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GENDER DIFFERENCES IN COMPLETED SCHOOLING

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ABSTRACT

This paper summarizes the dramatic changes in relative male-females educational attainment over the past three decades. Stock measures of education among the entire adult population show rising attainment levels for both men and women, with men enjoying an advantage in schooling levels throughout this interval. Cohort specific analysis reveals that these stock measures mask two interesting patterns: (a) gender difference at the cohort level had vanished by the early 1950 birth cohort and reversed sign ever since; (b) for several cohorts, attainment rates were flat for women and flat and falling for men. This last is puzzling in the face of the large college premia that these cohorts observed when making their schooling choices. We present a simple human capital model showing how the anticipated dispersion of future wages should affect educational investment and find that a model which includes measures of future earnings dispersion fits the data for relative schooling patterns quite well.

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1. Introduction

In the large and active economics literature on investment in education, a question which has been the subject of virtually no formal analysis is how levels of completed schooling have changed among adult American men and women in the past three decades.[1] This paper carefully documents changes in relative male-female schooling attainment, showing recent patterns which depart from historical trends in interesting, dramatic, and often puzzling ways. It then offers an explanation for the patterns which the schooling literature has heretofore ignored.

Throughout, the paper focuses on schooling attainment among the population of Americans whose schooling activity can reasonably be expected to have ended. As such, we concentrate on completed schooling among mature adults – those above age 25 – and eschew the use of enrollment rates in the late teens or early 20's as a measure of the schooling which people ultimately complete by the time that they are adults. After all, people enrolled in one year may drop out in the next, or people might delay the age at which they initially enroll.[2] Our view that completed schooling at age 25 is a good indicator of the schooling people will possess for the majority of their working life is buttressed the evidence that educational attainment at 30 or 40 years of age is nearly identical to education by age 25.

Using a *stock* measure of educational attainment –schooling among all adults aged 25 or older- we find that levels of completed schooling have risen consistently over the past thirty years for both men and women. And, in every year since the early 1960's, adult men have been more highly educated than adult women. But, these trends in the stock of education mask several interesting facts about education *flows*. For both men and women there was a noticeable

[1] Card and Lemieux (2000), who study the slowdown in college enrollment rates in the 1970's is an important exception. Their work neither focuses on gender differences, nor gives the same explanation for the findings we present here.

[2] Many other writers such as Kane (1994) and Card and Lemieux (2000) have used the enrollment rate to measure schooling attainment.

slowdown in schooling for cohorts born between 1950 and 1964. For men, there was actually an absolute reduction after the 1948 birth cohort. For successive generations of American men and women born since the early 1940's, educational attainment for men has been decreasing relative to that of women. Indeed, since the 1953 birth year cohort women have been consistently more educated than men, reversing the historical schooling attainment advantage enjoyed by men.

What accounts for these patterns? In standard human capital models (Becker (1967), Mincer (1974), Rosen and Willis (1979)), variations in education attainment arise mainly from changes in the opportunity costs of time, the direct costs of education such as tuition, discount rates, and the education premium – the degree to which earnings may be expected to rise as a result of greater schooling. Nearly all empirical work on the determinants of education outcomes has particularly emphasized the role of the education premium as a key explanatory variable. But this standard approach, with its focus on the education premium, cannot by itself account for the patterns in male and female education we document.

During the years that they were making decisions whether to attend college, recent generations of men and women observed high and rising education among people who were older than they and who had already completed their schooling.[3] These potential student would likely have thus expected to receive high returns to schooling themselves.[4] For both men and women, but especially for men, the prediction of the standard human capital investment model

[3] Many authors have documented recent increases in the education premium. See Juhn, Murphy, and Pierce (1993) for example.

[4] Among a group of mature adults at any point in time, the education premium could be high either because of supply and demand factors, or because the packet of skills possessed by educated mature people generates a high marginal revenue product in the market. Young people who use observations of the premium to estimate what premium they themselves might receive in the future cannot perfectly distinguish between these two effects, and so must suppose that a high premium indicates to some extent how the market values education now and, hopefully, in the future. The failure to increase their own education in the face of high premia is therefore a puzzle.

that the demand for schooling should rise with the expected level of the education premium is not, at first blush, borne out in the data.

We argue that the standard approach in most of the empirical literature, which relates the college premium to schooling outcomes, misses an important aspect of the investment decision – namely that it is choice between two *uncertain* investment options. The college premium that potential students expect to receive from college investment merely summarizes the difference in the expected payoff between the different educational options they could take. But risk averse students should also care about the inherent relative uncertainty or *riskiness* of these different options when choosing between them. We present a simple model of college investment in which both the premium and the anticipated dispersion of future wages affect schooling decisions. Our model suggests that a possible explanation for recent relative male-female education patterns could be the fact that anticipated future earnings inequality has evolved over time very differently for the two sexes.

To assess the model, we study relative male-female schooling within a cohort to purge our results of any contamination that might arise from unseen cohort-specific factors that affect educational attainment of all persons in a cohort. The main explanatory variables, as suggested by the theoretical discussion, are male-female differences in: the anticipated college premium, the anticipated dispersion of log earnings of people without college training, and the anticipated dispersion of log earnings those with college education. We construct proxies for these three sets of variables and find that the parsimonious, human capital investment model does a very good job of summarizing relative schooling patterns.

Section 2 describes schooling attainment among adult men and women since the early 1960's, showing first schooling trends among the entire population and then among successive generations of adults. Section 3 presents our model of education choice. Section 4 discusses how we implement a test of that model and presents the results of those tests. In Section 5 we briefly discuss alternative explanations for the observed schooling patterns, including the possible effects of shifting social norms and the possibility that increased enrollment by women in colleges and universities may have "crowded-out" men from places in universities. Section 6 concludes.

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2. Completed Schooling Among Adult Men and Women

We focus on completed schooling among the "mature adult" population of persons at least 25 years of age.[5] Our main source of information on schooling patterns are the 37 March Current Population Surveys (CPS) conducted between 1962 and 1998, but we supplement this individual-level data with information with institutional data at various points. Each of the C.P.S. surveys is a random sample of the American working-age population, consisting of approximately 50,000 observations. In each survey, information is elicited about a respondent's age and level of completed schooling.

Figure 1 depicts mean years of completed schooling among persons aged 25-65 between the years 1962 and 1998, using C.P.S. numbers. The figure reveals several interesting things. First, for both men and women, average education among mature adults is high, and has been high for many years. Today, average education among both men and women over age 25 is substantially above 12 years (the level of education synonymous with only a high-school education) and has been so ever since at least the late 1970's. Second, for both adult men and

[5] Using data from the The *National Center for Education Statistics*, we estimate that most people who complete undergraduate college training do so by 6 years after high school graduation. Thus, even allowing for the fact that some may follow non-traditional education trajectories, either stretching out the number of years over which they attend college, or starting their advanced schooling later in life, age 25 seems a reasonable entry age into the mature adult pool. We also use completed schooling by age 30, and the results are virtually identical in instances where they are comparable.

women, mean years of schooling have increased steadily since the early 1960's. For adult women, the year-to-year increase over the past 30 years has occurred at essentially a constant rate. Third, average education among adult men has exceeded that of women in each of the past 30 years, though the gap fell substantially between the mid-1970's and mid-1990's. The patterns in Figure 1 are also evident when we examine schooling attainment among adults 30-65, suggesting that, as we had hoped, little additional schooling occurs in the late 20's. The aggregate trends presented in Figure 1 do not tell us how educational attainment has evolved over the past several decades *for different generations* of men and women.

The mean level of education in any year, t, for adults of a given sex is the weighted average of the mean levels of education across the different birth year cohorts c who are between 25 and 65 in t, where the weights equal the ratio of the size of the birth year cohort, N_C, to the size of the adult population in year t, N_t. That is,

$$E_t = \frac{1}{N_t}\sum_c N_c E_{ct}$$

where E_t is the mean education in the adult population in year t, and E_{ct} is mean education of a particular birth year cohort, c. Education of the entire mature adult population is a "stock" measure. It changes over time either because of changes in the relative sizes of the cohorts comprising the adult population, or from changes in the education choices of successive cohorts, both two "flow" measures. Directly studying the cohort-specific education rates may reveal patterns that the stock measures do not capture. And, using a flow measure of schooling better reveals how levels of education attainment are likely to evolve in the future.

Figures 2 depicts mean years of completed schooling as of age 25 for men and women, by birth year cohort, for the cohorts born between 1936 and 1972. Like Figure 1, these data come from individual level C.P.S. data. The figure may be interpreted as depicting education flows into the mature adult population. The figure shows that education for women rose across successive cohorts, though there was a noticeable flattening after the 1950 birth cohort. For men, years of completed schooling rose with each successive cohort until about the 1948 birth-year cohort and then declined absolutely for each birth year cohort until the 1963 cohort, after which it has leveled off. The combined effect of these changes is that whereas men were once more educated than women of the same generation, this gender gap in completed schooling had vanished by the 1956 birth cohort and has reversed sign for cohorts born after 1960. The figure also reveals that education attainment for American men achieved a maximum with the 1948-49 birth year.[6]

Further evidence about the trends in cohort-specific educational attainment comes from reports of degrees granted by U.S. educational institutions. These data are drawn from the *Digest of Education Statistics*, and cover the years 1966 to 1998. The patterns for degrees awarded provide independent verification of the accuracy of the individual-level C.P.S numbers in Figure 2. Comparability between the two sets of numbers is complicated by the fact that we report education from the C.P.S. in cohort-specific *rates*, whereas institutions report total degrees awarded, by year. We thus divide the total degree awarded by institutions in a year by the size of the population "at risk". For Bachelor's and Associate's degrees, we define these populations to be persons aged 20-23, as estimated from the Natality Tables in *Vital Statistics of the United States*.[7] Changing the age ranges does not change the main features of these graph in any way.

[6] The convergence and ultimate cross-over in completed schooling among successive generations of men and women is also evident when we measure schooling attainment by distinct schooling levels, such as high school, college but not degree, and college degree or more. As with the years of schooling numbers, the cross-over and convergence is not evident in the stock measures of schooling among adults.

[7] The evidence for Masters' degrees awarded shows the gender convergence and cross-over. For Phd's there is dramatic convergence, though cross-over has not yet occurred. We do not present these figures to avoid clutter and because post-graduate education accounts for such a small share of educational attainment.

Figure 3 indicates that the pattern for Bachelors' (4 year) and Associates (2 year) degrees awarded to different generations of Americans, as reported by institutions, is very similar to the individual-level completed schooling numbers from the C.P.S. Degrees awarded show both the patterns of gender convergence and cross-over found in the individual-level data. For Bachelors' degrees, there is a downturn and then a flattening of male degree attainment after the early and mid-1970's, respectively. Among women, notice that while Bachelors' attainment rates grew over the entire time period depicted, there was a definite flattening and even a slight dip in the trend between 1970 and 1982. There is much the same pattern of convergence and cross-over for Associates degrees, suggesting that limiting attention to 4 year college degree attainment misses an important source of the gender convergence in completed schooling.[8]

What accounts for these relative educational attainment patterns? The data indicate that most of the variation in schooling comes from variation in college level attainment. In the next section we present a model of the demand for schooling (college education) by age 25 which builds on the standard human capital investment models. An implication of the model which has not been emphasized in previous work is emphasized.

