model imposes a common "entry-level" gender earnings gap on all cohorts in a world where this gap was declining dramatically over time. It would seem, therefore, that future attempts to understand the evolution of the gender earnings gap should focus more on explaining this trend in entry-level wages and less on gender differences in accumulated experience.

6. Summary and Conclusions

Previous research on the evolution of the U.S. gender wage gap has established that (a) the gender wage gap is falling; (b) at least since the 1980's the average experience of working women has been converging to men's; and (c) in recent cross-sections, women's estimated return to potential experience is much higher than in earlier cross sections. Together these facts have been interpreted as support for an "experience-based" explanation of trends in the gender wage gap over the past few decades. In this paper we argue and show that such a model is not necessarily implied by the above facts. Instead, we show that women are not falling farther behind men as they age in *any* of the cohorts in our data. Instead, when we follow individual cohorts (or individuals) over time, we see that the gender gap does tend to widen during the earliest years of the career, but then actually *narrows* substantially during most of the life cycle, for a net lifetime gain relative to men of roughly zero. Hence, it would appear to us that the observed gender gap patterns cannot be attributed to the cumulative effects of either discrimination or differential labor force attachment as the career progresses. Instead, it makes more sense to investigate the factors that influence starting salaries as women enter the labor market for the first time.

In addition to clarifying the kinds of influences that are (or are not) contributing to the recent declines in the gender wage gap, the current paper presents new information regarding wage growth among college-educated women during the 1990's. In particular, we show that in all age ranges except the youngest, college-educated women experienced somewhat faster wage growth than the men in their cohort during this period. This faster wage growth is not a statistical artifact of differences in college major, increases in hours worked per week, or changing childcare responsibilities. Despite the faster wage growth among women, large gender gaps remain in older cohorts, even among women with very high levels of labor force attachment. The between-cohort differences in gender earnings gaps cannot be explained by differences in educational investments or prior work history. These robust empirical findings of large and persistent gender gaps in earnings among older, highly attached workers defy explanation by existing human capital models.

References

Blau, Francine D. "Trends in the Well-Being of American Women, 1970-1995". Journal of Economic Literature 36(1) (March 1998): 112-165.

Blau, Francine D. and Lawrence M. Kahn. "Gender Differences in Pay". Journal of Economic Perspectives 14(4) (Fall 2000): 75-100.

Blau, Francine D. and Marianne Ferber. *The Economics of Women, Men and Work.* Englewood Cliffs, N.J.: Prentice-Hall, 1986

Deaton, Angus S. and Christina H. Paxson. "Saving, Growth and Aging in Taiwan". In David A. Wise, ed. Studies in the Economics of Aging. Chicago: University of Chicago Press, 1994. pp. 331-361.

Brown, Charles and Mary Corcoran. "Sex-Based Differences in School Content and the Male-Female Wage Gap." Journal of Labor Economics 15 (1997):431-465.

Card, D. "Intertemporal Labor Supply: An Assessment". in Christopher Sims, ed., Advances in Econometrics, Sixth World Congress, (New York, Cambridge University Press, 1994).

Daymont, Thomas and Paul Andrisani. "Job Preferences, College Major and the Gender Gap in Earnings." Journal of Human Resources 19 (Summer 1984):408-428.

Ferber, Marianne and Betty Kordick, "Sex Differentials in the Earnings of Ph.D.s" Industrial and Labor Relations Review, 31(2) (Jan. 1978).:227-238.

O'Neill, June. "The Gender Gap in Wages, circa 2000". American Economic Review 93(2) (May 2003): 309-314.

O'Neill, June and Solomon Polachek. "Why the Gender Gap in Wages Narrowed in the 1980's". Journal of Labor Economics 11(1) (Jan. 1993): 205-228.

Weinberger, Catherine J. "Race and Gender Wage Gaps in the Market for Recent College Graduates." Industrial Relations 37(January, 1998):67-84.

Weinberger, Catherine J. 1999. "Mathematical College Majors and the Gender Gap in Wages." Industrial Relations 38 (July, 1999):407-13.

Weinberger, Catherine J. "Is Teaching More Girls More Math the Key to Higher Wages?" in *Squaring Up: Policy Strategies for Raising Women's Incomes in the U.S.*, edited by Mary C. King. Forthcoming June 2001a, University of Michigan Press.