3. A Model of Educational Attainment by Birth Cohort

3a. Uncertainty and the Schooling Decision

Consider a model in which people born in year c choose whether or not to attend college during the years $c+18$ to $c+24$, when they are between 18 and 24, and during what might be called their "advanced schooling years". Let e_{ic} be the education choice that person i makes

[8] Kane (1999) has documented the growing importance of this type of college training, but do not emphasize the gender difference.

during these years, with $e_{ic} = A$ indicating the choice to get no college training and $e_{ic} = B$ indicating that college training is chosen. Suppose there are no costs incurred with the decision $e_{ic} = A$, but let there be three types of costs associated with choosing to attend college. One of these is the direct costs of college training, T_c, paid by every person in a cohort who chooses to get a college education. The main direct cost is, of course, tuition and other fees. Next are opportunity costs of college education, O_c. The main opportunity cost are the earnings foregone during the years someone spends as a college student. We suppose, for simplicity, that they are constant for all people of a given sex within cohort. Finally, there are psychic costs of schooling, κ_i. These are the various frustrations and irritations associated with college-level learning.[9] Suppose that these costs are distributed among men and women in any cohort according to the cumulative density $F(\kappa)$ and marginal density $f(\kappa)$.

During their "mature working years" between ages 25 and 65, and conditional on the education choice made during their mature schooling years, individuals receive labor income in each time period given by $y_t^{e_i}$. Out of these streams of income, adult consumption C_t is financed, and people choose consumption in every period so as to maximize lifetime utility. Suppose that per-period utility, U, is

$$U = aC_t - b\frac{C_t^2}{2} \tag{1}$$

[9] There are obviously psychic benefits to be derived from attending college as well. Whether one calls the various non-pecuniary gains from college attainment benefits or costs as we do here is immaterial. The essential point is that the valuation for the non-monetary factors vary across different individuals in a population.

where $a > 0$, $b > 0$, $c > 0$ and $C_t < \frac{a}{b}$. Notice that this utility function is strictly concave in consumption. There is a discount factor of β and individuals can save income at rate of R. Let $R\beta = 1$.

In every period t of mature adulthood and given a level of schooling, consumption C_t is chosen to solve:

$$\begin{aligned} \max\ E_t(V_t) &= E_t \sum_{j=0}^{\infty} \beta^j U\left(C_{t+j}\right) \\ s.t\ \sum_{j=0}^{j=\infty} R^{-j} C_{t+j} &= \sum_{j=0}^{j=\infty} R^{-j} y_{t+j}^{e_i} \end{aligned} \tag{2}$$

The optimal solution to a life-cycle problem such as (2) requires that the expected marginal utility be equated across time. That is,

$$U'(C_t) = \beta R E_t U'\left(C_{t+j}\right), \qquad \forall j \tag{3}$$

Given the utility function we have assumed, and the fact that $R\beta = 1$, (3) implies that

$$C_t = E_t C_{t+j}. \tag{4}$$

Taking a 2nd order Taylor expansion, and using (4), lifetime expected utility can be re-written:

$$\begin{aligned} E_t V &= \sum_{j=0}^{j=\infty} \beta^j E_t U\left(C_{t+j}\right) \\ &= E_t \left\{ \sum_{j=0}^{j=\infty} \beta^j \left(U(C_t) + U'(C_t)\left(C_{t+j} - E_t C_{t+j}\right) + U''(C_t)\left(C_{t+j} - E_t C_{t+j}\right)^2 \right) \right\} \\ &= \frac{1}{1-\beta}\left(U(C_t) + U''(C_t) Var_t\left(C_{t+j}\right) \right) \end{aligned} \tag{5}$$

Again using (4), the budget constraint in problem (2) may be re-written

$$C_t = \frac{1}{1-R} E_t \sum_{i=0}^{i=\infty} R^{-i} y_{t+i}^{e_i} = \mu_{e_i}. \tag{6}$$

Consumption in any period depends on the full history of earnings, both in the past and those yet to be realized. As of any period, the expected variance of future consumption equals the sum of the expected variance of all future earnings streams as of that period, plus any expected co-variance terms between these future income streams. Throughout, we ignore these covariances yielding expected future variance of

$$Var_t\left(C_{t+i}\right)=\sum_{i=0}^{\infty}Var_t\left(y_{t+i}^{s}\right)=V_c^{e_i}. \tag{7}$$

Given the concave utility function we have assumed, and ignoring the discount factor, expected lifetime utility from any particular schooling choice, for an individual from a particular birth cohort c is

$$a\mu_c^{e_{ic}}-\frac{b}{2}\left(\mu_c^{e_{ic}}\right)^2-bV_c^{e_i}. \tag{8}$$

Thus, as would be true for *any* concave utility function, and not just the tractable one we have assumed, lifetime expected utility from a particular schooling choice is strictly increasing in the *average* of future lifetime earnings that this level of education is expected to bring; and is strictly decreasing in the expected cross-section variance of future lifetime earnings.

The expected net lifetime utility return which an individual from cohort c expects to receive from getting college training (B) or not getting one (A)

$$a\left(\mu_c^B-\mu_c^A\right)-\frac{b}{2}\left(\left(\mu_c^B\right)^2-\left(\mu_c^A\right)^2\right)-b\left(V_c^B-V_c^A\right)-\left(O_c+T_c+\kappa_{ic}^{*}\right) \tag{9}$$

Momentarily ignoring the various costs of college, an individual's expected return from getting college training depends on what the literature refers to as the (anticipated) college premium – the expected difference in *average* discounted future earnings from the future "college" and "no college" earnings distributions. But the expected return from college training also depends on the difference in the anticipated future variances of the "college" and "no college" distributions - σ_{ac}^2 and σ_{Bc}^2.

If a person does not get college training during his schooling years, he makes an investment decision with an uncertain future payoff: his lifetime earnings as a mature adult will be a draw from a future distribution of "no college" earnings. Alternatively, he can pay a fee (the various costs of college training) and go to college. This is an alternative investment decision with its own uncertain payoffs. Expected utility theory tells us that the agent's willingness to pay this fee should depend on the relative average payoffs of the two investment options and the expected relative *riskiness* of the two options, as measured by the dispersion of his likely future outcomes around the average.

From (9) that, it follows that in any cohort and for both men and women, the marginal college attendant is that person whose psychic costs of schooling are given implicitly by

$$0 \equiv a\left(\mu_c^B - \mu_c^A\right) - \frac{b}{2}\left(\left(\mu_c^B\right)^2 - \left(\mu_c^A\right)^2\right) - b\left(V_c^B - V_c^A\right) - \left(O_c + T_c + \kappa_{ic}^*\right) \tag{10}$$

and the fraction of individuals from the cohort who choose to obtain college level education is

$$E_c = F\left(\kappa_{ic}{}^*\right). \tag{11}$$

The proportion of people in a cohort who obtain college level training is increasing in κ_{ic}^*, since

$\delta F(\kappa) \big/ \delta(\kappa) = f(\kappa) > 0$, where f is the marginal density defined above.

We know that κ_{ic}^* may be written as the implicit function

$$\kappa_{ic}^* = \kappa_{ic}^*\left(P_c, V_c^A, V_c^B, O_c, T_c\right). \tag{12}$$

where $P_c = \mu_c^B - \mu_c^A$ is the anticipated college premium. Applying the implicit function theorem, the share of people in a cohort who get college level training is falling in the direct and opportunity cost of such training. But the partial derivatives of greatest interest in this paper are

$$\frac{\partial \kappa_{ic}^*}{\partial P_c} > 0; \frac{\partial \kappa_{ic}^*}{\partial V_c^A} > 0; \text{and } \frac{\partial \kappa_{ic}^*}{\partial V_c^B} < 0. \tag{13}$$

From the first derivative in (13), the college attainment rate rises among any sub-population in a cohort the larger the college premium the members of that sub-population expect to receive as mature adults. This is the familiar result from the standard literature. Less familiar is the second result in (13), which says that more people choose college in a cohort the more variable the earnings of "no college" mature adults are expected to be. As the riskiness or uncertainty of the "no college" investment option increases, risk averse agents should be ever more willing to choose to attend college instead. By similar logic, the third partial derivative says that college attendance rates should fall as the variance of the earnings that college-educated mature adults are expected receive in the future goes up.

The basic intuition of the model is summarized in Graph 1. B and B' are two alternative distributions from which future "college" log weekly earnings can be drawn, and A and A' represent two possible future "no college" weekly earnings distributions. The college premium is the difference at the means between the "college" and "no college" distributions. Under the naïve approach in which the anticipated premium is the only labor market factor determining whether people will choose to go to college, an agent would be indifferent between any pair of "college" and "no college" investment options presented in the Graph. But if an individual with a concave utility function can undertake either option A, or can pay a fee to take investment option B or B', he will be more willing to pay the fee if the option is B. Similarly if someone is observed to have paid a fee to take option B, he is more likely have forgone the education choice A' than A.

Though the potential role of anticipated earnings uncertainty of the form discussed here has not been emphasized in the previous literature, the fact that workers make human capital education decisions under less than perfect certainty about what might prevail in the future has been discussed in particular papers. Altonji (1993) notes that nearly all education models in the literature ignore the fact that students embarking upon a particular course of study are uncertain about whether they will complete the schooling. His model of schooling as a sequential process, explicitly accounts for this important dimension of uncertainty. Gould, Moav, Weinberg (2001) investigate uncertainty of a different form. They argue that advanced schooling may render future earnings less susceptible to random technology shocks, and thus to greater future variance. A precautionary demand for schooling is generated as a result. The model in this paper adds to this literature by showing how forms of uncertainty related to but distinct from those identified in these papers can affect education choices.

3B Expectations of Future Earnings

The model outlined above emphasizes potential students' costs and their *expectations* about both the future education premium and riskiness of their future earnings under alternative education choices. Despite the central role of expectations in all human capital model, empirical work almost never directly controls for subjective expectations about features of future earnings. This is likely because expectations information is rarely available; because of economists' traditional unwillingness to rely on subjective reports; and , and because very little is known about precisely how expectations are formed. By far the most common approach in the literature, whether in papers which explicitly assume a rational expectations process (Siow (1984), Zarkin (1983), and

Zarkin (1985)), or in the far larger number of papers which make no explicit assumption at all about the expectations process, has been to proxy for expectations about *future* wages with information about *current* wages.

Is there any reason to suppose that this convention is sensible? That is, is there any evidence that potential students' have expectations about aspects of their future earnings under different education choices? Are these expectations in any way related to the wages which prevail when these students are making their human capital decisions? Neither question has received much attention, but the results from two papers are particularly noteworthy.[10]

Dominitz and Manski (1996) elicit information from about 100 Wisconsin high school students about students' expectations of *their own* future earnings, under different assumptions about years of schoolings completed. Dominitz and Manski's questions about students' subjective probabilities of reveal that students clearly believe that their earnings will be drawn from a *distribution*– precisely the point emphasized in the model above. The results indicate that nearly all students anticipate a positive, individual return to college education, judging from the medians of their subjective probability reports. The students also appeared to feel students appear to feel that their future earnings were they to have only a high school education would not only be lower on average, but would be less uncertain (that is, has smaller subjective variance) that if they got a college degree. Interestingly, this greater anticipated uncertainty of future "college" earnings relative to future "high school" earnings corresponded to the greater earnings variance of college educated adult workers at the time the students were reporting their subjective expectations.

[10] There is little work on this subject partly because of the paucity of useful, direct information about expectations. In the few cases in which explicit earnings information is available, Juster (1966) and Manski (1990) among others have noted that various data limitations prevent credible tests of alternative models of expectations formation.

Betts (1996) conducts a survey 1200 University of California undergraduates in which students are asked information about average (but not the distribution) of earnings among young workers at the time of the survey. Actual current were derived from the C.P.S., in addition to other data sources. Betts shows that, on average, students knowledge of current earnings estimated from the C.P.S. were quite good. Moreover, Betts reports that by far the most common information source students claim to have used was information from newspapers and magazines, and not information from teachers, or family members. To the extent that these sources are likely to accurately represent facts about the current distribution of earnings, it seems reasonable to suppose, as most of the previous literature does, that a good proxy for expectations about features of the distribution of future earnings is the distribution of the earnings people observe during the time that they are making the decision.

Taken as a whole, these results indicate that though the observed distribution of earnings at the time of decision-making do not perfectly proxy for potential students' expectations about future earnings, the distribution is economically meaningful in the sense that students beliefs about the future can in fact be represented by a subjective probability distribution of future earnings, and that that expected distribution correlate roughly with what is widely true at the time of decision-making.

To operationalize this notion in this paper, we suppose that an individual's earnings in any future period depends both on the market weekly wage commanded in the future by that individual, and on the number of weeks he or she will wish to work in the future. Desired weeks of work at any future point will depend on the future realization of a number of variables (marital status, own and family health, presence or number of children, and others) which the information possessed by someone in their late teens or early 20's will be of little use at predicting. Our first simplifying assumption is thus that *all* persons born in cohort c conjecture that their weeks of desired work in every period of their mature adulthood will equal some constant – say 42. Thus, if $y^{e_i}_{i,c,j}$ is what an individual born in cohort c received in labor income during the year j of his mature adulthood (with $j=1$ corresponding to age 25, $j=2$ to age 26 and so forth), then his expectation as of any time t before mature adulthood about future earnings is

$$E_t\left(y^{e_i}_{i,c,j}\right) = 42\, E_t\left(w^{e_i}_{i,c,j}\right) \tag{14}$$

where $w^{e_i}_{i,c,j}$ is the weekly wage paid to people from cohort c with education e_i during year j of their mature adulthood. We assume that weekly wages evolve in a particularly simple fashion through time – specifically, that

$$w^{e_i}_{i,c,j} = \frac{1}{7}\sum_{k=1}^{7} \overline{w}^{e_{i'}}_{i',c-j-k,j} + \delta j + \varepsilon_{i,c,j}. \tag{15}$$

The expression $\overline{w}^{e_{i'}}_{i',c-j-k,j}$ is the average weekly wage earned by persons with education e_i, who are born in year $c-j-k$ during the year j of their mature adulthood. The term δ is an annual growth rate, and $\varepsilon_{i,c,25+j}$ is a mean-zero error, with variance equal to

$$\frac{1}{7}\sum_{k=1}^{5} Var\left(w^{e_i}_{i,c-j-k,j}\right) \tag{16}$$

Given the various assumptions, we proxy for the expectations about the future premium and uncertainty of the distributions ($P_c, \sigma^2_{ac},$ and σ^2_{Bc} in the model) using

$$\begin{cases} \tilde{P}_c = \frac{1}{7}\sum\limits_{j=1}^{j=40} \sum\limits_{k=1}^{k=7}\left(\overline{w}^{B}_{i,c-j-k,j} - \overline{w}^{A}_{i,c-j-k,j}\right) \\ \tilde{V}^{A}_c = \frac{1}{7}\sum\limits_{k=1}^{7} Var\left(w^{A}_{i,c-j-k,j}\right) \\ \tilde{V}^{B}_c = \frac{1}{7}\sum\limits_{k=1}^{7} Var\left(w^{B}_{i,c-j-k,j}\right) \end{cases} \tag{17}$$

Thus, we measure the mean of expected future lifetime college earnings premium for people born in a given cohort as the average, age specific, weekly wage premium that cohort observes among persons aged 25 to 64 during the time that the cohort is between 18 and 24. Of course, young people expect to earn weekly wages at age 55 which are much larger than what they observe people who are currently 55 years old earning, but the assumption of a constant rate of growth of weekly wages δ across different types of education allows us to focus on the earnings gap observed currently.[11] Moreover, because of discounting, the earnings that potential students aged 20 expect to receive many years in the future would be significantly discounted, further rendering innocuous the assumption of a constant growth rate of earnings for different education types over time. We measure a cohort's expectation of the variance of the future earnings distribution in similar fashion: as the variance of the average hourly wages observed among people aged 25 to 65 during the years that the decision-maker is between 20 and 24.

3c. Trends in Factors Likely to Affect Relative Schooling Choice

The model emphasizes the role of various costs of human capital investment and expectation of the premium and the variances of future earnings distributions. We illustrate trends in all of these factors in this section.

The anticipated average log weekly earnings premia for men and women born from 1945 on are depicted in Figure 4. These premia are calculated from C.P.S. data and are the difference in mean log weekly wages between people with at least 2 years of college training and people

[11] One other option would be to use an exogenous projection of earnings growth, as from the Bureau of Labor Statistics, for example. However, the B.L.S. projections about earnings growth do not extend more than that 10 years into the future. Perhaps because of the difficulty associated with coming up with an estimate of wages multiple decades into the future, most previous work on college choice focuses on "starting" wages or earnings – the education premium people might expect a few years into their 20's. Our approach subsumes this standard approach, and also includes information (albeit imperfect, for the reasons discussed) about what earnings might be many years into mature adulthood.

with no college training aged 25-65 over the years $c+18$ to $c+24$.[12] For men, the anticipated log weekly earnings premium declined slightly between the 1945 and 1954 birth cohorts. It was flat for the next three cohorts and then rose dramatically by 50% between the 1956 and 1969 birth cohorts. Yet, it was for this last set of men for whom college attainment rates were flat. For women, the anticipated log weekly earnings premium is higher than that of men throughout, but shows the same temporal pattern. These trends suggest that the human capital prediction most emphasized in the literature – that college education rises with the college premium – does not appear to be a likely explanation for the educational patterns of men documented above. By contrast, the patterns are consistent with the educational choices of women.[13]

Figures 5a and 5b depict estimates of the opportunity and direct costs of advanced schooling faced by men and women born since 1945. Figure 5a depicts the labor market earnings that people in these cohorts would have foregone by obtaining advanced schooling: the mean log weekly wage of men or women ages 18-24 with only a high school education or less during the years $c+18$ to $c+24$. The figure show that for both men and women, the opportunity cost of obtaining advanced training has been trending steadily downwards since about the 1954 birth cohort. Again, while these numbers are consistent with the educational attainment of women, they are not consistent with what has been happening to male schooling. Figure 5b shows that real tuition costs rose in an almost linear fashion across cohorts.[14] Presumably, the

[12] We also measure the anticipated premium using the difference in log weekly earnings between people with 4 years of college and people with no college training. The patters are virtually identical to those in the Figure, but the premium not shown is obviously slightly larger.

[13] While there is likely some regional variation in the college premium, the mobility of educated workers suggests that they belong to a national labor market, lowering concern about the use of the national C.P.S. numbers.

[14] Tuition costs measure the weighted average of tuition payments at the 4 types of colleges and universities, where the weights equal the institutions share of total undergraduate enrollment during t he years $c+18$ to $c+24$ for birth cohort c. The tuition numbers are drawn from the *Digest of Education Statistics* 1997, Table 312: Average undergraduate tuition and fees paid by students in institutions of higher education, by type and control of institution.

changes in direct costs should have had similarly signed marginal effects on the education of men and women, so changes in tuition by themselves seem unlikely to explain rising education for one sex and falling education for the other.

Figures 6a and 6b depict, for different generations of men and women, the uncertainty associated with the future earnings to be derived from different types of advanced schooling choices. These figures present different measures of dispersion of adult (25-64) earnings which different generations of men and women would have observed while making their advanced schooling choices. Three measures are shown: the difference between the 90^{th} and 10^{th} percentile; the difference between the 80^{th} and 20^{th} percentile; and the standard deviation of the respective log (weekly wage) distributions. Figure 6a shows that uncertainty about future earnings for both education choices rose for men between the 1945 and 1972 birth cohorts, according to all three measure of dispersion. The graph also shows that the anticipated uncertainty associated with the "no college" option rose much more dramatically than did the uncertainty of the "college" option. According to the 80^{th}-20^{th} measure, for example, anticipated future dispersion of log weekly "college" wages rose by 24% (from 0.75 to 0.93), while the comparable increase for the "no college" dispersion was 48% (from 0.63 to 0.93). Indeed, a difference in anticipated dispersion of 0.11 between the two distributions for the 1945 birth cohort had virtually disappeared by the 1972 cohort.

Figure 6b presents a very different picture of anticipated future wage uncertainty among women. All three measures show a *decrease* in the dispersion of the "college" distribution across the cohorts studied. For the "no college" distribution, there was first a reduction in anticipated dispersion between the 1945 and 1957 birth cohorts, and then a either a flat or slightly increasing pattern afterwards, depending on the measure. According to the 80^{th}-20^{th} measure, the effect of these changes is that the anticipated future dispersion in the "no college" and "college" distributions essentially overlap until the 1957 birth cohort, after which the "no college" distribution is more dispersed than the "college" distribution. The other two measures do not show this crossing over, but both indicate a sharp reduction in the difference in dispersion after the 1957 cohort.

These very different trends in uncertainty about future earnings offers the prospect that the education trends described earlier for men and women might be explained by the simple human capital demand model described above, in which this uncertainty is explicitly accounted for. We more formally assess this idea below.

4. Effect of Earnings Uncertainty on Schooling Choices

4a. Empirical Set-up

We suppose that college attainment, E_{sc}, among persons of type s in birth year c, where $s = m$ for men and $s = f$ for women, may be written

$$E_{sc} = \beta_1 \tilde{P}_{sc} + \beta_2 \tilde{V}_{sc}^{B} + \beta_3 \tilde{V}_{sc}^{A} + \beta_4 X_c + v_c + \varepsilon_{jc}. \tag{18}$$

In (18), $\tilde{P}_{sc}$ is our measure of the anticipated average college premium for persons of type s. $\tilde{V}_{sc}^{B}$ and $\tilde{V}_{sc}^{a}$ are the measures of the uncertainty (anticipated dispersion) of log wages for people with and without advanced education, among persons of type s, which have typically been excluded from college attainment regressions such as (18) in the existing literature.