Wood, Robert G., Mary E. Corcoran, and Paul N. Courant. "Pay Differences among the Highly Paid: The Male-Female Earnings Gap in Lawyers' Salaries". Journal of Labor Economics 11(3) (July 1993): 417-441.

Table 1 Gender Earnings Gaps by Cohort and Year
(Full time, full year workers, age 23-62, all education levels)

Data from 1970, 1980, 1990 and 2000 Census; Dependent Variable: Log of annual wage and salary income
(Follow cohorts along the diagonal)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	1969	1979	1989	1999	1969	1979	1989	1999
female*(age 23-32)	-0.424	-0.329	-0.216	-0.198	-0.438	-0.362	-0.264	-0.257
	(0.004)**	(0.002)**	(0.002)**	(0.003)**	(0.003)**	(0.002)**	(0.002)**	(0.003)**
female*(age 33-42)	-0.571	-0.509	-0.350	-0.263	-0.585	-0.543	-0.401	-0.327
	(0.004)**	(0.003)**	(0.002)**	(0.002)**	(0.003)**	(0.003)**	(0.002)**	(0.003)**
female*(age 43-52)	-0.600	-0.587	-0.460	-0.334	-0.613	-0.622	-0.508	-0.397
	(0.003)**	(0.003)**	(0.003)**	(0.003)**	(0.003)**	(0.003)**	(0.003)**	(0.003)**
female*(age 53-62)	-0.539	-0.537	-0.458	-0.336	-0.549	-0.569	-0.506	-0.395
	(0.004)**	(0.004)**	(0.004)**	(0.004)**	(0.004)**	(0.004)**	(0.004)**	(0.004)**
Age	0.029	0.040	0.041	0.039	0.029	0.041	0.042	0.041
	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**
(age-22) squared	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**
35-39 hours/week	0.007	-0.069	-0.121	-0.158				
	(0.003)*	(0.003)**	(0.003)**	(0.004)**				
41-48 hours/week	0.050	0.089	0.121	0.133				
	(0.002)**	(0.002)**	(0.002)**	(0.002)**				
49+ hours/week	0.049	0.115	0.188	0.245				
	(0.003)**	(0.002)**	(0.002)**	(0.002)**				
Observations	296103	393118	497703	538469	296103	393118	497703	538469
R-squared	0.35	0.32	0.34	0.32	0.35	0.32	0.32	0.28

Robust standard errors in parentheses * significant at 5%; ** significant at 1%

Sample: IPUMS white workers age 23-62, born in the U.S., employed full time, full year (at least 50 weeks, usual hours/week at least 35), annual income at least $2000 (1990 dollars).

Additional controls: Census division (9 regions), 9 educational attainment levels (which control for the combined effects of more years of education and less work experience). (Columns 1-4 include hours/week controls, columns 5-8 do not)

Table 2-- Gender Earnings Gaps by Cohort and Educational Attainment, 1989 and 1999.

(Follow cohorts along rows)

	Not A College Graduate		Bachelor Level College Graduate		Graduate or Professional Degree	
	(1)	(2)	(3)	(4)	(5)	(6)
	1989	1999	1989	1999	1989	1999
female*(1989 age 13-22)		-0.217		-0.152		-0.148
		(0.003)**		(0.005)**		(0.011)**
female*(1989 age 23-32)	-0.240	-0.287	-0.141	-0.212	-0.175	-0.204
	(0.003)**	(0.003)**	(0.005)**	(0.006)**	(0.011)**	(0.009)**
female*(1989 age 33-42)	-0.367	-0.330	-0.305	-0.356	-0.285	-0.320
	(0.003)**	(0.003)**	(0.006)**	(0.006)**	(0.009)**	(0.008)**
female*(1989 age 43-52)	-0.457	-0.338	-0.491	-0.339	-0.411	-0.313
	(0.003)**	(0.004)**	(0.009)**	(0.011)**	(0.011)**	(0.012)**
female*(1989 age 53-62)	-0.446		-0.545		-0.415	
	(0.005)**		(0.016)**		(0.019)**	
Age	0.038	0.033	0.045	0.048	0.050	0.053
	(0.000)**	(0.000)**	(0.001)**	(0.001)**	(0.002)**	(0.001)**
(age-22) squared	-0.001	-0.000	-0.001	-0.001	-0.001	-0.001
	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**
35-39 hours/week	-0.121	-0.169	-0.128	-0.148	-0.092	-0.104
	(0.004)**	(0.004)**	(0.008)**	(0.008)**	(0.012)**	(0.011)**
41-48 hours/week	0.121	0.129	0.120	0.143	0.127	0.148
	(0.002)**	(0.002)**	(0.005)**	(0.005)**	(0.008)**	(0.007)**
49+ hours/week	0.169	0.223	0.194	0.260	0.200	0.257
	(0.003)**	(0.002)**	(0.005)**	(0.004)**	(0.007)**	(0.006)**
Observations	366532	373803	87216	109375	43955	55291
R-squared	0.27	0.23	0.23	0.20	0.19	0.18