The vector X_c are various observable factors which vary across cohorts but not among different types of persons within a cohort. It includes variables such as the size of a birth cohort,[15] and the average tuition charged by colleges during the year that a cohort is enrolled in

[15] Apart from the crowd-out idea discussed earlier, some writers such as Connelly (1986) have argued that that members of idiosyncratically large cohorts anticipate that their wage premium from advanced schooling

college. The variable v_c summarizes unobserved factors which vary across cohorts, and which are the same for the two sexes. For example, across different birth cohorts, changes in public sentiment about the desirability of college training, in the extent of advertising by colleges and universities, or in the availability of particular types of aid could be expected to similarly affect all persons in a cohort similarly. Finally, ε_{jc} represents random, mean-zero factors which affect schooling outcomes.

We are mainly interested in the coefficients β_1 to β_3 but, for a variety of reasons, estimating equations (18) by O.L.S. is unlikely to produce unbiased estimates of them using cohort-specific data. First, there is the problem that the various observable regressors all have a time component. The large resulting multi-collinearity problem in estimating (18) when all of the variation is across cohorts (that is, time series) makes it quite difficult to separately disentangle each of these variables' separate effects. Second, there might be correlation between the measures summarizing future wage returns and the unobserved factors v_c which vary systematically across cohorts.

Our estimation strategy exploits the fact that *within* a cohort, the *relative* levels of schooling attainment between men and women is

$$E_{mc} - E_{fc} = \beta_1\left(\tilde{P}_{mc} - \tilde{P}_{fc}\right) + \beta_2\left(\tilde{V}^B_{mc} - \tilde{V}^B_{fc}\right) + \beta_3\left(\tilde{V}^A_{gc} - \tilde{V}^A_{gc}\right) + \left(\varepsilon_{mc} - \varepsilon_{fc}\right). \qquad (19)$$

In equation (19), cohort-specific factors which affect both male and female schooling attainment, whether observed or not, are differenced out, and the three remaining regressors in this difference model are orthogonal to the error by construction.

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will be depressed when many members of the cohort enter the workforce. Fewer members of such cohorts decide to get advanced training as a result. There is only weak support for this idea in the data.

One final note about the regressions (18) and (19) is why they are performed using aggregate level data rather than the individual level data from the C.P.S. out of which the aggregate measures are constructed. The answer is that, for the variables of interest, all of the variation occurs at the level of the cohort. Estimating (18) and (19) as individual regressions therefore effectively adds no degrees of freedom. Individual level regressions would of course yield more precise estimates if performed on a dataset with individual level information on determinants of schooling choice. The problem is that there is no continuous micro data set with this type of information for the cohorts of men and women studied here. For this reason, researchers (such as Card and Lemieux (2000)) interested in education over the time period and over the cohorts studied here have used the C.P.S. data as we do here.

4b. Formal Assessment of Role of Earnings Uncertainty

This section presents results of regressions which relate relative male-female cohort-specific education outcomes to male-female differences in the *anticipated future* average wage premium, and different measures of anticipated future dispersion of "college" and "no college" earnings. We emphasize that the regressions relate relative schooling outcomes for a cohort before the time they are age 25 to the premium and dispersion that cohort would have observed among people aged 25-65 when the cohort was between 18 and 24.

In all of the regressions the "college" distribution maps the log weekly wages of people with at least 2 years of college education, and the "no college" distribution maps log weekly earnings of people with no college education. We try alternative definitions of these two distributions, such as the log earnings of people with 4 or more years schooling. The results are basically the same under these alternative definitions. We present results for gender differences in three measures of schooling attainment - the number of years of completed schooling; the fraction of people who have completed at least 1 year of college by age 25; and the fraction who have completing at least 4 years of schooling by age 25. We present results for two dispersion measures – the 80^{th}-20^{th} percentile difference in the log weekly earnings distribution; and the standard distribution of the distribution. Results for the 90^{th}-10^{th}; and the 70^{th}-30^{th} percentile differences are very similar to what we present here.

The relative schooling attainment are, of course, our preferred estimates. We present first various estimates of (18) – the regressions which are run separately by sex using the cohort-level data. We present the results from estimating (18), using a binary variable which measures whether fraction of the cohort with any college training. We estimated but do not present regressions (18) for the two other educational outcomes, and with different measures of the anticipated future dispersion of the log weekly earnings distribution. Those results are qualitatively the same as what we present here.

The first column of Table 1 reports the results of a regression with, apart from a constant term, only three controls: a trend term, the log of the size of birth cohort, and the opportunity cost of attending college. The results indicate that, net of trend, cohort size has a modest negative effect on educational attainment for both men and women. Oddly, the opportunity cost of higher education has a positive effect on attainment for both sexes. When controls for tuition are added in the second column, it is estimated to have a positive effect on attainment, and the perverse positive sign on forgone earnings remains. The negative effect of cohort size falls in absolute value for both men and women and no longer statistically significant. Columns 3 add the anticipated premium. For both men and women, this is shown to have a positive effect, but the strange signs for both the tuition and foregone earnings persist. Finally, in the fourth set of numbers we add the anticipated dispersion measures. Cohort size is negative but insignificant. Tuition now has the right sign, but this good news is more than offset by the fact that the other estimated effects are, from the perspective of a standard human capital model, nonsensical. In particular, notice that the anticipated premium for women is estimated to have a negative effect on attainment, though the effect is not significant. These results indicate forcefully the limitations of the separate regressions for men and women described above.

Table 3 presents the results of the relative schooling attainment regressions, (19), which are our preferred estimates for reasons discussed. Panel A in the table presents results for years of completed schooling. Each regression reported in the table also contains a measure for the gender difference in the opportunity wage – the only other regressor from Table 2 which varies across sexes in a cohort. In no specification is this variable statistically significant. The first column presents the results when the gender difference in the anticipated college premium is the only other regressor. The estimated coefficient is of the wrong sign according to basic human capital theory. But our model suggests that this measure which has been used exclusively in the literature as a measure of the expected labor market return from more schooling is an incomplete measure of the dispersion of the distributions from which future earnings will be drawn.

When we add the anticipated dispersion measures, both their effect and that of the premium are estimated with the right sign. Moreover, the positive estimate of the premium is strongly statistically significant. The results indicate that men's total years of schooling by age 25 relative to women's is smaller, the greater the relative riskiness of the "college" option for men as opposed to women. This effect is strongly statistically significant, and is very consistent with the model outlined above. And the results indicate that the riskier the "no college" option is expected to be for men as opposed to women, the higher will be men's years of completed schooling relative to women. Unfortunately, this estimate is not statistically significant.

The other education outcomes in panels B and C of the table show essentially the same results as Panel A. The college premium's effect is positive and statistically significant; the anticipated future dispersion of the “college” distribution has a negative and statistically significant effect on schooling outcomes; and the anticipated future dispersion of the “no college” distribution has a positive estimated effect on schooling outcomes, though the effect is always statistically insignificant.

As shown, these results are robust to the choice of relative education measure. We try two other robustness checks, only one of which changes the results in any appreciable way. First, rather than use the observed variances described in the previous section, we estimate instead the residual variance in “no college” and “college” earnings. These observed residual dispersion measures are computed according to expression (17), except that they are computed not from the weekly earnings, but rather from the residuals of weekly earnings after race, potential experience and region are controlled for. Using these measures of anticipated future dispersion leaves all of the results in Table 2 essentially unchanged.

Next, we consider that the use of the log of weekly earnings in all of the empirical work to this point in the paper does not capture the fact that, for the cohorts we study the anticipated labor force participation of women likely changed dramatically over cohorts. Table 3 presents labor force participation rates for men and women born from different birth cohorts. These data are computed from multiple years data of from the C.P.S. The table shows that whereas these rates have always hovered for men around ninety-percent for men of all education levels, the have risen dramatically for women in recent birth cohorts. By the reasoning employed earlier, these changes would have led women in 1944-1972 birth cohorts to anticipate that it would be more likely that they would work as mature adults. Because we use the log of weekly earnings in the regressions, even the preferred estimates in Table 2 might be assigning importance to the anticipated dispersion measures which truly attributable to this labor supply effect.

To assess the possible importance of this effect, we compute an expected labor force participation measure for each sex using the same methodology given by (17), and then divide the two to get a relative measure. When this relative measure is added to the models in the last column of Table 2, we find that the effect of the relative anticipated dispersion measures is not affected in any of the models. On the other hand, the estimated effect of the anticipated premium falls by about one third in each of the models. However, it remains of the correct sign and is statistically significant in all of the models.

One interesting note about the dispersion measures is that in most specifications, the estimated effect of the anticipated variance of high school earnings is either only marginally significant, or not significantly different from zero, whereas the anticipated college variance has a very significant effect. One reason this might be is that potential students' may have relatively good information about where in the distribution of "no college" earnings they would fall as mature adults. Between the ages of 18 and 24, young people who work (in the summers for example) do so as young "no college" workers, and will obtain information about their suitability for work in this segment of the market. This means that students may effectively perceive their options as choosing between a certain "no college" earnings outcome, and a draw from a distribution if they got advanced educations. Only the observed variance of the college earnings would affect education choices in that case.

To show the quality of the fit from our very parsimonious human capital investment model, with education modeled as a choice among human capital investment options, we conclude with Figures 7 which shows the actual values of the three educational outcomes, and predicted values of these variables from the regressions reported in Table 2. These figures indicate that the model fit the data very well. Empirical investigation of the human capital model which do not account for the riskiness of earnings from the different investment options the choosing agent undertakes may sometimes produce curious estimates of the effect of the average expected return, or premium, on the propensity to invest.[16]

5. Alternative Explanations

While the human capital account presented in the paper does a good job both theoretically and empirically of explaining observed patters of relative attainment, there are other potential explanations which the paper does not directly study which may also be important driving factors. We briefly discuss two of the these alternative here.

Perhaps the main alternative explanation about which the paper is silent is the possible role of broader changes in society. Women (and men to a smaller degree) in the generations discussed in this paper were subject to more sweeping societal changes than almost any generations of American women in history. They experienced the Women's Rights Movement, saw the introduction of the Birth Control Pill, and faced changing patterns of fertility of marriage and family formation. These all likely changed women's education choices in at least two important ways. Some of these changes may have affected standard human capital calculations. For example, Goldin and Katz (2000) argue that find that the introduction of oral contraceptives allowed women to more carefully time the start of their fertility, which in turn affected both their willingness and ability to obtain very advanced educations and their marriage patterns. Notice, that by this argument the Birth Control Pill may have reduced women's anticipated future earnings uncertainty, albeit via a mechanism distinct from anything we discuss above.

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[16] See, for example, Averett and Burton (1996), for another investigation of schooling demand in which the premium has either no effect, or the opposite of that suggested by the theory.

The second likely effect of these social changes is an effect attributable to changes in social norms. It is unarguable that there has been a dramatic change over the past thirty years in what is considered socially *appropriate* for women to do. Such a shift in social norms would have affected not only how women felt about acquiring educations, but also how their families and support networks felt. Importantly, potential spouses may well have been affected by these changing social norms, rendering it possible that women in recent generations acquiring higher educations would not be effectively taking themselves out of the marriage market. These arguments are all speculative, and research is needed on these questions before definitive statements can be made. However, if there is any truth to any of them, relative schooling of women would have risen for reasons distinct from the human capital arguments we have emphasized.