Sample: IPUMS white workers age 23-62, born in the U.S., employed full time, full year (at least 50 weeks, usual hours/week at least 35), annual income at least $2000 (1990 dollars), by educational attainment.

Additional controls: Census division (9 regions), finer educational attainment (columns 1-2 8 levels, columns 5-6 3 levels (ma, phd and professional), columns 3-4 no additional educational attainment controls).

Table 3-- College Graduate Gender Earnings Gaps with better controls (1989 Full time, full year workers, college graduates age 23-52) . Data from the National Survey of College Graduates, a follow-up survey of college graduates drawn from the 1990 Census

	(1)	(2)	(3)	(4)	(5)	(6)
Year &Sample	1989 Census College Graduates	1989 NSCG College Graduates	1989 NSCG College Graduates	1989 NSCG College Graduates	1989 NSCG College Graduates Bachelor's degree only	1989 SESTAT subsample (Also full-time in 1999) Bachelor's degree only
female*(age 23-32)	-0.146	-0.140	-0.092	-0.076	-0.082	-0.095
	(0.004)**	(0.008)**	(0.008)**	(0.008)**	(0.009)**	(0.027)**
female*(age 33-42)	-0.299	-0.290	-0.219	-0.192	-0.214	-0.216
	(0.005)**	(0.009)**	(0.010)**	(0.010)**	(0.013)**	(0.036)**
female*(age 43-52)	-0.444	-0.430	-0.333	-0.297	-0.356	-0.423
	(0.007)**	(0.014)**	(0.014)**	(0.014)**	(0.020)**	(0.057)**
Age	0.049	0.054	0.061	0.061	0.061	0.067
	(0.001)**	(0.002)**	(0.002)**	(0.002)**	(0.002)**	(0.005)**
(age-22) squared	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**	(0.000)**
ma	0.083	0.053	0.068			
	(0.004)**	(0.007)**	(0.007)**			
phdprof	0.247	0.276	0.302			
	(0.006)**	(0.011)**	(0.011)**			
College major controls:	No	No	Broad college major, level of graduate degree	Narrow college major, second majors, minors, field and level of graduate degrees	Narrow college major, second majors, minors	Narrow college major, second majors, minors
Observations	118123	45197	45197	45197	29745	5396
R-squared	0.24	0.26	0.31	0.35	0.32	0.32

(notes on next page)

table 3 Sample: white college graduates age 23-52, born in the U.S., employed full time, full year (at least 50 weeks, usual hours/week at least 35), annual income at least $2000 from Census (Column 1) or NSCG (Columns 2-4). Column 5 further restrict the NSCG sample to bachelor's level graduates only, and columns 6 to bachelor's level graduates with selected college majors who were resurveyed, working full-time, and had no graduate degrees in 1999. Table 3 Dependent Variable: Log of annual wage and salary income; Additional controls included in all regressions: $(age-22)^2$, 35-39, 41-48, and 49+ hours/week, geographic controls for 9 census divisions. College major controls: Column 3: 9 broad categories, Column 4: Detailed college majors (156 categories), 8 categories of college minor or second major, 9 categories of master's degree, 5 categories of Ph.D., and 4 categories of professional license, Column 5: Detailed college majors (146 categories), 8 categories of college minor or second major, Column 6: Detailed college majors (71 categories), 8 categories of college minor or second major.

Tables 4—matched SESTAT Samples. repeated cross section regressions.
(Follow cohorts along rows)

				With college Major controls		
	(1)	(2)	(3)	(4)	(5)	(6)
Year	1989	1995	1999	1989	1995	1999
female*(1989 age 23-32)	-0.170	-0.176	-0.158	-0.081	-0.093	-0.075
	(0.028)**	(0.030)**	(0.030)**	(0.027)**	(0.029)**	(0.030)*
female*(1989 age 33-42)	-0.313	-0.281	-0.215	-0.206	-0.169	-0.109
	(0.036)**	(0.038)**	(0.035)**	(0.037)**	(0.038)**	(0.037)**
female*(1989 age 43-52)	-0.562	-0.378	-0.352	-0.434	-0.253	-0.228
	(0.062)**	(0.052)**	(0.061)**	(0.060)**	(0.054)**	(0.063)**
Observations	5183	5183	5183	5183	5183	5183
R-squared	0.25	0.17	0.14	0.33	0.25	0.22

Age dummies and dummies for 35-39, 41-48, and 49+ hours/week included in all regressions.
Detailed college major & minor controls in regressions 4-6 & 10-12.

Table 5—things that do NOT explain why older women's earnings grow so quickly: region, college major, changes in hours worked per week, changes in childcare responsibilities.

	(1)	(2)	(3)	(4)	(5)
	grow8999	grow8999	grow8999	grow8999	grow8999
female*(1989 age 23-32)	-0.043 (0.030)	-0.043 (0.030)	-0.051 (0.031)	-0.040 (0.029)	-0.046 (0.035)
female*(1989 age 33-42)	0.078 (0.029)**	0.078 (0.029)**	0.071 (0.030)*	0.069 (0.029)*	0.058 (0.038)
female*(1989 age 43-52)	0.205 (0.059)**	0.209 (0.059)**	0.197 (0.059)**	0.199 (0.057)**	0.158 (0.063)*
% change in hours per week if increase				0.144 (0.064)*	
% change in hours per week if decrease				0.693 (0.126)**	
Mother in 89, empty nest in 99					0.097 (0.057)
Mother in 89 & 99					0.013 (0.041)
Mother in 99 Not in 89					-0.021 (0.059)
Other Controls		region	Broad college major		
Observations	5396	5396	5396	5396	5396
R-squared	0.14	0.14	0.14	0.16	0.14

Age dummies and dummies for 35-39, 41-48, and 49+ hours/week included in all regressions.

Table 6—gender differentials in earnings levels and growth, by age and labor force attachment.

	(1)	(2)	(3)	(4)	(5)	(6)
	Age 23-32	**Age 33-52 more attached women**	**Age 33-52 less attached women**	**Age 23-32**	**Age 33-52 more attached women**	**Age 33-52 less attached women**
Dep var	**Earnings Levels**	**Earnings Levels**	**Earnings Levels**	**Earnings Growth**	**Earnings Growth**	**Earnings Growth**
Female differential	**-0.071**	**-0.151**	**-0.478**	**-0.043**	**0.051**	**0.190**
	(0.028)*	**(0.040)****	**(0.046)****	**(0.030)**	**(0.031)**	**(0.042)****
Observations	**2285**	**2926**	**2849**	**2285**	**2926**	**2849**
R-squared	**0.40**	**0.18**	**0.24**	**0.08**	**0.03**	**0.04**

Sample: Worked full-time full year in 1989, full-time in 1999, with earnings measured in both years.

Age dummies included in all regressions. Other controls in columns 1-3: dummies for 35-39, 41-48, and 49+ hours/week, region and detailed college major/minor.

Descriptive Stats for Table 8 sample:

	Women Age 23-32	**Men Age 23-32**	**more attached women Age 33-52**	**less attached women Age 33-52**	**Men Age 33-52**
Full-time exper /potential exper (s.d.)	**.82 (.21)**	**.83 (.18)**	**.93 (.06)**	**.53 (.21)**	**.83 (.21)**
Worked Full-time in 93, 95 & 97 (indicator)	**.74**	**.80**	**.76**	**.61**	**.78**
Observations	**463**	**1822**	**262**	**185**	**2664**

"More attached women" are defined as those with
(full-time professional experience/potential exper)≥.8