Another possible explanation for changes in relative education about which additional research would be useful is the notion that women may have crowded men out of college. That this is a possible effect is strongly hinted at by the negative cohort size effects in the previous section. It is well known that college university campuses have become increasingly female over the past 30 years. Figure 8a shows that total undergraduate enrollments of women have risen consistently since the mid-1960's. For men, by contrast, enrollments rose only until about 1974 and have remained flat ever since. A majority of students on college campuses have been women since 1980.[17] But does this imply that crowdout has caused these shifting patterns?

If colleges offer spaces along a rising supply function, then increases in the size of the college applicant pool, such as those which have occurred since the late 1960s lowers the probability of admission for *each person* in the pool either by because of increased tuition or because of increased admission standards. Only for colleges where spaces are offered are

[17] The data indicate that a majority of students at *every type* of undergraduate college are now female.

offered relatively elastically would this not be true. Can this fact be used to provide any suggestive evidence about crowdout possible effects?

In the U.S, it seems likely that the colleges which could most easily expand their capacity to serve larger applicant pools would be public institutions for two reasons. First, apart from some very well known exceptions, the most selective colleges and universities tend to be private institutions.[18] Second, public institutions, precisely because they are public, would probably be much more responsive to public demand for greater educational access than would their private counterparts. Thus, we expect 4-year private schools to be places where crowding would most affect attendance; 4-year public schools should be the ones next most likely to be affected; and 2-year public schools the least affected.[19]

Figures 8b and 8c show how the total enrollment of college students of a given sex is distributed across different types of universities. The figures indicates that prior to 1977, when both total male and total female enrollment were increasing, the odds of a college student of either sex being enrolled in 4 year public schools, and in 4 year private schools, was falling. Since these schools, particularly the four year private schools, were the ones where the supply of spaces was least elastic, this is precisely what one would expect if there was crowding out. This is *prima facie* evidence of a possible crowding-out effect. [20] Interestingly, the figure also shows

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[18] Among universities denoted as "highly selective" in the 1999 *Peterson's College Guide*, more than 65% were private universities. This does not mean that 4-year private universities serve 65% of "highly able" students, as their enrollment levels tend to be smaller than those of their "highly selective" public counterparts.

[19] We ignore two year private schools because they account for a miniscule share of total enrollments.

[20] This is the effect that Card and Lemiux (2000) have in mind when they argue that large cohort sizes may have accounted for the flattening in college enrollments in the 1970s among men and women. Crowd-out could also come about because of various direct cost pressures. For a large fraction of college students, the direct costs of college are defrayed by local, state or federal government aid. An increase in the number of students of a particular type (say women) wishing to obtain higher educations, could lower the fraction of students of another type able to receive aid. This type of crowd-out is the focus on Hoxby's (1998) work assessing whether immigrants crowded low income natives out of spaces in California universities and colleges.

that the period after the mid-1970, when increases in total enrollment came exclusively from women, there was no similar reduction in the odds of attending the most selective schools for either men or women. Thus, any effect of crowdout is more subtle than can be assessed with this indirect evidence. More research on this question, perhaps with explicit information about admission standards used by universities is needed before the definitive effect of crowd-out can be established.

6. Conclusion

This paper summarizes the dramatic changes in relative male-females educational attainment over the past three decades. Stock measures measuring education among the entire adult population show rising attainment levels for both men and women, with men enjoying an advantage in schooling levels throughout this interval. Cohort specific analysis reveals that these stock measures mask two interesting patterns: (a) gender difference at the cohort level had vanished by the early 1950 birth cohort and reversed sign ever since; (b) for several cohorts, attainment rates were flat women and flat and falling for men . This last is puzzling in the face of the large college premia that these cohorts observed when making their schooling decisions. The addition of the other variables suggested by the standard human capital investment model does little to improve the fit between that model and the data.

We argue that the existing empirical literature has failed to incorporate the idea that education is choice between uncertain investment options, in which both the difference in the expected payoff across those options (the college premium) and the relative riskiness of the options (the anticipated future dispersion of future earnings) matter in risk averse agents' willingness to choose one education level over another. We present a simple model showing the theoretical impact of these anticipated variances. The data indicate that these anticipated future dispersions have evolved over time very differently for men and women,. We estimate various relative male-female schooling models at the cohort level which include measures of future log earnings dispersion, and find that this extension of the basic human capital model fits the data for relative schooling patterns quite well. That the model performs so well argues strongly for an important role of the factors the paper studies, irrespective of the effect of some of the alternative explanations we discuss.

Our results suggest an interesting and to this point unexplored consequence of labor market inequality. Policy makers have lamented growing earnings dispersion because of its presumed ill effects on the population who actually experience it at any point in time. Our work suggests that growing inequality within education groups, and particularly among the highly educated, may affect other generations as well. When potential students observe that college graduates are doing well on average, they wish to go to college themselves. But our results show that, for a given average return, how the worst off college graduates do relatively to the highest earnings ones affects potential students education decisions as well.

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Table 1. O.L.S. Estimates of Effect of Various Factors on Years of Schooling by Age 25 by Cohort, Men and Women Estimated Separately* (Standard Errors in Parentheses).

	Women				Men			
	(I)	(II)	(III)	(IV)	(I)	(II)	(III)	(IV)
Trend	0.009	-0.007	0.006	0.016	0.01	-0.016	0.01	0.013
	(0.002)	(0.007)	(0.009)	(0.01)	(0.003)	(0.01)	(0.006)	(0.007)
log(Cohort Size)	-0.302	-0.12	-0.05	-0.11	-0.71	-0.35	-0.03	-0.04
	(0.14)	(0.15)	(0.l4)	(0.15)	(0.16)	(0.19)	(0.11)	(0.13)
Foregone Labor Earnings: Log weekly earnings of persons 18-24 with only high school education	0.39	0.44	0.8	0.9	0.58	0.54	1.01	0.71
	(0.17)	(0.16)	(0.22)	(0.22)	(0.15)	(0.14)	(0.09)	(0.31)
log (Mean National) Tuition		0.53	0.066	0.26		0.81	-0.2	-0.35
		(0.23)	(0.3)	(0.27)		(0.31)	(0.2)	(0.23)
Anticipated Premium: mean log “college” weekly earnings – mean log “no college “ weekly earnings			0.66	-0.22			1.11	1.05
			(0.3)	(0.48)			(0.14)	(0.19)
80th percentile - 20th percentile of "no college" log weekly earnings distribution				0.26				-0.73
				(0.51)				(0.56)
80th percentile - 20th percentile of "college" log weekly earnings distribution				1.22				0.06
				(0.76)				(0.49)
Sample Size	39	39	39	39	39	39	39	39
R-Squared	0.87	0.89	0.91	0.94	0.52	0.63	0.9	0.92

* Each regression in this table contains a constant term. See text for description of variable construction.

Table 2. O.L.S. Estimates of Effects of Characteristics of the log weekly earnings on Male-Female Education Difference

A: Male/Female Difference in Years of Completed Schooling by Age 25

Gender Difference in:	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**
Anticipated College Premium						
mean log "college" weekly earnings – mean log "no college " weekly earnings	-0.99	0.38	2.82	1.39	6.96	0.77
Anticipated Future Dispersion of Log Weekly Earnings						
80th percentile - 20th percentile of "no college" distribution			1.27	1.28		
80th percentile - 20th percentile of "college" distribution			-4.15	1.13		
Standard deviation of "no college" distribution					2.79	2.18
Standard deviation of "college" distribution					-8.83	2.41
R-Squared	0.19		0.79		0.72	

B: Male/Female Difference in Fraction of People with at Least 1 Year College by age 25

Gender Difference in:	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**
Anticipated College Premium						
mean log "college" weekly earnings – mean log "no college " weekly earnings	-0.164	0.088	0.865	0.268	1.65	0.16
Anticipated Future Dispersion of Log Weekly Earnings						
80th percentile - 20th percentile of "no college" distribution			0.15	0.24		
80th percentile - 20th percentile of "college" distribution			-0.83	0.22		
Standard deviation of "no college" distribution					0.17	0.46
Standard deviation of "college" distribution					-1.53	0.51
R-Squared	0.11		0.81		0.8	

C: Male/Female Difference in Fraction of People with at Least 4 Years College by age 25

Gender Difference in:	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**
Anticipated College Premium						
mean log "college" weekly earnings – mean log "no college " weekly earnings	-0.28	0.06	0.29	0.25	0.84	0.13
Anticipated Future Dispersion of Log Weekly Earnings						
80th percentile - 20th percentile of "no college" distribution			0.15	0.23		
80th percentile - 20th percentile of "college" distribution			-0.56	0.2		
Standard deviation of "no college" distribution					0.43	0.36
Standard deviation of "college" distribution					-1.28	0.4
R-Squared	0.41		0.79		0.77	

All regressions have a constant term, and the difference in opportunity cost of time. Data are from the Current Population Survey. See text for variable descriptions, and summary of how constructed..

Each regression reported above on observations from 39 cohorts.

Table 3. Labor Force Participation Rates of Men

	Birth Year Cohort							
	1936-38	1939-44	1945-49	1950-54	1955-59	1960-64	1964-69	1970-74
All	0.93	0.92	0.92	0.91	0.92	0.92	0.90	0.88
Education								
High School	0.90	0.90	0.89	0.89	0.90	0.91	0.89	0.87
Some College	0.93	0.92	0.92	0.92	0.93	0.93	0.91	0.88
College Grad	0.94	0.93	0.94	0.93	0.94	0.93	0.90	0.89
Age								
18-24	0.65	0.79	0.86	0.83	0.87	0.88	0.87	0.87
25-34	0.93	0.94	0.93	0.95	0.95	0.95	0.95	0.95
35-44	0.94	0.95	0.95	0.94	0.94	0.94	n.a.	n.a.
45-54	0.93	0.92	0.92	0.93	n.a.	n.a.	n.a.	n.a.

Labor Force Participation Rates of Women

	Birth Year Cohort							
	1936-38	1939-44	1945-49	1950-54	1955-59	1960-64	1964-69	1970-74
All	0.65	0.70	0.75	0.78	0.80	0.80	0.81	0.80
Education								
High School	0.59	0.62	0.67	0.70	0.71	0.71	0.70	0.69
Some College	0.65	0.70	0.77	0.81	0.82	0.83	0.84	0.85
College Grad	0.72	0.76	0.81	0.85	0.86	0.85	0.88	0.86
Age								
18-24	0.45	0.60	0.71	0.76	0.79	0.79	0.80	0.79
25-34	0.53	0.60	0.69	0.77	0.79	0.81	0.81	0.84
35-44	0.69	0.75	0.80	0.81	0.81	0.81	n.a.	n.a.
45-54	0.76	0.79	0.81	0.82	n.a.	n.a.	n.a.	n.a.

Source: Current Population Survey. See text for additional description.

Figure 1. Years of Completed Schooling Among Adults Aged 25-64, by Year and Sex

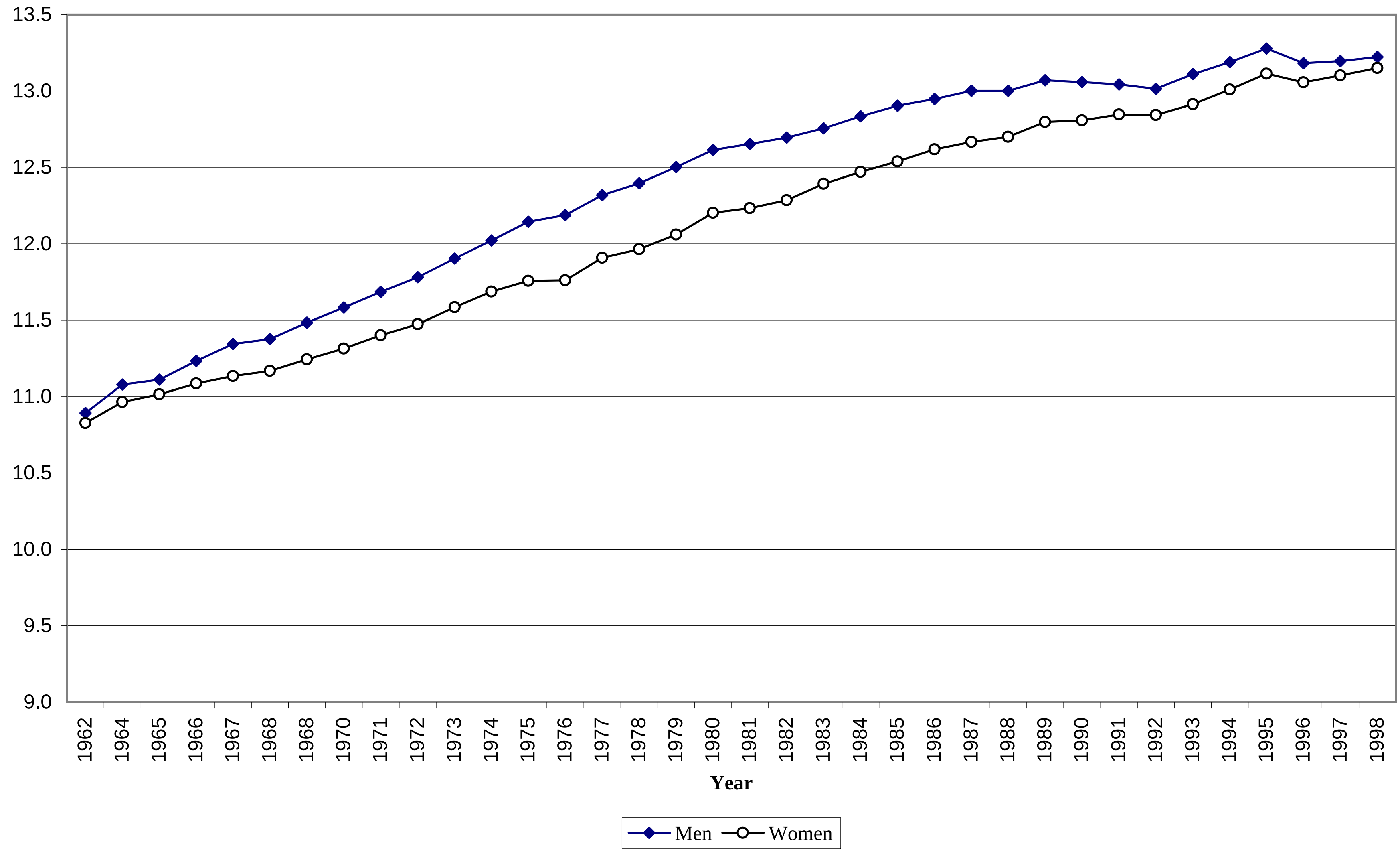


Figure 2. Completed Years of Schooling by Age 25, By Birth Cohort and Sex

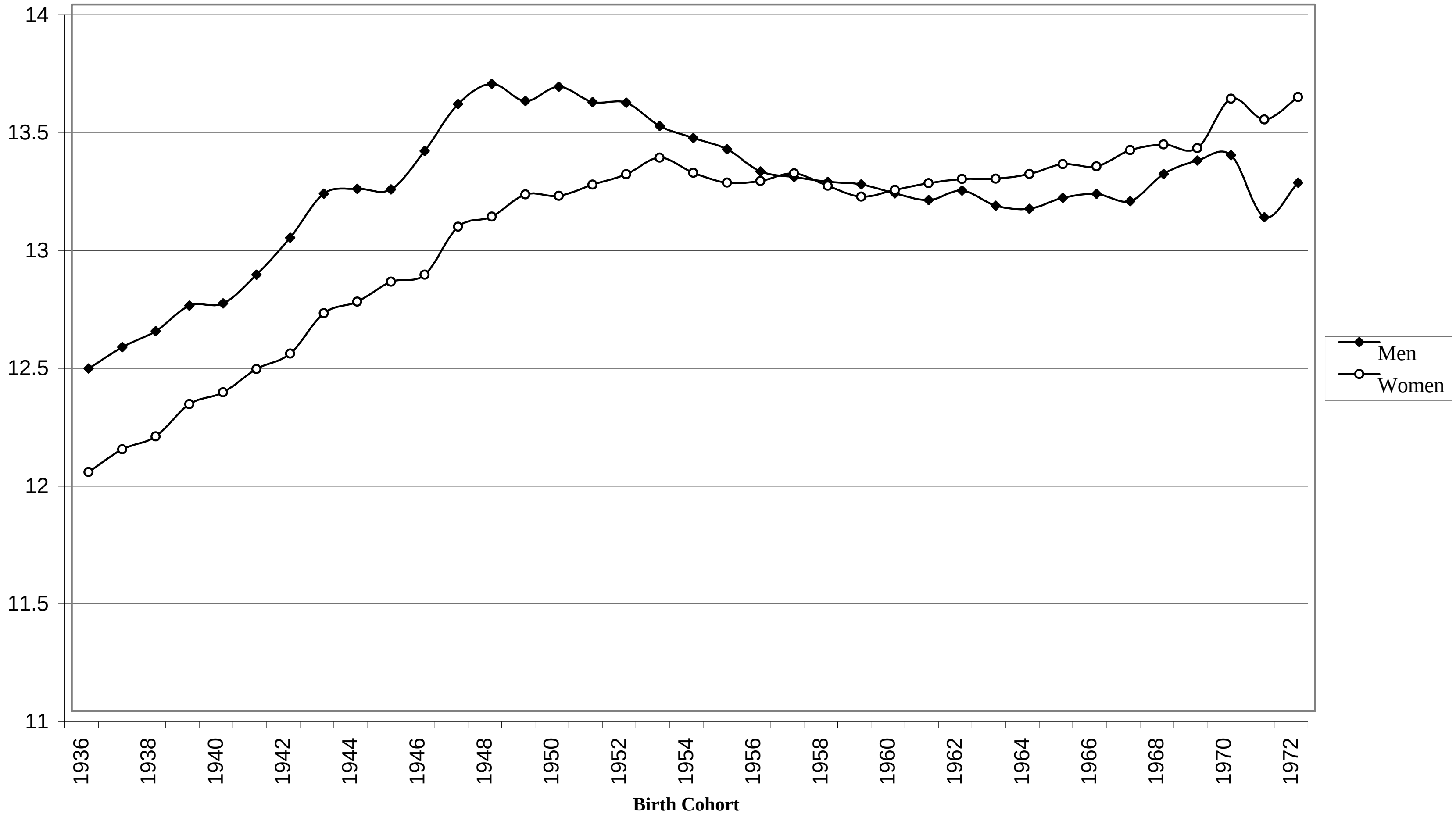


Figure 4. Anticipated Colllege Premium: log (college weekly wage) - log (no college weekly age) Among persons Aged 25-64 while cohort Between 18 and 24

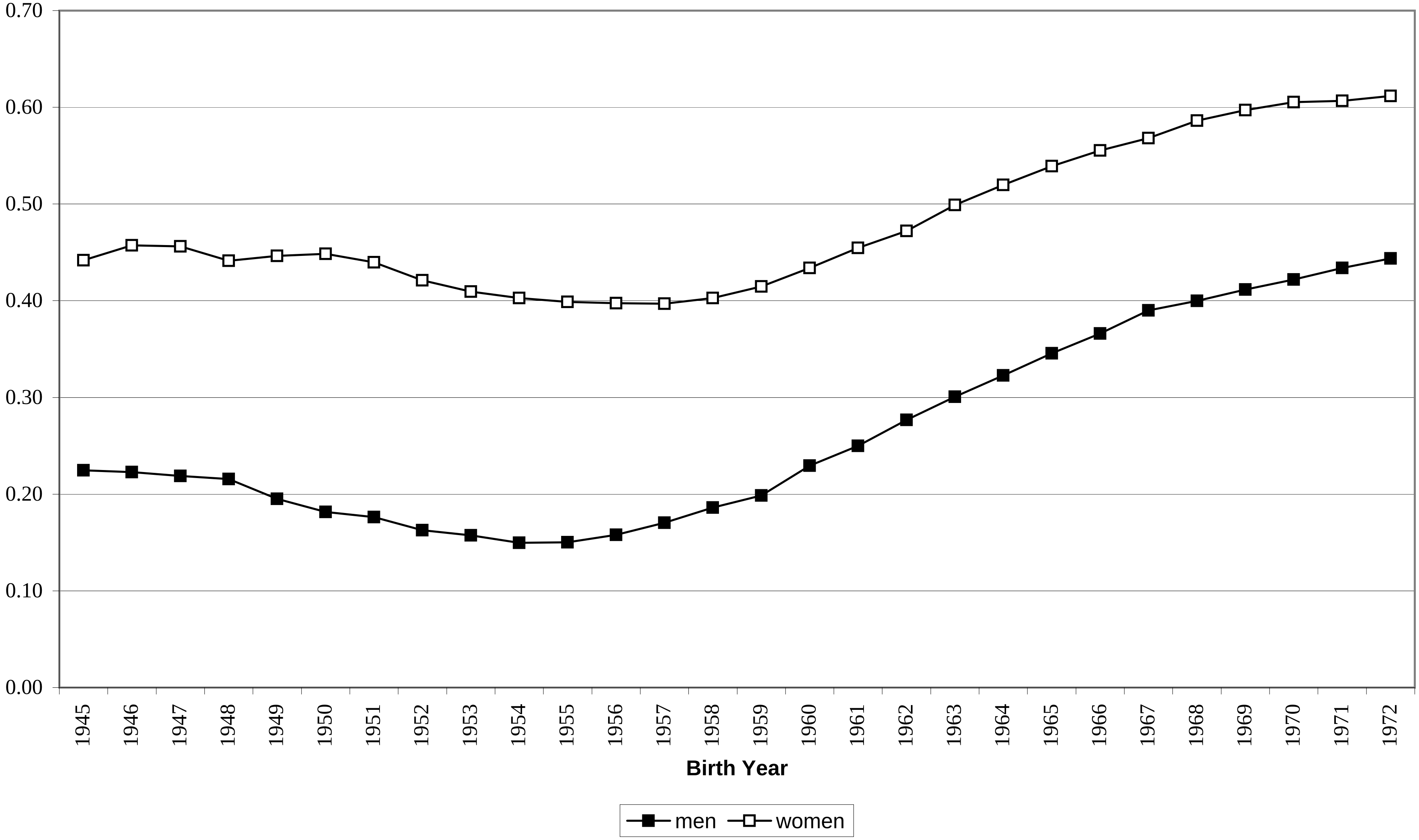


Figure 5a. Opportunity Cost of Advanced Schooling: Average log (weekly earnings) of persons aged 18-24 with Only High School Education While Cohort Between 18 and 24

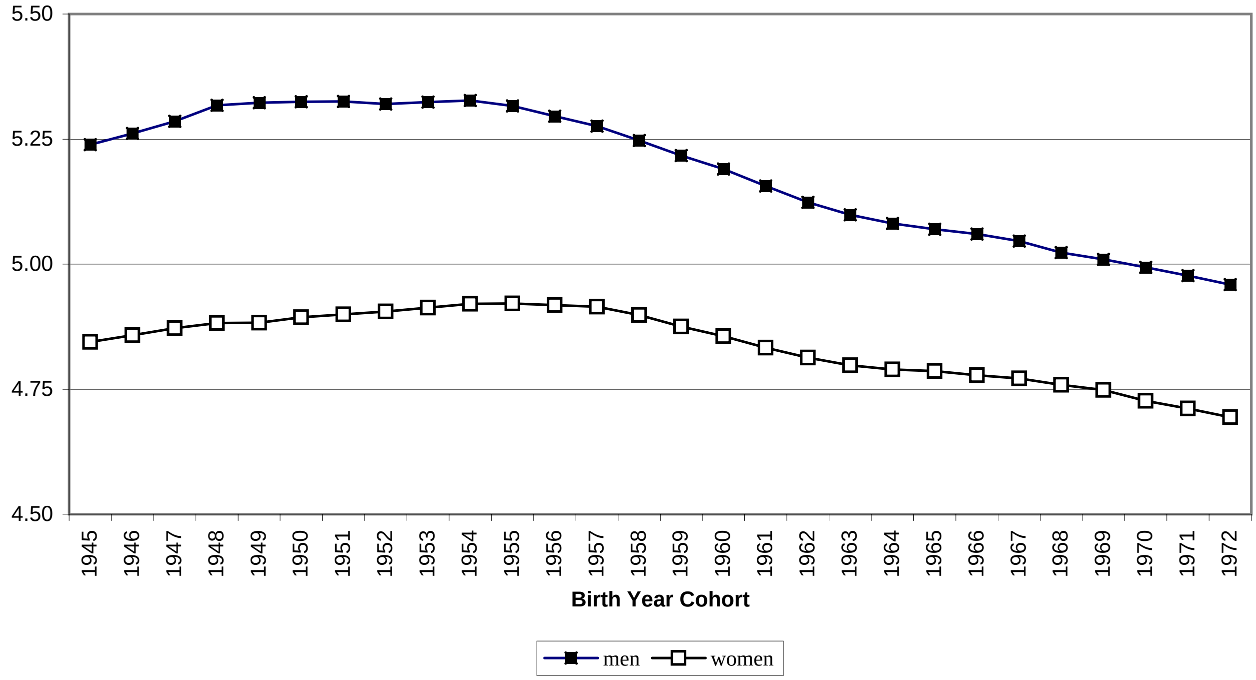


Figure 5b. Direct Costs of Advanced Schooling: Weighted Average of Log (Tuition and Fees) at Private and Public College While Cohort Between 18 and 24

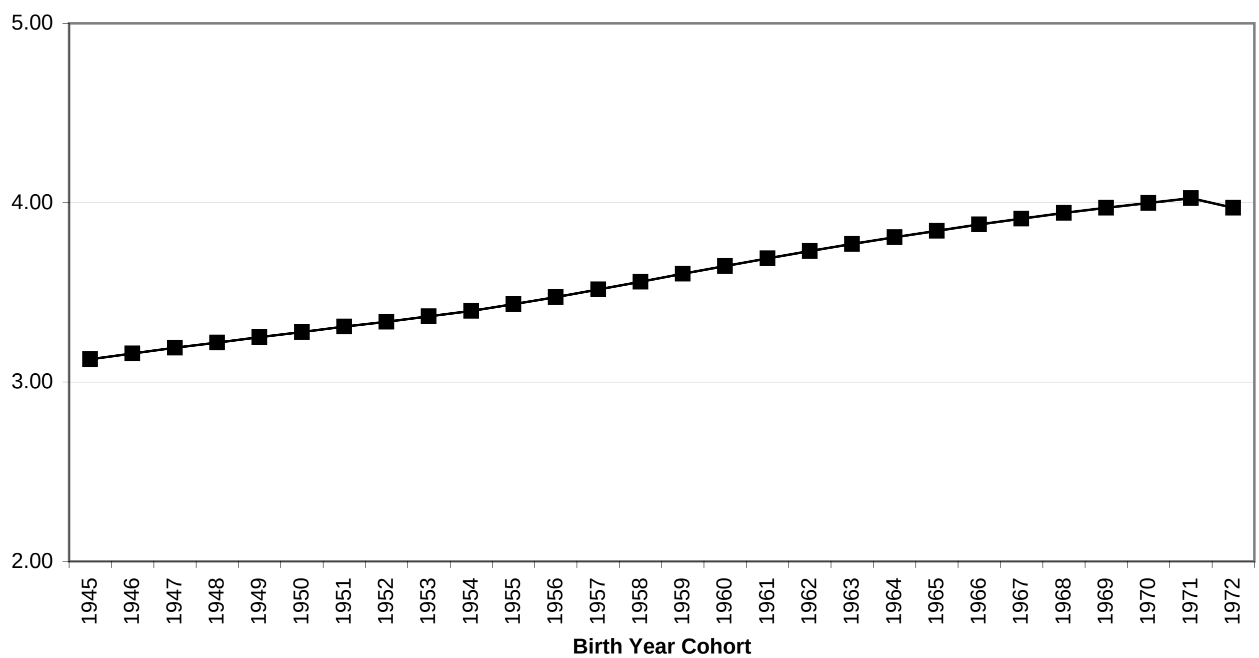


Figure 6a. Male Uncertainty over Future Earnings with Different Levels of Education: Dispersion of log (weekly wage) among Men 25-64 When Cohort Between 18 and 24

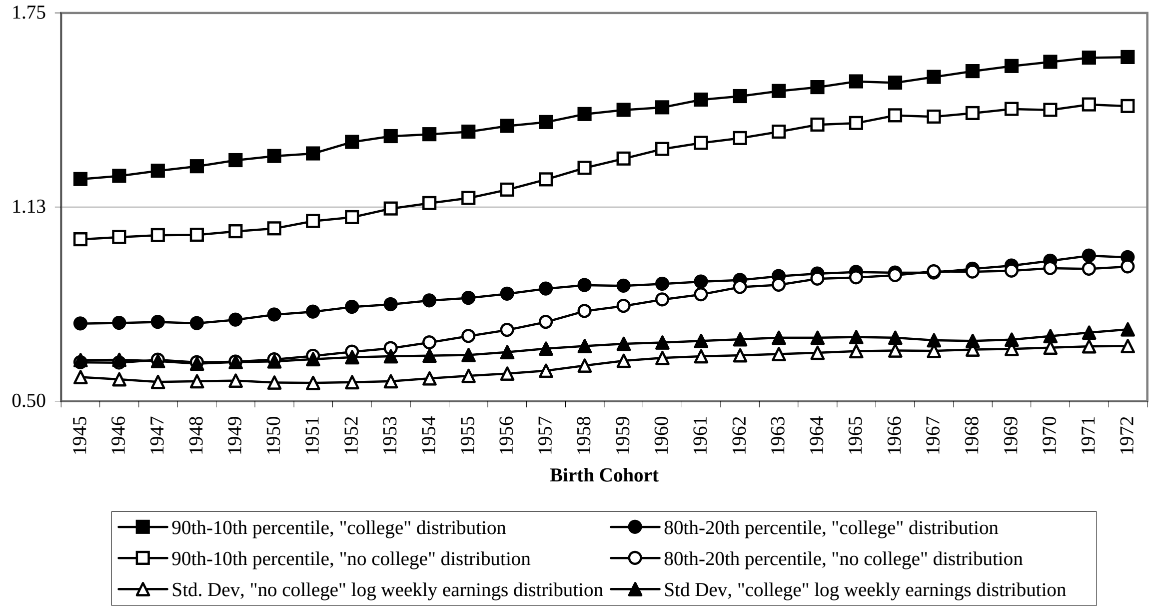


Figure 6b. Female Uncertainty over Future Earnings with Different Levels of Education: Dispersion of log(weekly wage) among Women 25-64 when Cohort Between 18 and 24

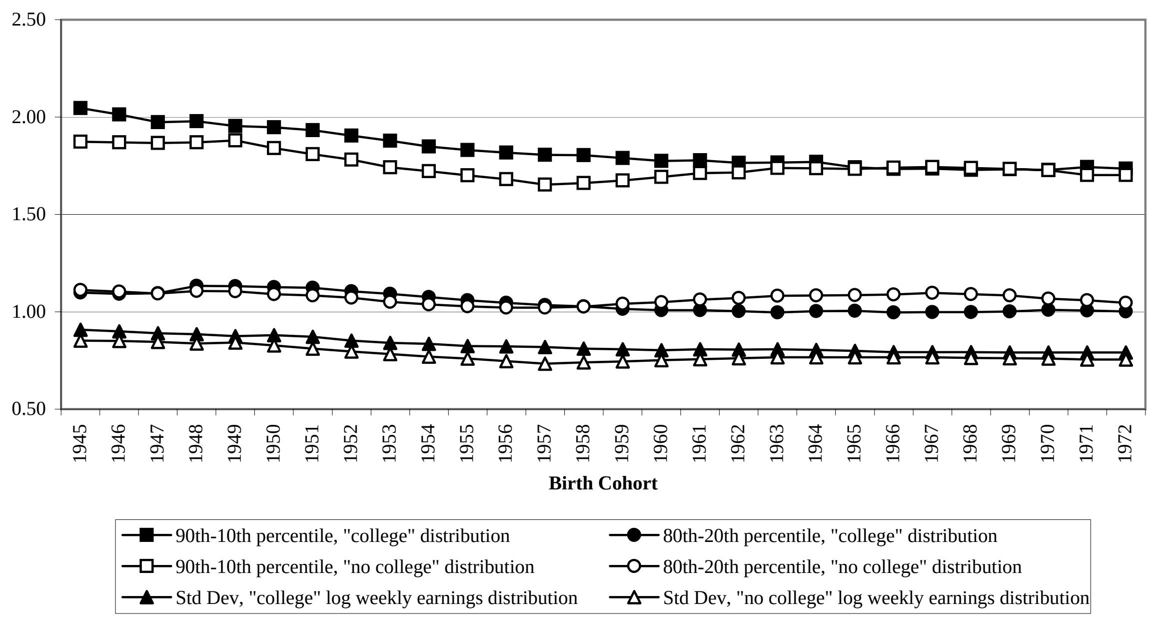
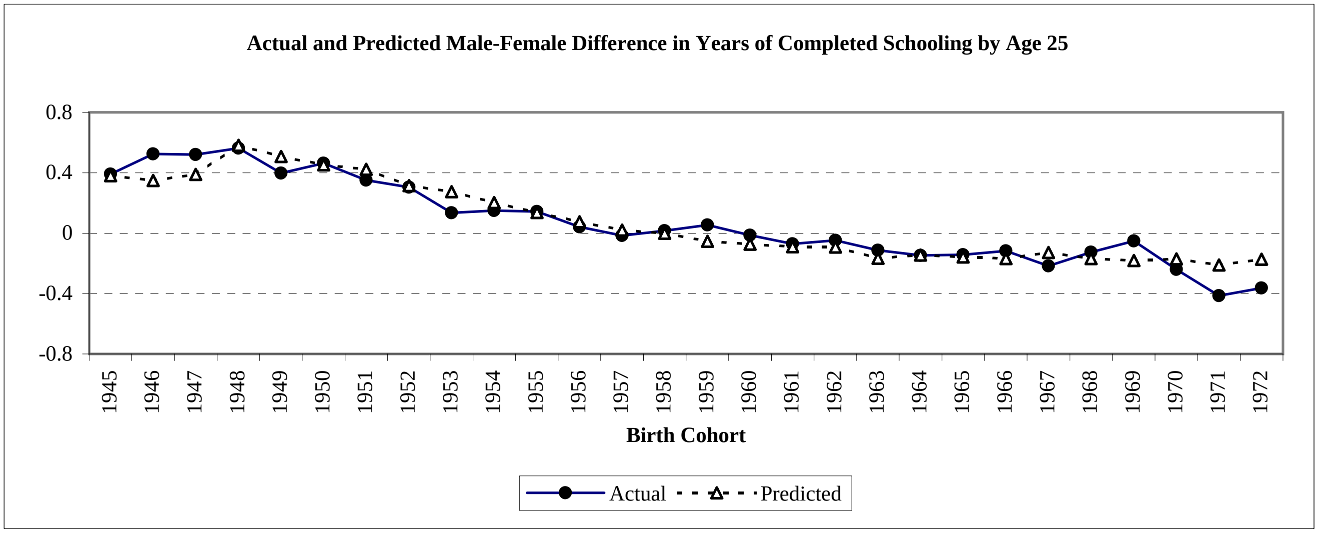
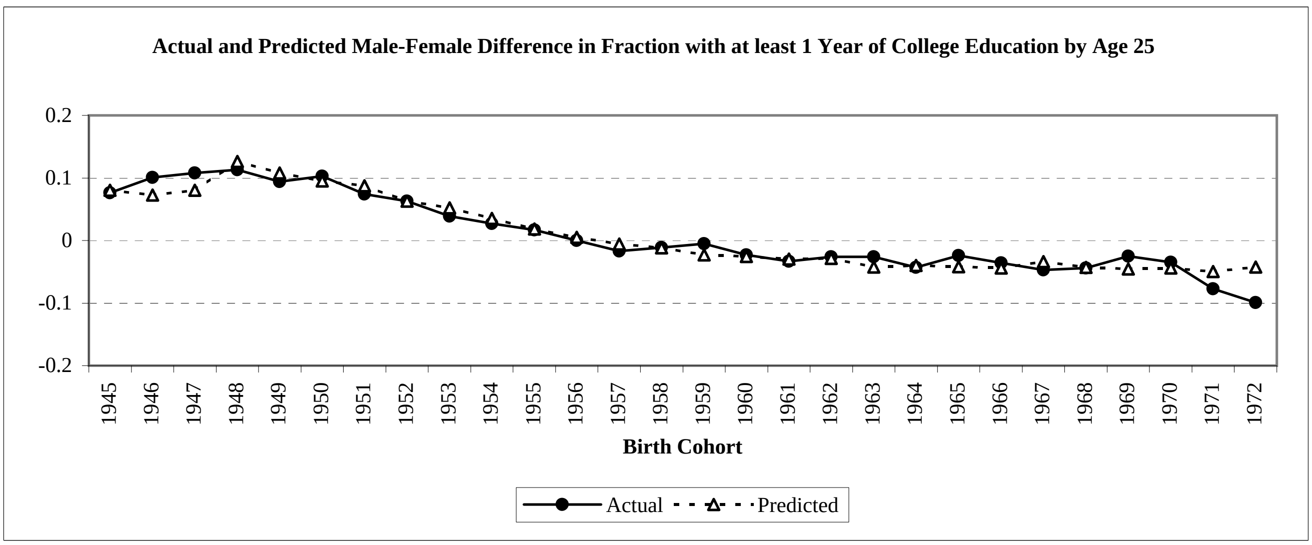


Figure 7. Fit of Human Capital Model Which Accounts for Both Premium and Earnings Uncertainty





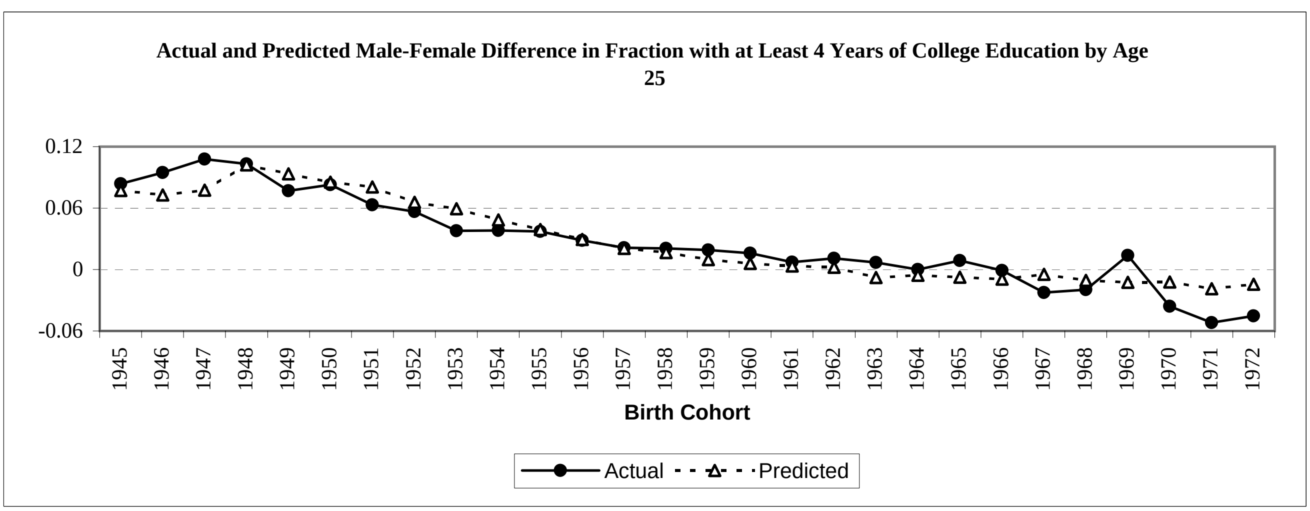


Figure 8a. Total Undergraduate Enrollment in All Institutions, by Sex

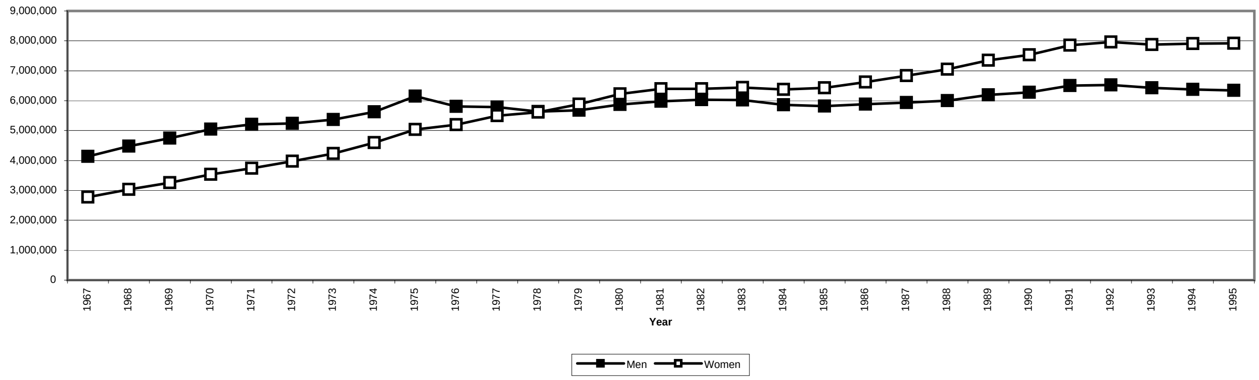


Figure 8b. Fraction of Female Undergrads in Different Types of Schools

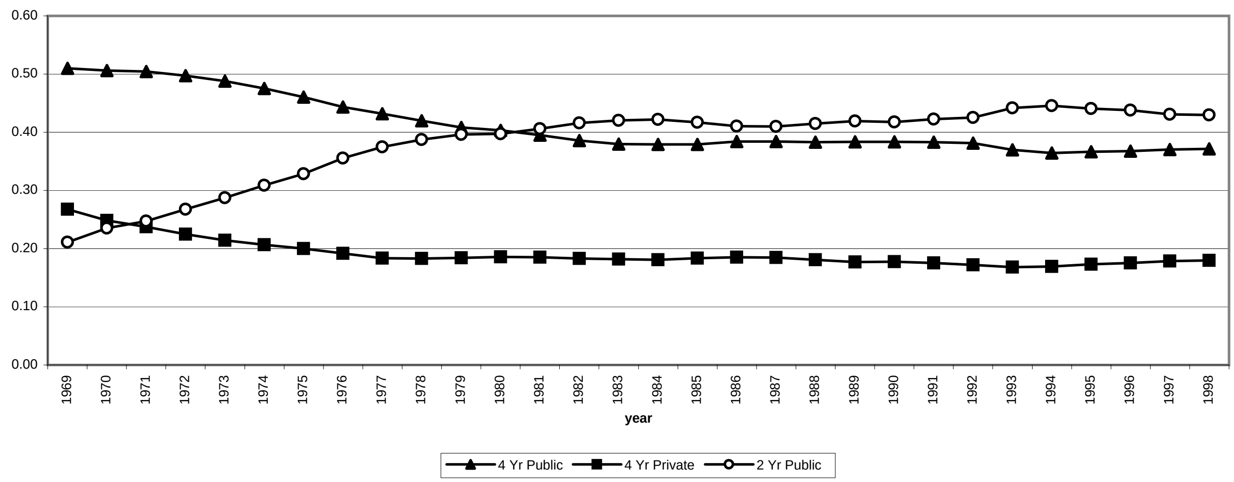


Figure 8c. Fraction of Male Undergrads in Different Types of Schools