Table 7: Modeling Changes in the Female/Male Wage Ratio

	(1)	(2)	(3)	(4)
Cohort 2 (born 1917-1926)	-.187 (.228)	-.016 (.064)	-.030 (.070)	
Cohort 3 (born 1927-1936)	-.113 (.111)	.028 (.062)	.000 (.066)	
Cohort 4 (born 1937-1946)	.060 (.079)	.148 (.063)	.107 (.064)	
Cohort 5 (born 1947-1956)	.204 (.082)	.256 (.069)	.201 (.066)	
Cohort 6 (born 1957-1966)	.323 (.086)	.368 (.076)	.300 (.070)	
Cohort 7 (born 1967-1976)	.341 (.086)	.423 (.089)	.341 (.081)	
Potential Experience * Cohort 2	.063 (.086)			-.067 (.040)
Potential Experience * Cohort 3	.057 (.043)			-.057 (.040)
Potential Experience * Cohort 4	.031 (.027)			-.008 (.040)
Potential Experience * Cohort 5	-.003 (.043)			.029 (.064)
Potential Experience * Cohort 6	-.047 (.086)			.124 (.135)
Potential Experience		.003 (.002)		
Constant	.461 (.061)	.306 (.108)	.461 (.057)	.613 (.051)
R squared	.944	.918	.890	.408
Adjusted R squared	.790	.846	.816	.111

Sample size for all regressions is 16 age-year cells for the years 1969, 1979, 1989 and 1999. Cohort 1 (born 1897-1906) is the omitted cohort; cohort-specific earnings growth rates cannot be estimated for cohorts 1 and 7 since we have only one year of data on each of these. Potential experience is measured as *decades* elapsed since the cohort was aged 23-32.

Table 8-- Modelling Changes in the Female/Male Wage Ratio using Flexible Age Effects

	(1)	(2)	(3)	(4)
Cohort 2 (born 1917-1926)	.002 (.030)	.023 (.030)	-.030 (.070)	
Cohort 3 (born 1927-1936)	-.089 (.109)	.078 (.029)	.000 (.066)	
Cohort 4 (born 1937-1946)	-.029 (.110)	.186 (.028)	.107 (.064)	
Cohort 5 (born 1947-1956)	.080 (.114)	.306 (.032)	.201 (.066)	
Cohort 6 (born 1957-1966)	.185 (.114)	.405 (.034)	.300 (.070)	
Cohort 7 (born 1967-1976)	.204 (.114)	.424 (.040)	.341 (.080)	
Age 33-42	-.139 (.047)	-.045 (.018)		-.265 (.058)
Age 43-52	-.200 (.087)	-.021 (.020)		-.324 (.060)
Age 53-62	-.137 (.110)	.083 (.023)		-.241 (.058)
Potential Experience * Cohort 3	.055 (.038)			.019 (.024)
Potential Experience * Cohort 4	.079 (.039)			.068 (.024)
Potential Experience * Cohort 5	.098 (.046)			.154 (.040)
Potential Experience * Cohort 6	.092 (.057)			.294 (.084)
Constant	.598 (.113)	.378 (.032)	.461 (.057)	.708 (.035)
R squared	.997	.988	.890	.851
Adjusted R squared	.974	.970	.816	.720

Sample size for all regressions is 16 age-year cells for the years 1969, 1979, 1989 and 1999. Omitted categories are cohort 1 (born 1897-1906); age 23-32; and potential experience x cohort 2. Potential experience is measured as decades elapsed since the cohort was aged 23-32

Figure 1:

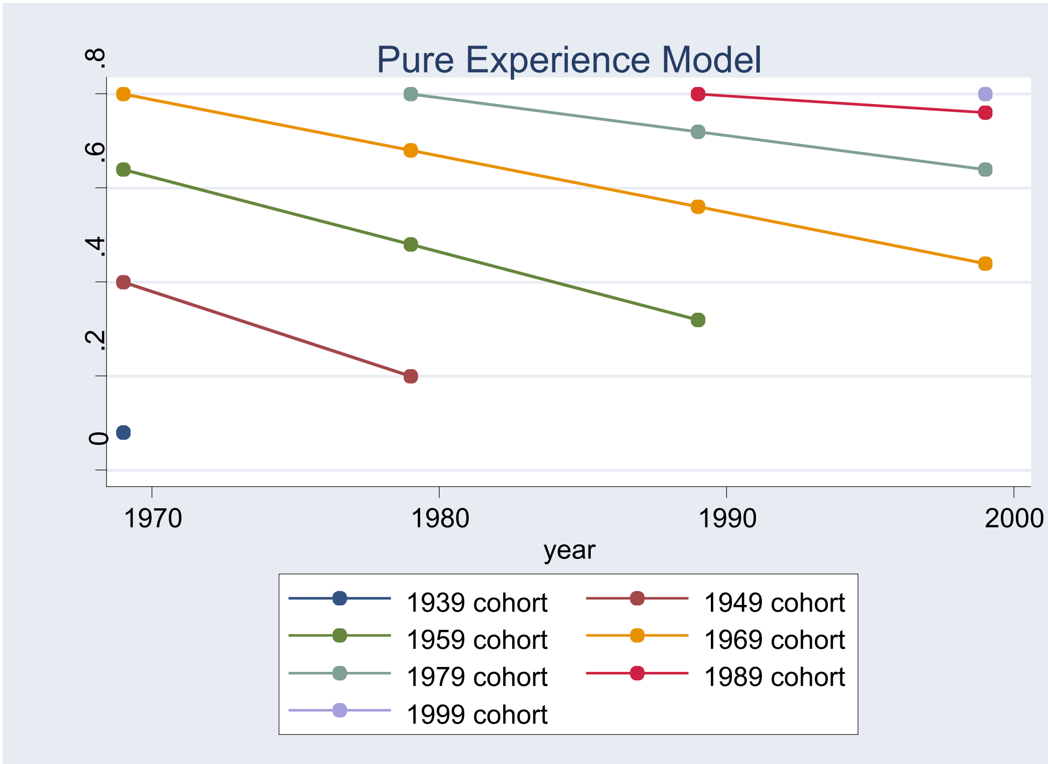

Figure 2:

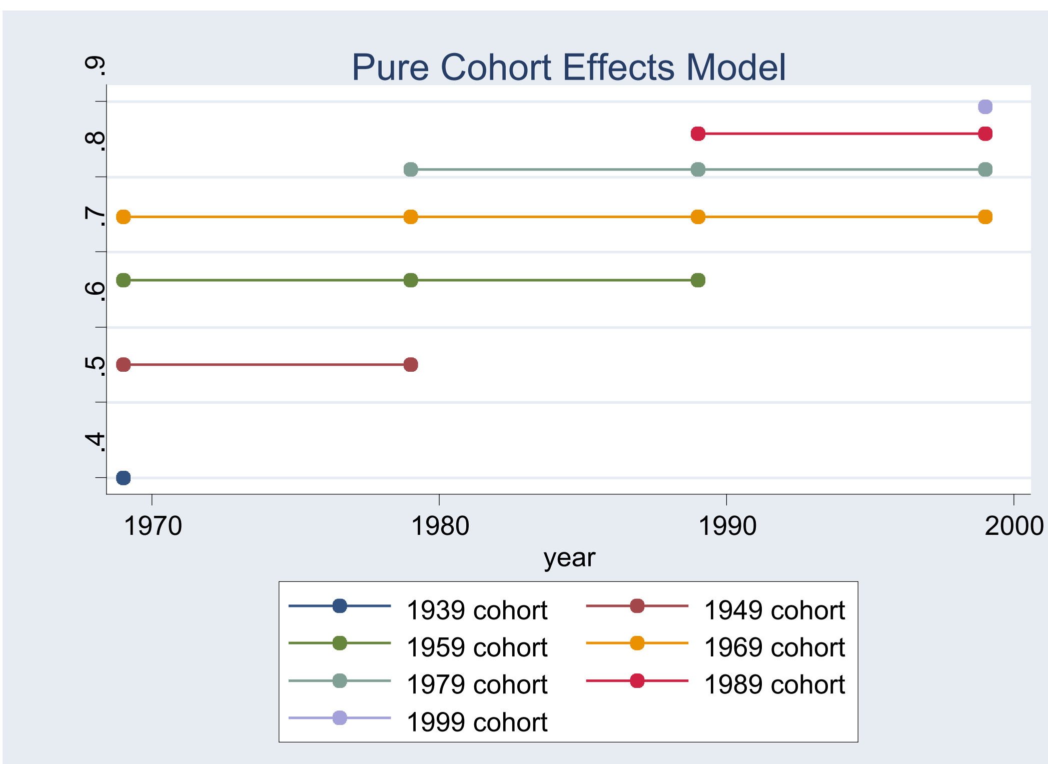

Figure 3: Estimated Female-Male Earnings Ratios, U.S. Census Data

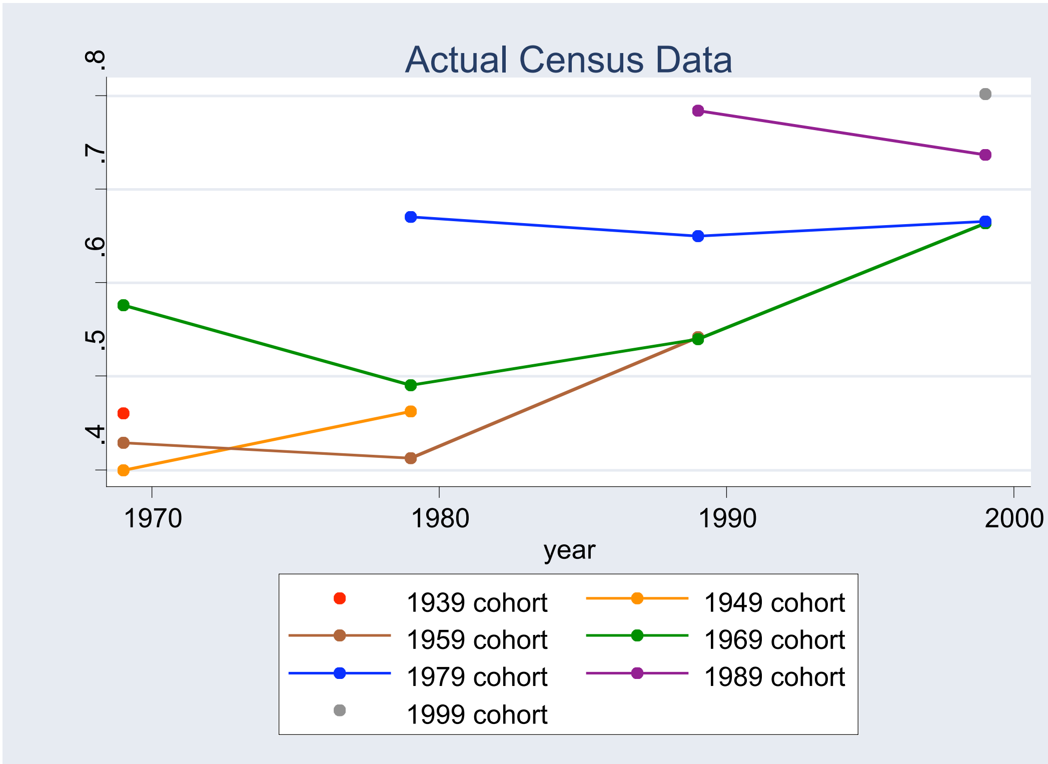

Figure 4:

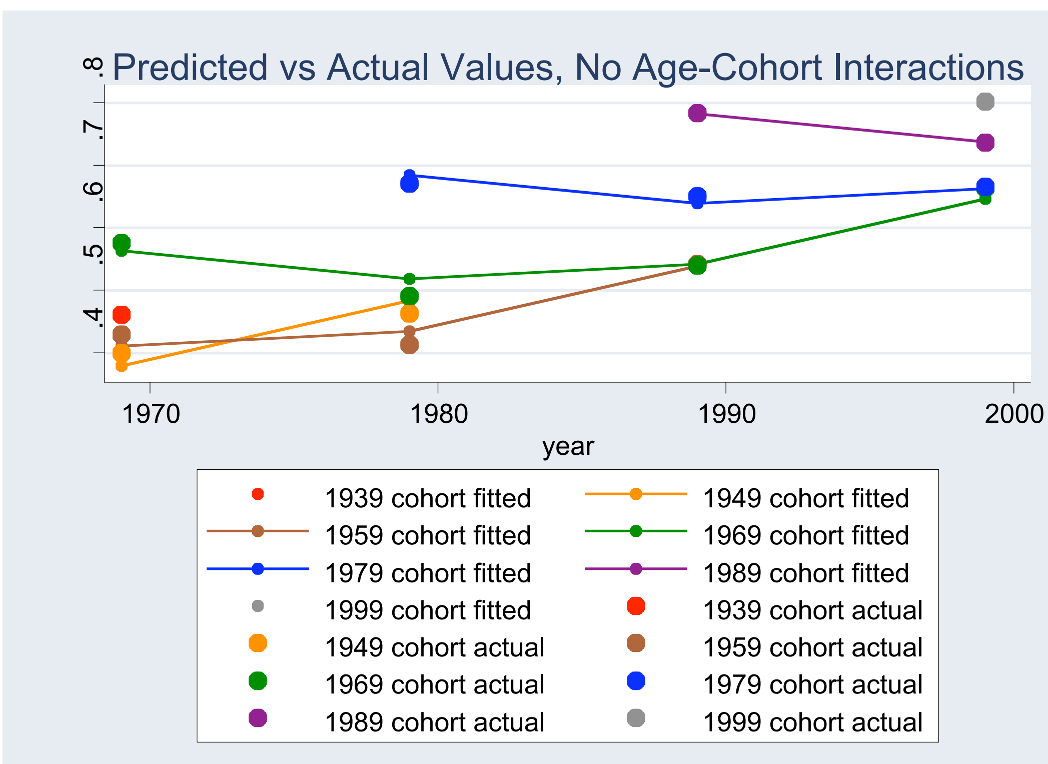

Figure 5:

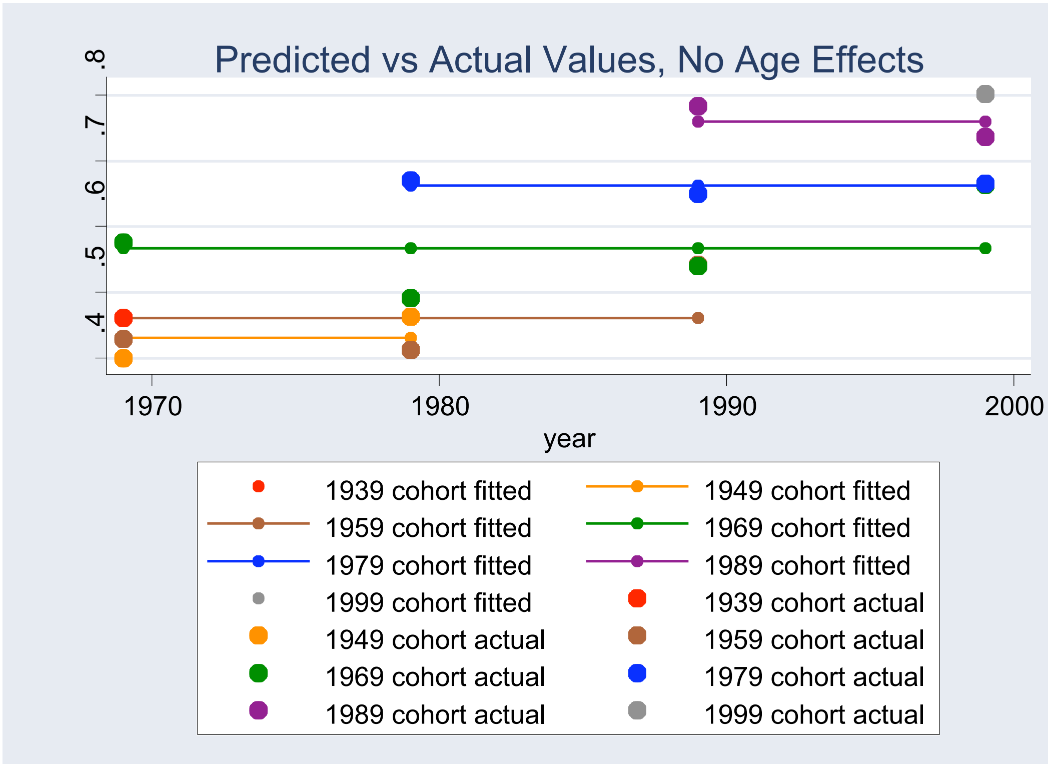

Figure 6: