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The Homecoming of American College Women: The Reversal of the College Gender Gap

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Although the fact is not widely known, the ratio of male-to-female undergraduates in the United States was about at parity from 1900 to 1930. Male enrollments began to increase relative to female enrollments in the 1930s and later as GIs returned from World War II. A highpoint of gender imbalance in college attendance was reached in 1947 when undergraduate men outnumbered women 2.3 to 1. But starting then and continuing until the present in an almost unbroken trend, female college enrollments have increased relative to male enrollments.

The relative improvement for females was slow at first and then increased with remarkable speed. In 1960, there were 1.60 males for every female graduating from a U.S. four-year college and 1.55 males for every female undergraduate (U.S. Department of Education, 2005, Table 247). But beginning in the late 1960s and early 1970s, young women's expectations of their future labor force participation radically changed and their college-enrollment and graduation rates relative to males began to soar. No longer did young women anticipate that they would follow in their mothers' footsteps. This group changed behavior along many dimensions: taking more math and science courses in high school, electing different college majors that were more like those of their male peers, marrying and having children later, and demonstrating greater attachment to a career.

By 1980, the college gender gap in enrollments had evaporated. This change was a return or a "homecoming" to the parity of the early twentieth century, although the *levels* of college going were almost six times higher in 1980 than in the

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1920s for both men and women. But rather than stopping at equality in 1980, women's greater rate of increase continued. In 2003, there were 1.35 females for every male who graduated from a four-year college and 1.30 females for every male undergraduate (U.S. Department of Education, 2005, Tables 176, 247).

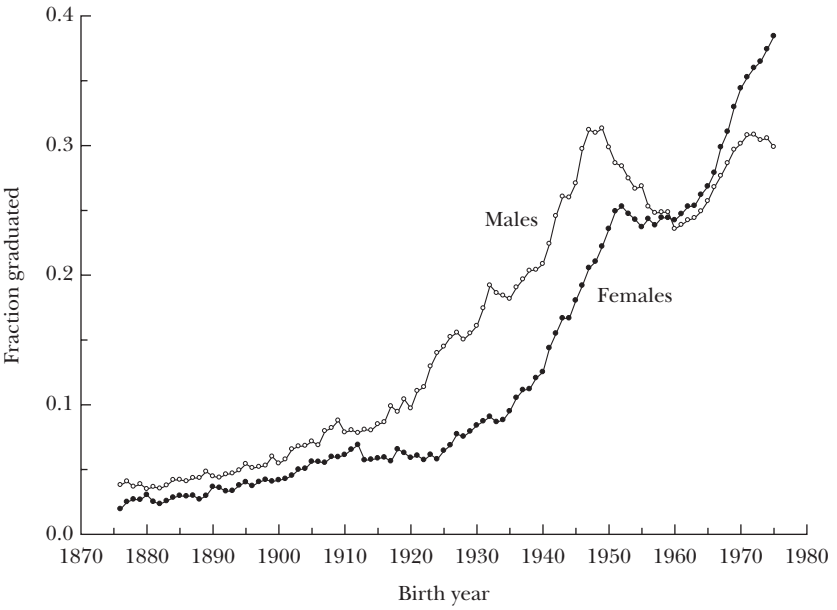
This article explores the homecoming of American college women and the catch-up and reversal in the gender gap in college attendance and graduation. We use three longitudinal data sets of high school graduates in 1957, 1972, and 1992 to understand the sources of the narrowing of the gender gap in college and its reversal. We find that high school girls improved relative to boys in college preparation as measured by achievement test scores and by math- and science-course taking. The changes in these proximate determinants of college investments appear to be driven by increases in girls' expected economic returns to college, which in turn arose from improvements in perceived labor market opportunities and an increase in the age of first marriage. We also find that long-standing behavioral and developmental differences between boys and girls appear to have contributed to the new college gender gap favoring females.

Historical and Comparative Evidence

The gender gap in higher education can be observed using various college outcomes, such as college or postsecondary school enrollment and the receipt of a bachelor's (four-year college) degree. Figure 1 shows a century of four-year college graduation rates by sex, beginning with the cohort born in 1876 and measured for each cohort at 35 years of age. Figure 2 better illustrates gender differences in these trends by plotting the male-to-female ratios of those graduating from a four-year college and those attending "any college." In reading both figures, remember that the horizontal axis shows the year in which a cohort is born; members of the cohort would be attending or graduating from college approximately two decades later. Four different periods in the history of the college gender gap can be inferred from Figures 1 and 2: an initial period of almost gender parity; a relative increase in male enrollments during the Great Depression and especially just after the end of World War II; a relative increase in female enrollments after 1947 with rapid change in the 1970s; and finally, a reversal of the gender gap starting around 1980.

Men and women in the earlier cohorts born prior to 1910 attended college in almost equal numbers. Because many women enrolled in two-year teacher's colleges, women lagged behind in the ratio of bachelor's degrees. Later, for cohorts born around 1950, the relative graduation rate of men to women was 1.25, equal to that achieved earlier in the century for cohorts born from 1880 to 1910. The "homecoming"—the return to the previous level—took three or four decades. The relative advance for women in both college-graduation and attendance rates began in the 1950s (for cohorts born in the 1930s), but it was especially rapid for the generation born in the late 1940s. Parity was reached by the cohorts born in 1960, and the female advantage widened considerably in the next decade.

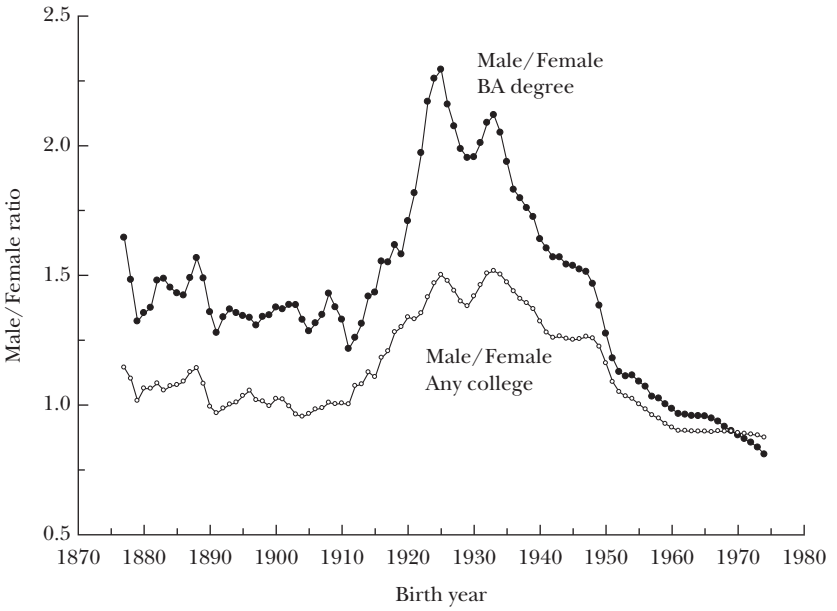
Figure 1
College Graduation Rates (by 35 years) for Men and Women: Cohorts Born from 1876 to 1975



Sources: 1940 to 2000 Census of Population Integrated Public Use Micro-data Samples (IPUMS).
Notes: The figure plots separately by sex the fraction of each birth cohort who had completed at least four years of college by age 35 for the U.S. born. When the IPUMS data allows us to look directly at thirty-five-year-olds in a given year, we use that data. Since educational attainment data was first collected in the U.S. population censuses in 1940, we need to infer completed schooling at age 35 for cohorts born prior to 1905 based on their educational attainment at older ages. We also don't observe all post-1905 birth cohorts at exactly age 35. We use a regression approach to adjust observed college graduation rates for age based on the typical proportional life-cycle evolution of educational attainment of a cohort. The age-adjustment regressions are run on birth-cohort year cells pooled across the 1940 to 2000 IPUMS with the log of the college graduation rate as the dependent variable and a full set of birth cohort dummies and a quartic in age as the covariates. The details of the age-adjustment method are the same as used by DeLong, Goldin, and Katz (2003, Figure 2–1). College graduates are those with 16 or more completed years of schooling for the 1940 to 1980 samples and those with a bachelor's degree or higher in the 1990 to 2000 samples. The underlying sample includes all U.S. born residents aged 25 to 64 years.

The early period of gender parity in college enrollments from 1900 to 1930 (covering the birth cohorts of 1880 to 1910) was not the result of a situation where only an elite class sent children of both genders to college. Just 5 percent of the women enrolled in privately-controlled colleges in 1925 attended the elite "seven-sister" schools and only 22 percent were in any all-women's college. Half of all American college students in 1925 were in publicly-controlled institutions of higher education, and 55 percent of women were. A substantial fraction of women during this period attended teacher-training colleges, and many of these schools had two-year programs. In 1925, for example, 30 percent of the female enrollments

Figure 2
Ratio of Male-to-Female College Rates: Birth Cohorts from 1876 to 1975
(*three-year centered moving averages measured at 35 years of age*)



Sources: 1940 to 2000 Census of Population Integrated Public Use Micro-data Samples.
Notes: College graduates are those with 16 or more completed years of schooling for the 1940 to 1980 samples and those with a bachelor's degree or higher in the 1990 to 2000 samples. The "any college" category includes those with 13 or more years of school attended in the 1940 to 1980 samples and those with some college or more in the 1990 to 2000 samples. The age-adjustment methodology is that described in the notes to Figure 1.

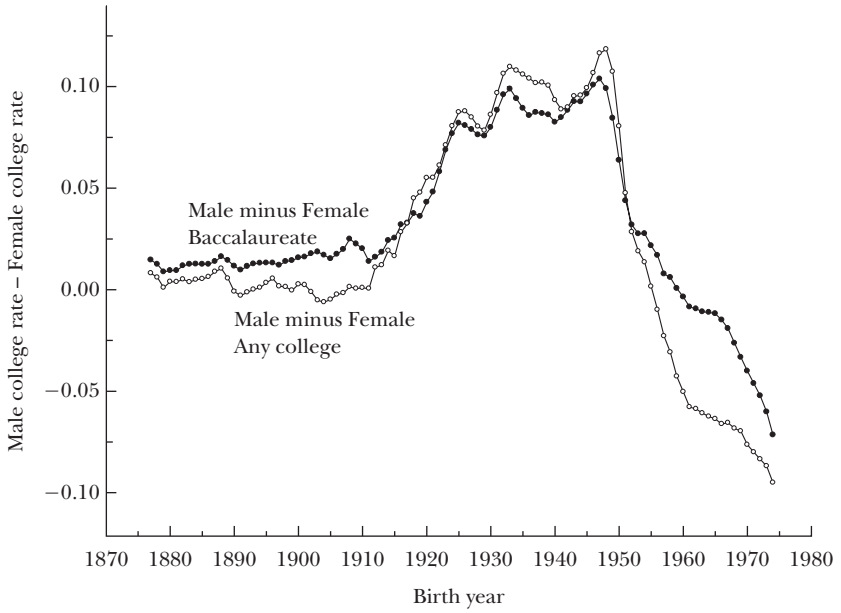
were at teacher-training schools whereas just 8 percent of the male enrollments were (U.S. Office [Bureau] of Education, various years from 1916–17 to 1956–58).

More difficult to understand is why women, whose later labor force participation rates when married were low, went to college at rates almost equal to those of men. One answer is that a substantial fraction of the women who graduated in these early classes never married and did enter the labor force. Those who did marry were far more likely to marry a college-educated man. Thus, the economic return to college was garnered, separately, through the labor and the marriage markets (Goldin, 1997).

The college gender gap began to widen in favor of men during the 1930s (starting with the birth cohorts of the 1910s) when unemployment left many with little else to do and a college degree could greatly enhance employability. At the time, marriage bars—regulations that barred married women from employment—were extended in many school districts making a teaching degree less valuable for most women (Goldin, 1991). In fact, the number of women in teacher's colleges declined substantially from 1929 to 1935, while the number of men increased.

Male college graduation surged further during the 1940s and 1950s, when the

Figure 3
Difference between Male and Female College Rates: Birth Cohorts from 1876 to 1975
(*three-year centered moving averages measured at 35 years of age*)



Sources and Notes: See Figure 2.

GI Bill helped to finance college education for men who had fought in World War II and the Korean War (Bound and Turner, 2002; Stanley, 2003). During the period, college expanded across the ranks of Americans and increasingly became an entry requirement for many jobs. Male college graduation rates peaked with the cohorts born in the late 1940s, who reached college age when the prospect of draft deferments for the Vietnam War was encouraging men to attend college (Card and Lemieux, 2001). After that point, the graduation rate of men sagged, rebounded slightly, and flattened out. Starting with those born in the mid-1930s, and especially with those born in the late 1940s, females increased their college graduation rates relative to males.

Trends in the college gender gap measured in differences (as opposed to ratios) are of particular interest here, since we will consider changes in these differences in our econometric analysis of the college outcomes of high school seniors from 1957, 1972, and 1992. The data expressed in Figure 3 in terms of differences, differs from that expressed in ratios in one major respect. Rather than beginning with the 1930s cohorts, the narrowing of the college gender gap measured in differences starts with the cohorts born in the late 1940s, and the catch-up is extremely rapid.

The data from the household surveys (census) are fully consistent with administrative data from higher education institutions. We have graphed the administra-

tive enrollment data (the line labeled "Contemporaneous") against the cohort data from Figure 2 on "Any college" (with 20 years added to the birth year) to produce Figure 4. The two series for the ratio of college males to females closely track each other except during and immediately following World War II. The cohort series measures the share of individuals that attended any college, whereas the contemporaneous series is implicitly weighted by years in college; thus, the latter is a somewhat exaggerated version of the former.

The decline in the male-to-female ratio of undergraduates during the past 35 years is not due primarily to changes in the ethnic mix of the college-aged population, nor to the types of postsecondary institutions they attend. The substantial decrease in the ratio of male-to-female undergraduates is apparent for all types of institutions including research universities, liberal arts colleges, public institutions, and private institutions; for both full-time and part-time enrollment; and for all ethnic and racial subgroups (Integrated Post-Secondary Education System (IPEDS) data, ⟨http://caspar.nsf.gov⟩). The female advantage in college enrollment and graduation is now substantially larger for Hispanics and black non-Hispanics than for white non-Hispanics.

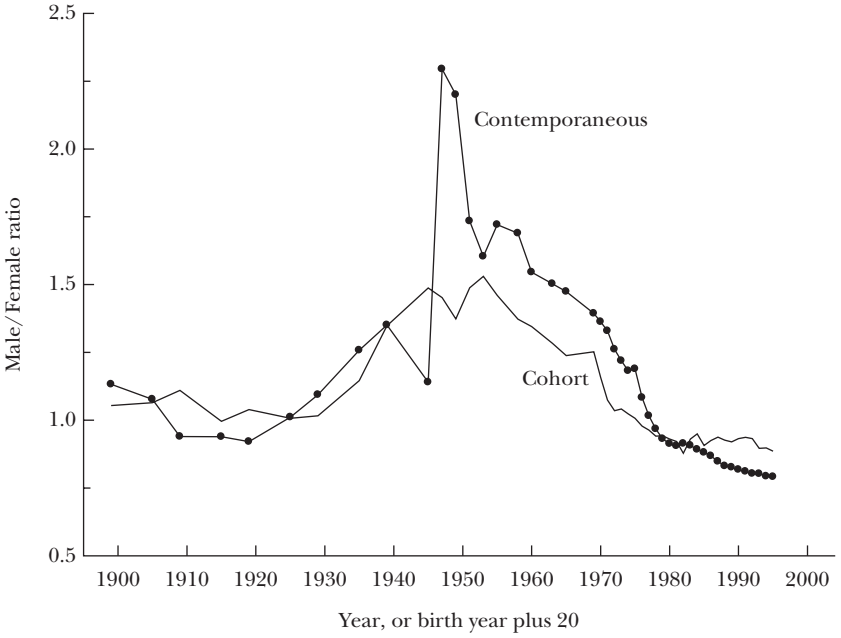
Not only has the gender gap in college attendance and graduation reversed in the United States in the past decades, but almost all countries in the OECD now have more women than men in college and have had a growing gender gap among undergraduates that favors women (OECD Education Online Database, ⟨http://www.oecd.org⟩). Of the 17 OECD countries with consistent tertiary schooling enrollment data for 1985 and 2002, only four of them—France, Portugal, Sweden, and the United States—had a ratio of male-to-female undergraduates that was below one in 1985. By 2002, higher-education enrollment of women outnumbered that of men in eleven more countries: Austria, Belgium, Denmark, Finland, Ireland, Italy, Netherlands, Norway, New Zealand, Spain, and the United Kingdom. By 2002, of the 17 OECD countries, only Turkey and Switzerland had a ratio of male-to-female higher-education enrollment that was greater than one, but both of them had a declining gender gap from 1985 to 2002. Any explanation of how U.S. women have caught up and surpassed men in college trends should be consistent with this common pattern of international changes.

Evidence from Longitudinal Samples of High School Seniors

Proximate Determinants of College Outcomes

Youth must plan for college in high school. Thus we start with a set of *proximate* changes in college preparation, which are high school grades (rank), aptitude (or achievement) test scores, and courses taken. We use three longitudinal surveys of high school pupils, but we limit the samples to graduating seniors. Two of the surveys are nationally-representative: the 1972 National Longitudinal Survey (NLS), a sample of high school seniors in the spring of 1972, and the 1988 National

Figure 4
Ratios of Males to Females with Any College by Cohort and Year (Contemporaneous)
(*census (plus 20 years) and administrative data*)



Sources: Cohort: Data from the 1940 to 2000 Census of Population Integrated Public Use Micro-data Samples (IPUMS). Contemporaneous: Administrative enrollment data from U.S. Office of Education *Annual Reports (Report of the Commissioner of Education for [various years to 1917]), Biennial Reports (Biennial Survey of Education for [various years from 1916-18 to 1956-58]),* and *Opening Fall Enrollments.*
Notes: Cohort: See Figures 1 and 2. Contemporaneous: Enrollment before 1946 was asked at the end of the year. After 1946, enrollment was asked at the start of the fall term. Duplicates have been removed. Graduate and professional students are omitted from the undergraduate totals, as are preparatory students in college. In the case of professional students, some may have been pursuing their first degrees, thus their omission understates the number of undergraduates, particularly for men. Data for teaching and normal (college) schools exclude those attending only summer sessions. Students attending normal schools were generally enrolled in teacher training, but sometimes not. Up to and including 1930, only the data for the teacher training students were reported. The omission probably understates total enrollment by at most 10 percent. The 1930 number is understated by at most 5 percent. The data to 1955/56 are for "resident college enrollment," that is individuals registered for a degree. Beginning in 1963 schools also reported nondegree enrollment and separated the enrollment into full-time and part-time. The data given here are for full-time and part-time, but it is not clear what part-time enrollment was relative to the total in the pre-1963 period. Summer session enrollment is not included for any of the groups, and the same is true for enrollment in extension schools and correspondence courses.

Educational Longitudinal Survey (NELS), a sample of eighth-graders in the spring of 1988 who were seniors in 1992. We also use the less familiar Wisconsin Longitudinal Survey (WLS), which commenced in 1957 with one-third of all graduating

seniors in the state of Wisconsin.[1] We will mainly use the receipt of a bachelor's degree (four-year college degree) within seven to eight years of high school graduation as the outcome measure, for the sake of consistency across the three samples, although the patterns in the college gender gap across our three surveys are similar for alternative measures of college attendance.

In all three surveys, girls achieved considerably higher grades in high school than did boys.[2] In the Wisconsin data of high school seniors graduating in 1957, the high school rank of the median girl was 21 percentile points above the median boy. In the NLS data for 1972 graduates, the median girl was 17 percentile points above the median boy and the difference was almost 16 percentile points for the 1992 graduates in the NELS data.

Whereas girls always achieved higher class-rank than boys, aptitude and achievement tests show a different pattern. For 1957 graduates, junior-year IQ scores—the only cognitive test score measure available in the Wisconsin data—display almost identical distributions by sex. Twelfth-grade math and reading achievement test scores available for the 1972 graduates show that boys did far better in math, whereas girls did better in reading. Boys were more than one-quarter of a standard deviation ahead of girls in math at the mean but trailed by 0.035 of a standard deviation in reading. By 1992, however, girls had widened their lead in reading and narrowed the gap with boys in math. From 1972 to 1992, girls gained about 0.17 of a standard deviation in both math and reading.[3]

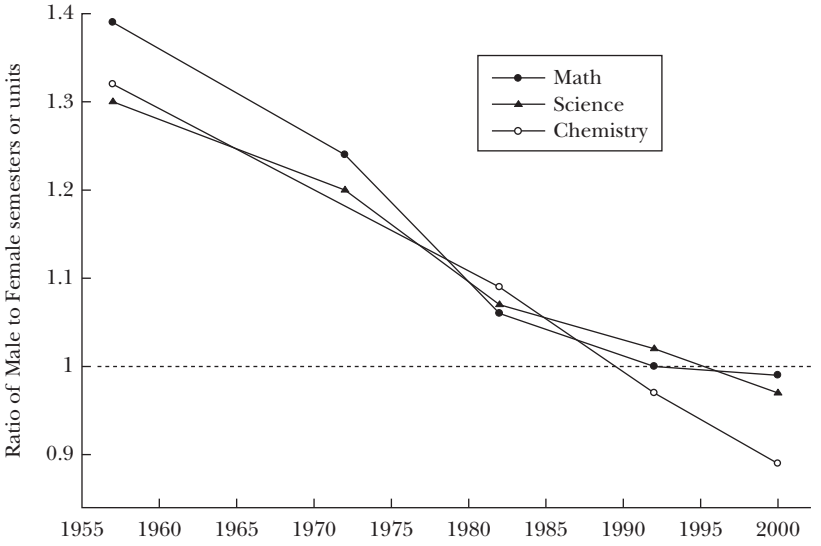
The courses taken by high school graduates are another part of their college preparedness and, other than foreign languages, math and science courses, are most predictive of college attendance and completion. As shown in Figure 5, boys in the 1957 Wisconsin data took far more math and science courses than did girls; for example, the average boy took 4.02 semesters of math compared with 2.89 semesters for girls, and the average boy took 3.76 semesters of science compared with 2.90 semesters for girls. The difference in 1957 was particularly

[1] Information and documentation for the 1972 NLS is available at ⟨http://nces.ed.gov/surveys/nls72⟩, and that for the 1988 NELS is available at ⟨http://nces.ed.gov/surveys/nels88⟩. We use the restricted-access version of the NELS to analyze information on high school courses and high school rank. The documentation and data for the WLS are available at ⟨http://dpls.dacc.wisc.edu/wls/index.html⟩.

[2] The text discusses main themes and patterns we have found in these three surveys. Detailed tables providing more information for each of these three data sets appear in an on-line appendix, which is attached to this paper at the website ⟨http://www.e-jep.org⟩. The first three appendix tables show breakdowns for each dataset by gender of the distributions for IQ or reading and math scores and of high school rank. They also display gender differences in the fraction obtaining a BA by high school grades and test scores. The fourth table shows the mixture of high school courses taken by male and female high graduates from 1957, 1972, 1982, and 1992.

[3] The finding of large relative gains in both math and reading scores for females is robust and holds for non-Hispanic whites and all high school seniors. Cho (2005) also reports large relative gains for females from 1972 to 1992 using the NLS and NELS samples. A well-known standardized test given to seventeen-year-olds (or eleventh graders) the National Assessment of Educational Progress (NAEP) shows a 0.12 standard deviation gain in math scores for females relative to males from 1973 to 1992 and a small gain in female relative reading scores from the mid-1970s to 1996 (U.S. Department of Education 2004). We are not certain why the female relative gains are somewhat smaller in the NAEP.

Figure 5
Male-to-Female Ratio of High School Courses in Math and Science, 1957 to 2000



Sources: 1957 Wisconsin Longitudinal Survey; 1972 National Longitudinal Survey; 1992 National Educational Longitudinal Survey; and 1982 and 1992 are from U.S. Department of Education (2004, Table 137).
Notes: The figure plots the ratio of the mean number of high school courses taken by male graduating seniors to that of female graduating seniors in each reported subject area for the high school graduating classes of 1957, 1972, 1982, 1992, and 2000. Courses are measured in semesters for 1957 and 1972 and are measured in Carnegie units for 1982, 1992, and 2000.

striking in the harder math courses and in chemistry and physics; for example the average boy took 1.01 semesters of physics, and the average girl took just 0.30 of a semester of physics. But by 1992 there was virtual parity in almost all science and math courses, and girls remained considerably ahead of boys in foreign languages. In 2000 the male-to-female ratio for overall science courses was 0.97; for physics courses it was 1.21 (U.S. Department of Education, 2004, Table 137). Although the trend was continuous over the period examined, the greatest advances for girls relative to boys occurred between 1972 and 1982.

For the cohort that graduated in 1957 (born around 1939) the female college graduation rate (measured seven years later in 1964) was 0.66 that of males, according to the Wisconsin longitudinal data, which is in line with the estimates from the national data presented earlier. The ratio varied little across the IQ distribution. Because girls had higher high school ranks than boys, but boys had higher college graduation rates, it is not surprising that boys went to college at enormously higher rates than did girls at every decile of high school rank. Girls in the second-to-the-highest high school rank decile had a college graduation rate similar to that of boys in middle high school rank deciles. In 1979, seven years after graduation for the high school seniors in the NLS data, the ratio of females to males obtaining a bachelor's degree had risen to 0.87. In

2000, eight years after the NELS seniors graduated, the ratio of female to male college graduates was 1.21. Expressed in terms of differences, rather than ratios, the college completion rate advantage for males shrank from 7.5 percentage points for the 1957 graduating class to 3.9 percentage points for the 1972 class, and the advantage for females was 7.3 percentage points for the 1992 class.

The enormous catch-up in college outcomes and leapfrogging for females are found in *all* portions of the ability distribution. From the 1957 class to the 1972 class, as college going and graduation rates increased among young women relative to men, the greatest changes were initially among the brightest and highest-achieving women and reflected increased sorting on the basis of ability. From 1972 to 1992, relative increases in female graduation rates were found throughout the achievement distribution, although the growth was somewhat larger at the center.

Explaining Change in College Outcomes Using the Proximate Determinants

A regression framework can be used to separate the role of each of the proximate determinants, to see how much the changes in these characteristics explain the evolution of the college gender gap.[4] We estimate an ordinary least squares model, in which the dependent variable takes on a value of one if a bachelor's degree is completed, and zero otherwise. Our first explanatory variable is whether the person is female; the coefficient on that variable shows how much being female alters the probability of receiving a bachelor's degree. The other explanatory variables include high school rank (in percentiles); aptitude measured from standardized tests (normalized as z-scores); high school courses; and family background, such as parental income, mother's education, race, and ethnicity. Our measure of aptitude is the normalized reading and math achievement test scores, except in 1957 when it is the normalized IQ score.

In the first panel of Table 1, the first column shows that the raw gender gap in completion of a bachelor's degree for females in the 1957 high school graduating class in the Wisconsin data is 7.5 percentage points. Adjusting for family background factors, the second column shows that a gender gap of 6.7 percentage points remains.[5] We will emphasize the family background-adjusted values as our

[4] Cho (2005) provides a complementary analysis of gender differences in college attendance within two years of high school graduation for high school seniors from 1972, 1982, and 1992. Long (2005) examines the increase in the female-to-male college enrollment ratio using state-panel data from 1972 to 1998. Her results indicate that states with a greater growth in finance-sector employment and slower growth in public college tuition for flagship institutions experienced greater increases in the ratio. Charles and Luoh (2003) investigate how the college wage premium and the anticipated dispersion of future wages help explain the gender gap in educational attainment.

[5] One potential concern in comparing the 1957 regressions to those for 1972 and 1992 is that race information is not available in the Wisconsin Longitudinal Survey. But the presumption is that almost all the 1957 Wisconsin high school graduates were white since the 1960 U.S. census indicates that 97 percent of Wisconsin residents in the 1939 birth cohort were white. The results for 1972 and 1992 on the magnitude of the college gender gap and its determinants are quite similar to those reported in the bottom two panels of Table 1 when one restricts the samples to non-Hispanic whites, to be more comparable with the 1957 Wisconsin sample.

Table 1

Determinants of College Completion among High School Graduates: 1957, 1972, and 1992

WLS: 1957 graduates	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*
Female	−0.075 (0.0083)	−0.067 (0.0080)	−0.067 (0.0075)	−0.128 (0.0077)	−0.075 (0.0081)
IQ score			0.121 (0.0039)	0.051 (0.0047)	0.029 (0.0048)
High school rank percentile/100				0.413 (0.017)	0.329 (0.017)
Courses (semesters)					
Math					0.029 (0.0021)
Science					0.016 (0.0023)
Family background	No	Yes	Yes	Yes	Yes
Observations	8380	8380	8380	8380	8380
R^2	0.095	0.103	0.196	0.252	0.281
NLS: 1972 graduates	(1)	(2)	(3)	(4)	(5)
Female	−0.039 (0.0092)	−0.019 (0.0088)	0.0089 (0.0083)	−0.051 (0.0085)	−0.025 (0.0085)
Math score			0.147 (0.0056)	0.093 (0.0059)	0.059 (0.0062)
Reading score			0.057 (0.0055)	0.034 (0.0054)	0.031 (0.0054)
High school rank percentile/100				0.410 (0.018)	0.383 (0.019)
Courses (semesters)					
Math					0.025 (0.0026)
Science					0.025 (0.0020)
Family background	No	Yes	Yes	Yes	Yes
Observations	9375	9375	9375	9375	9375
R^2	0.002	0.120	0.251	0.289	0.311
NELS: 1992 graduates	(1)	(2)	(3)	(4)	(5)
Female	0.073 (0.012)	0.091 (0.011)	0.101 (0.010)	0.047 (0.010)	0.055 (0.010)
Math score			0.196 (0.0077)	0.124 (0.0082)	0.081 (0.0084)
Reading score			0.015 (0.0076)	−0.002 (0.0074)	0.003 (0.0072)
High school rank percentile/100				0.515 (0.023)	0.402 (0.024)
Courses (Carnegie)					
Math					0.068 (0.0067)
Science					0.058 (0.0057)
Family background	No	Yes	Yes	Yes	Yes
Observations	6671	6671	6671	6671	6671
R^2	0.006	0.133	0.280	0.330	0.358

Sources: Wisconsin Longitudinal Survey (WLS) 1957; National Longitudinal Survey (NLS) 1972; and National Educational Longitudinal Survey (NELS) 1988.

Notes: The dependent variable is whether the high school senior received a four-year college degree (bachelor's degree) within seven years (WLS, NLS) to eight years (NELS) of high school graduation. The mean of the dependent variable by sex is 0.143 for females and 0.217 for males in the 1957 class (WLS); is 0.257 for females and 0.297 for males for the 1972 class (NLS); and is 0.420 for females and 0.347 for males in the 1992 class (NELS). Math and reading achievement test scores and IQ scores are normalized into z-scores. High school rank percentile is a student's percentile rank in their senior class. Courses are measured in terms of semesters in the WLS and NLS and by Carnegie units (full-time annual equivalents) in the NELS. Family background variables include log (family income), four race/ethnicity dummies, and four dummies for mother's education. The race and ethnicity dummies are not available for the WLS. Missing data dummies are included for the three course variables, mother's education, and family income. The regressions are linear probability models run by ordinary least squares. The regression samples are slightly smaller than the full samples for the descriptive tabulations in Appendix Tables 1, 2, and 3 because we delete observations with missing college-completion, test-score, or high-school-rank information from the regression samples. Standard errors are in parentheses.

starting point, because males dropped out of high school at higher rates than did females from more disadvantaged families. Because girls outperformed boys in high school rank but graduated from college at considerably lower rates, the coefficient on the female dummy almost doubles in absolute value when high school rank percentile and IQ decile are added in column 4. The addition of semesters of math and science courses shrinks the gender gap back to 7.5 percentage points. Thus the covariates taken together do nothing to explain the gross gender difference in 1957.

In the comparable regressions for 1972 shown in the second panel of Table 1, the raw gender gap in college completion in the first column shows a disadvantage for women of 3.9 percentage points, which falls to 1.9 percentage points when adjusted for family background factors in column 2. Adding test scores and high school rank increases the female deficit, this time to 5.1 percentage points, and adding math and science classes reduces the deficit back to 2.5 percentage points. Once again, the gender gap is not much affected by adding these additional covariates.

In the third panel of Table 1, using the data for 1992 high school graduates, the family-background-adjusted coefficient on the female variable (in column 2) reverses from a disadvantage of 1.9 percentage points in 1972 to an advantage of 9.1 percentage points in 1992, for a total gain of 11.0 percentage points. The addition of the full set of variables in column 5 in 1992 reduces the female coefficient by 40 percent of its gross value (0.055 versus 0.091). Whereas almost none of the gender gap favoring males could be explained for the 1957 and 1972 graduating classes, about 40 percent of the female advantage can be explained through the combined impacts of test scores, grades, and courses in 1992.

Table 2 estimates separate coefficients for the determinants of receiving a bachelor's degree for males and females using the 1972 and 1992 cohorts, an approach offering some new insights. Even though the typical high school senior female in 1972 had a high school rank considerably above her male counterpart, the importance of her high school rank paled in comparison to that of a male's. Each percentile rank point for the girl was worth just 0.6 that for the boy, using the coefficients in the top panel of Table 2 (0.295/0.472). By 1992, the situation had reversed and each percentile rank point for a girl was worth almost 1.6 times that for a boy. Girls gained substantially on boys in taking science and math courses essentially reaching parity in 1992, and these courses were more important determinants of college completion in 1992 than 1972 (even adjusting for the shift between 1972 and 1992 in measuring math and science classes from semesters to Carnegie units, where about 0.6 semesters equal one Carnegie unit). Finally, the large increase in math and reading scores for girls relative to boys from 1972 to 1992 positively affected their college completion rate.

What role did the proximate determinants of high school test scores, courses, and grades play in the reversal of the gender gap in college graduation from the mid-1970s to the mid-1990s? One approach to answering the question involves taking the change in the female coefficient from 1972 to 1992 (using the regression

Table 2
Determinants of College Completion among High School Graduates by Sex

	Males		*Females*	
NLS: 1972 graduates	*Coefficient*	*Means*	*Coefficient*	*Means*
Dependent variable: BA = 1		0.297		0.257
Math score	0.063	0.158	0.054	−0.118
	(0.0091)		(0.0085)	
Reading score	0.022	−0.0013	0.041	0.034
	(0.0077)		(0.0075)	
High school rank percentile/100	0.472	0.489	0.295	0.604
	(0.026)		(0.025)	
Courses (semesters)				
Math	0.020	4.13	0.028	3.29
	(0.0036)		(0.0037)	
Science	0.016	3.78	0.027	3.13
	(0.0036)		(0.0037)	
Family background	Yes		Yes	
Observations	4506		4869	
R^2	0.323		0.303	

	Males		*Females*	
NELS: 1992 graduates	*Coefficient*	*Means*	*Coefficient*	*Means*
Dependent variable: BA = 1		0.347		0.420
Math score	0.086	0.088	0.068	−0.013
	(0.012)		(0.012)	
Reading score	−0.0013	−0.061	0.026	0.142
	(0.0097)		(0.011)	
High school rank percentile/100	0.315	0.520	0.492	0.616
	(0.033)		(0.034)	
Courses (Carnegie)				
Math	0.063	3.27	0.077	3.29
	(0.0095)		(0.0094)	
Science	0.060	3.06	0.056	2.99
	(0.0080)		(0.0081)	
Family background	Yes		Yes	
Observations	3170		3501	
R^2	0.340		0.380	

Sources: National Longitudinal Survey (NLS) 1972; National Educational Longitudinal Survey (NELS) 1988.
Notes: The dependent variable is whether the senior received a four-year college degree (BA) within seven years (NLS) to eight years (NELS) of high school graduation. Variable definitions and family background controls are the same as in Table 1. Standard errors are in parentheses.

that includes all the proximate determinants (column 5 of Table 1)) and comparing it with changes in the raw gender differential adjusted for family background variables (column 2 of Table 1). The change in the female coefficient from 1972 to 1992 given by the estimates in the bottom two panels of column 5 is 8.0 percentage points (0.055 + 0.025) as compared with the 11.0 percentage point raw change given in column 2. Thus, 3.0 percentage points or 27 percent of the raw change is explained by the proximate determinants of high school test scores, courses, and grades. This approach values gender differences in the proximate determinants in each year (1972 and 1992) by the coefficients in that year.

An alternative approach would be to use the coefficients on the proximate determinants from column 5 of Table 1 for either 1972 or 1992 multiplied by the change in the gender differences in the means of the proximate determinants, as shown in Table 2. The use of 1972 (or 1992) coefficients answers the counterfactual: how different would the gender gap in college completion have been in 1972 (or 1992) had the gender gap in proximate determinants been that prevailing in 1992 (or 1972). Using the 1972 coefficients, the three proximate determinants together explain 37 percent of the total change, whereas using the 1992 coefficients they explain almost 63 percent. The difference arises almost entirely from the increased importance of math and science courses in 1992. The relative increase in girls' test scores explains about 1.5 of the 11 percentage point increase; however the decrease in their high school rank (girls increased their load of "harder" courses) lowers the explained total. Girls' relative increase in math and science courses adds 3.3 percentage points using the 1972 weights and a whopping 6.2 points using the 1992 weights.[6]

Family Socioeconomic Status

The conventional presumption has been that more-educated parents and families with greater economic resources would be relatively gender-neutral in their willingness to pay for their children's education, whereas those lower down in the socioeconomic status distribution would tend to favor sons over daughters, when they could afford to educate only some. Thus, secular increases in parental education and family income would tend to improve female relative college outcomes (for example, Buchmann and DiPrete, 2005).

We utilize the standard measures of socioeconomic status available in each of our three longitudinal surveys. The measure of socioeconomic status for the Wisconsin data on 1957 high school graduates is based on four variables: father's schooling, mother's schooling, father's occupational prestige (using the Duncan index), and parents' income. The measure of socioeconomic status for the 1972 graduates in the NLS data

[6] The full contribution of the proximate determinants using the 1972 weights is 4.1 percentage points or 37 percent of the total; using the 1992 weights the contribution is 6.9 percentage points or 63 percent of the total. Because the 1992 courses are measured in Carnegie units and those in 1972 are measured in semesters, we use the difference in the ratios of female to male courses in the two years, scaled by the absolute level of courses in each of the years, to obtain comparable units. This method is almost equivalent to using the approximation that each Carnegie unit is worth 0.6 semesters. The means for the course variable in 1972 used in this calculation exclude observations with missing values for courses.

Table 3

College Completion by Socioeconomic Status and Sex: High School Graduating Classes of 1957, 1972, and 1992

A. Whites only

Socioeconomic status (quartiles)	*WLS 1957*		*NLS 1972*		*NELS 1992*	
	Males	*Females*	*Males*	*Females*	*Males*	*Females*
1	0.087	0.047	0.138	0.095	0.152	0.211
2	0.142	0.064	0.205	0.195	0.259	0.386
3	0.225	0.155	0.303	0.271	0.474	0.508
4	0.429	0.339	0.556	0.551	0.706	0.770
Overall	0.216	0.144	0.309	0.269	0.406	0.461
Observations	4379	4609	4129	4448	2864	3203

B. All

Socioeconomic status (quartiles)	*NLS 1972*		*NELS 1992*	
	Males	*Females*	*Males*	*Females*
1	0.127	0.094	0.112	0.168
2	0.184	0.181	0.217	0.355
3	0.277	0.252	0.394	0.467
4	0.536	0.521	0.630	0.732
Overall	0.290	0.253	0.344	0.424
Observations	5046	5549	4097	4604

Sources: Wisconsin Longitudinal Survey (WLS) 1957; National Longitudinal Survey (NLS) 1972; and National Educational Longitudinal Survey (NELS) 1988.
Notes: The socioeconomic status quartiles for each survey use those high school graduates in the follow-up surveys (1964 wave for the WLS, 1979 wave for the NLS, and 2000 wave for the NELS) with nonmissing socioeconomic status data. The samples in Panel A are restricted to white, non-Hispanics in the NLS and NELS, for comparability with the WLS.

and the 1992 graduates in the NELS data use these same four variables, plus mother's occupational prestige. The socioeconomic status index in each of these samples is constructed as an average of the standardized component variables.

Table 3 shows that the conventional presumption held in 1957, but not in 1992. For the 1957 class, a far lower ratio of females to males graduated from college in the bottom half of the socioeconomic status distribution than in the top half. From 1957 to 1972, females gained on males throughout the socioeconomic status distribution, and gender parity in college graduation was reached in the top quartile of socioeconomic status by 1972. From 1972 to 1992, females moved ahead of males generating a substantial female lead in college graduation rates at *all* levels of socioeconomic status—and even for the children of low-income parents. In fact, by 1992, the ratio of females to males graduating college became considerably *higher* in the lower half of the

socioeconomic status distribution than in the upper half. These trends in the college gender gap by socioeconomic status in recent decades are similar for white, non-Hispanics, and for the entire U.S. population, as shown by comparing panels A and B of Table 3. These results also hold when parental education and income are used separately as family background indicators.

The bottom line is that the new gender gap favoring females is found throughout the socioeconomic status distribution. In contrast to the traditional pattern, the female advantage has become greatest (at least in proportional terms) for the children of families with low socioeconomic status.

Understanding Trends in the College Gender Gap

Human Capital Investment

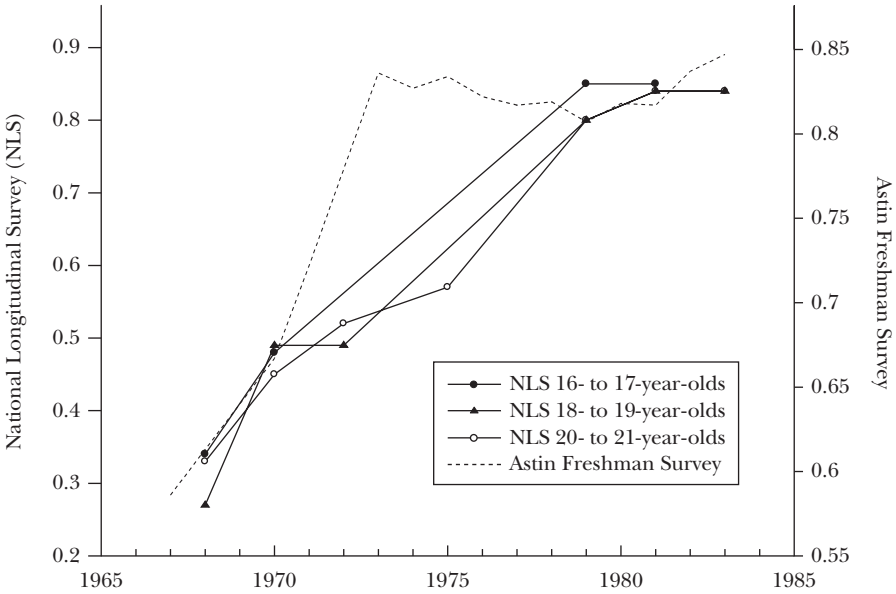
Individuals weigh the costs against the benefits of attending and graduating from college. The costs to the individual include the direct outlay for college, potential financing constraints, and the effort costs of college attendance and college preparation during high school. The benefits include the direct labor market returns to college, which depend on expected employment probabilities for those who attend college versus those who stop at high school graduation and the time path of earnings for both (thereby implicitly including the opportunity cost of college). Other possible benefits are the consumption value of higher education, its influence on one's health and parenting skills, and the role college plays in the marriage market, perhaps the most important additional factor for the issues we consider here. We will focus here on three factors that differ by sex and can help explain why females caught up and then surged ahead in college enrollment: changing expectations of future labor force participation; the age at first marriage; and behavioral problems at young ages.[7]

Changing Expectations, Social Norms, and Age at First Marriage

The expectations of young women about their future labor market participation can be gleaned from the National Longitudinal Survey of Young Women (NLS68), which surveyed fourteen- to twenty-four-year-old females beginning in 1968, and the National Longitudinal Survey of Youth 1979 (NLSY79), which surveyed fourteen- to twenty-one-year-olds beginning in 1979. Respondents were asked whether they would be "married, at home, with family" or "at work" when they were 35 years old. Figure 6 presents this data for three age groupings: 16–17, 18–19, and 20–21 years of age. In all cases the fraction who thought they would be

[7] Other factors that may have had a different effect on males and females are the constraints imposed by the admission policies of institutions of higher education, such as capacity constraints and the barring of one sex from particular institutions. For example, Currie and Moretti (2003) provide suggestive evidence that the transformation from a male-only to a coed college in one's county of residence as a youth is associated with an increase in female educational attainment.

Figure 6
Expectations and Opinions of Female Teenagers and College Freshmen: 1967 to 1984



Sources: Goldin (2005), which uses the 1968 National Longitudinal Survey of Young Women (NLS68) and 1979 National Longitudinal Survey of Youth (NLSY79); Astin Oseguera, Sax, and Korn (2002).
Notes: The National Longitudinal Survey (NLS) data are the response to whether an individual stated she expected to be in the paid labor force at age 35 and are given here for white women. The Astin Freshman Survey data are the response to whether the individual disagreed with the statement "the activities of married women are best confined to the home and family." The NLS data link the averages for each age group over time. Thus, the fourteen- to fifteen-year-olds in the NLS68 in 1968 became sixteen- to seventeen-years-olds in 1970 and are linked to the sixteen- to seventeen-year-olds in 1979 in the NLSY79. Also, the question asked in 1968 differs somewhat from that asked in subsequent years. The Astin et al. data are for female college freshman; about 84 percent of these freshmen were 18 years old in 1967 (on December 31) and 80 percent were in 1984 (on December 31).

"at work" began low—around 30 to 35 percent in 1968 and 40 to 45 percent in 1969—but rose almost continuously until the late 1970s when it reached about 80 percent. Although the rate of increase was great, it was not until the late 1970s that the expectations of young women caught up with their eventual labor force participation at 35 years of age.

A somewhat related question—concerning attitudes toward working married women—is available in the Astin Freshmen Survey, a national sample of college freshmen, the vast majority of whom were 18 years old (Astin, Oseguera, Sax, and Korn, 2002). The freshmen were asked to agree or disagree with the statement "The activities of married women are best confined to the home and family." Figure 6 graphs the fraction of female freshmen disagreeing with this statement—that is, 1 minus the fraction agreeing—for 1967 to 1984. In 1967, 41 percent of college freshmen women

agreed with this statement, but just seven years later in 1973 only about 17 percent did.[8] As in the case of work expectations, the change in attitudes towards women's employment after marriage changed substantially between the late 1960s and the early 1970s.

Rising expectations of future employment encouraged young women to attend and graduate from college. Table 4 demonstrates that large differences existed between the college attendance and completion rates of young women who stated mainly *prior to* leaving high school that they were planning to be in the labor force at age 35. Because there is noise in the responses, we focus on those who stated in *both* 1969 and 1970 that they expected to be in the labor force. For those who were 15–19 years old in 1969, the group who answered in the affirmative had an eventual college graduation rate of 0.328. Those who answered that they would be "at home" had a college graduation rate of 0.185, thus the difference is 0.143. For those 15 to 18 years old the difference is 0.121. Since the fraction expecting to be in the labor force at age 35 increased by about 40 percentage points from 1968 to 1979, the change in expectations would account for a 4.8 to a 5.7 percentage point increase in college graduation or about the entire increase from the 1949 birth cohort (0.22) to that of 1965 (0.27).

Startling demographic change occurred from the late 1960s to the mid-1970s. Young women in the 1950s could expect to marry young and have several children. Even those who eventually graduated from college married at a median age of under 23 years. With this life trajectory, many young women either secured a husband while in college or soon thereafter, and in consequence, college coursework was often taken less seriously. But after staying constant for decades, the age at first marriage began a rapid ascent.

The median age at first marriage among female college graduates increased by 2.6 years, from 22.4 to 25 years old, for cohorts born 1947–57 (and graduating college around 1969–79). The marriage age continued to increase, so that by the 1968 birth cohort (which would finish college around 1990) the median age at first marriage was 26.4 years.[9] One important contributing factor was access to reliable contraception through birth control pills. Research indicates this factor positively impacted women's college-going and graduation (Hock, 2004), post-college education, chances of having a high-powered professional career, age at first marriage (Goldin and Katz, 2002), labor force participation, and age at first birth (Bailey, 2006).

[8] A greater fraction of male than female freshmen agreed with the question in all years (54 percent in 1967). However the change in the attitudes of males corresponds to that of females (with the percentage of males agreeing declining to 27 percent by 1973). The transformation in the attitudes of college men about the paid work of married women may also have encouraged young women to further invest in college and labor market skills. See Fernández, Fogli, and Olivetti (2004) for an insightful analysis of how changes in male attitudes can affect women's labor force participation, fertility, and educational investments.

[9] These tabulations use the 1990 and 1995 Current Population Survey Fertility supplements. We estimate the median age of first marriage as the mean age of first marriage of those from the 48th to 52nd percentiles of the age-of-first-marriage distribution for college graduate women in each birth cohort.

Table 4
Role of Work Expectations on College Going and College Competition

Ages 14 to 17 in 1968 (15 to 18 in 1969)	*Expectations in 1969–70 when 35 years old*	
College outcome (N = 765)	Work	Not work
Fraction attending college (to 1985)	0.545	0.368
Fraction obtaining BA degree (to 1985)	0.312	0.191
Ages 14 to 18 in 1968 (15 to 19 in 1969)	*Expectations in 1969–70 when 35 years old*	
College outcome (N = 968)	Work	Not work
Fraction attending college (to 1985)	0.553	0.366
Fraction obtaining BA degree (to 1985)	0.328	0.185

Sources: 1968 National Longitudinal Survey of Young Women (NLS68).
Notes: The NLS68 began with females who were 14 to 24 years old in 1968. The sample used here includes white females who were in the sample in the year the question on expectations was asked. The sample is also restricted to those interviewed in 1985 to allow sufficient time for college completion and because of significant attrition from the original sample. Those who listed "married, keeping house, raising a family" as the answer to "what will you be doing when you are 35 years old" are coded as not planning to be in the labor force at age 35. The mean education for the fourteen-to-sixteen-year-olds (white) in 1985 is 0.225 for BA degree and 0.441 for any college, somewhat less than the national aggregate. Weights are not used and do not materially affect the results for whites in the NLS68. The number of observations given is that for the college attendance results.

Why Did Change Occur?

Two transformations since World War II greatly increased the pecuniary return to women's higher education: The first was an increase in female life-cycle labor force participation, without much change in the female occupational distribution. The second was a large shift in female employment out of the most traditionally female occupations such as teaching and into many previously male-dominated jobs, combined with a further increase in female labor force participation.

Table 5 places these transformations into historical perspective by looking at the labor force activity and fertility outcomes of thirty- to thirty-four-year-old, white, college-educated women at ten-year intervals since 1940. The early post–World War II cohorts of female college graduates were born from 1926 to 1930 and left college in the late 1940s and early 1950s. The group had high fertility: they were, after all, the mothers of the baby boom. They also had low labor force participation rates in their 20s and 30s, and worked most often in traditionally female-dominated occupations. As thirty- to thirty-four-year-olds in 1960, 39 percent were employed (26 percent full time), 73 percent had children at home, and 47 percent of those employed were teachers. In 1970, female college graduates born from 1936 to 1940

Table 5
Evolution of College Women's Labor Market Activities by Cohort

		White, college graduate women, 30 to 34 years old			
Birth cohort	*Year*	*Fraction employed*	*Fraction employed full time*	*Fraction with children*	*Fraction who are teachers (out of all those employed)*
1906–10	1940	0.484	0.333	0.422	0.555
1916–20	1950	0.402	0.318	0.631	0.418
1926–30	1960	0.387	0.255	0.734	0.471
1936–40	1970	0.494	0.299	0.746	0.555
1946–50	1980	0.695	0.546	0.597	0.363
1956–60	1990	0.806	0.663	0.534	0.185
1966–70	2000	0.801	0.651	0.530	0.184

Source: 1940 to 2000 Census of Population Integrated Public Use Micro-data Samples.
Notes: Samples consist of white, native-born, college graduate women, 30 to 34 years old. Fraction with children consists of those with own-children living in household.

had similarly high fertility rates, and many were teachers as well. The big difference between that cohort and the one a decade earlier was its substantially higher labor force participation: 49 percent were employed in 1970, at ages 30 to 34. In 1980, when female college graduates born from 1946 to 1950 were 30 to 34 years old, 70 percent were employed (55 percent full time), 60 percent had children at home, and only 36 percent of those employed were teachers.

Rapidly changing expectations among young women concerning their future life-cycle labor force participation started in the late 1960s. Teenage girls could look around and see the world was swiftly changing and female college graduates were increasing their labor force participation rates. The widespread legality and acceptance of the "pill" as a birth control device allowed young women to plan their futures more accurately and also helped facilitate a large increase in the age at first marriage. Other enabling factors include the resurgence of feminism, which empowered young women, and greater guarantees by the government that discrimination against women in education and employment would not be tolerated. Expectations of a large labor market payoff to college were reinforced, first in the 1960s, but especially since 1980, by a rising college wage premium and by secular labor demand shifts favoring occupations and industries disproportionately employing college-educated workers, particularly female college graduates (Katz and Murphy, 1992).

Rising expectations led to the better preparation of young women for college and the world of work. The largest narrowing in the gender gap in high school math and science courses occurred between 1972 and 1982, even though there was convergence during the entire period from 1957 to 2000. Better preparation eventually paid off as girls advanced greatly in math and reading test scores, relative

to boys, from around 1980 to 1992.[10] Not only did girls advance to college at greater rates and eventually at rates exceeding those of boys, but they also began to take courses and major in fields that were more career-oriented, especially since the mid-1970s. Whereas women earned only 9.1 percent of all bachelor's degrees in business in 1970–71, they earned 45.1 percent of such degrees in 1984–85 and 50 percent by 2001–2002. Disproportionately large increases in the female share of bachelor's degrees have also occurred in the life sciences, physical sciences, and engineering since the early 1970s (Wirt, Choy, Rooney, Sen, and Tobin, 2004).

Sources of the College Gender Gap Reversal

Why have females surpassed males in college going and college completion and not simply caught up to them? Once barriers to female careers were lowered and their access to higher education was expanded, two key factors may have played a role in the female college advantage: relatively greater economic benefits of college for females and relatively higher effort costs of college going and preparation for males.

According to most estimates, the college (log or percentage) wage premium is actually higher for women than men, and it has been higher for some time (Dougherty, 2005). As the labor force participation of women has begun to resemble men's, women have responded to the monetary returns, which have increased relatively and absolutely in recent decades.[11] Moreover, the rise in divorce rates since the 1960s and women's greater economic responsibility for children have both created incentives for women to invest in their own human capital.

Another possible reason for the reversal of the college gender gap is that girls may have lower nonpecuniary (or effort) costs of college preparation and attendance than boys. After all, girls exceeded boys in secondary school performance and attainment during most of the last century, even when the labor market barriers faced by women meant substantially lower expected labor market returns to schooling for girls than boys. The current gender gap in college curiously mimics that found for high school, especially in the early part of the twentieth century, when females in every region graduated high school at a higher rate than did males (Goldin, 1998).

One source of the persistent female advantage in K–12 school performance and the new female lead in college attainment is the higher incidence of behavioral problems (or lower level of noncognitive skills) among boys. Boys have a much higher incidence than do girls of school disciplinary and behavior problems, and

[10] We say between 1980 and 1992 because our data show a marked increase in girls' scores from 1972 to 1992, but Cho (2005) who uses the "High School and Beyond" sample for 1980 finds almost no change in the gender gap in scores from 1972 to 1980.

[11] Some evidence suggests the mean-family-income gap between those with college and high school degrees had become modestly greater for young women (25 to 34 years old) than for young men by 2000 (DiPrete and Buchmann, 2006).

spend far fewer hours doing homework (Jacob, 2002). Controlling for these noncognitive behavioral factors can explain virtually the entire female advantage in college attendance for the high school graduating class of 1992, after adjusting for family background, test scores, and high school achievement. Similarly, our own analysis of the 1979 and 1997 NLSY samples shows that teenage boys, both in the early 1980s and late 1990s, had a higher (self-reported) incidence of arrests and school suspension than teenage girls and that controls for such measures of behavioral problems significantly attenuate the female college advantage. Boys have two to three times the rate of Attention Deficit Hyperactivity Disorder (ADHD) than girls and much higher rates of criminal activity (Cuffe, Moore, and McKeown, 2003; Federal Bureau of Investigation, 2004). Boys are also much more likely than girls to be placed in special education programs.[12] The source of boys' higher incidence of behavioral problems is an area of active research and could be due to their later maturation as well as their higher rates of impatience (Silverman, 2003).

Women are now the majority of undergraduates and those receiving a bachelor's degree. The change did not occur overnight. Rather, women have made steady progress relative to men in their college attendance beginning with the 1930s birth cohorts. Between 1957 and 1972, women entered the workforce at a rapid clip, but many of them had not expected to do so and consequentially their academic preparation was lacking. By the end of the 1970s, girls had more realistic notions of their future labor force participation so that their high school preparation, especially in math and science, caught up with their expectations and their college completion rates continued to climb. Rising female college enrollment responded to changing social norms and expectations about the roles of work, marriage, and motherhood for women; greater legal protection for gender equality in the workplace; and the availability of reliable contraceptive technology. In short, a more level and wider playing field for girls enabled them to blossom and to take advantage of higher expected labor market returns to attending college. At the same time, the slower social development and more serious behavioral problems of boys remained and allowed girls to leapfrog over them in the race to college. The end result is the current gender imbalance among college undergraduates in the United States and elsewhere.

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[12] Personal communication from Janet Currie based on tabulations from the children's sample of the 1979 NLSY.

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Appendix Table 1
Wisconsin Longitudinal Survey, High School Graduating Class of 1957

Part A: Fraction in IQ and high school rank deciles by sex

IQ decile	*Male*	*Female*	*High school rank deciles*	*Male*	*Female*
0	0.106	0.0945	0	0.141	0.0617
1	0.0970	0.103	1	0.131	0.0705
2	0.0952	0.104	2	0.122	0.0789
3	0.101	0.0991	3	0.111	0.0900
4	0.0956	0.104	4	0.107	0.0932
5	0.0950	0.105	5	0.0967	0.103
6	0.105	0.0949	6	0.0827	0.116
7	0.0946	0.105	7	0.0802	0.118
8	0.104	0.0959	8	0.0684	0.130
9	0.106	0.0942	9	0.0601	0.138
Median percentile	50.7	49.4	Median percentile	39.7	60.2

Part B: Fraction obtaining BA by IQ decile, high school class rank decile, and sex

	BA degree			*BA degree*	
IQ decile	*Male*	*Female*	*High school rank decile*	*Male*	*Female*
0	0.0153	0.00965	0	0.0200	0.00376
1	0.0318	0.0201	1	0.0336	0.0132
2	0.0783	0.0333	2	0.0712	0.0263
3	0.105	0.0647	3	0.0804	0.0440
4	0.153	0.0971	4	0.194	0.0606
5	0.200	0.154	5	0.265	0.109
6	0.251	0.145	6	0.319	0.0838
7	0.305	0.236	7	0.387	0.152
8	0.431	0.275	8	0.585	0.249
9	0.560	0.427	9	0.810	0.425

Source: Wisconsin Longitudinal Survey (WLS) 1957.
Notes: The means and number of observations for the tabulation samples are:

	IQ test		*High school rank*	
	Males	*Females*	*Males*	*Females*
Obtain BA by 1964:	0.216	0.144	0.217	0.143
Number of observations	4,379	4,609	4,071	4,309

The sample includes those who responded to the 1964 follow-up survey. Deciles for each variable are based on the entire (male and female) sample for those who gave a valid response for that variable. "Obtain BA" means to have graduated from a four-year college by 1964.

Appendix Table 2
National Longitudinal Survey, High School Graduating Class of 1972

Part A: Fraction in reading and math test score deciles and high school rank deciles by sex[a]

	Composite[b]		*Reading*		*Math*		*High school rank*	
Decile	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
0	0.0947	0.105	0.109	0.0918	0.0815	0.118	0.136	0.0651
1	0.0855	0.114	0.0976	0.102	0.0901	0.110	0.125	0.0754
2	0.1050	0.0951	0.0985	0.102	0.0866	0.113	0.115	0.0849
3	0.0876	0.112	0.0958	0.104	0.0934	0.106	0.110	0.0905
4	0.0933	0.107	0.0987	0.101	0.0934	0.107	0.104	0.0959
5	0.106	0.0946	0.104	0.0963	0.101	0.100	0.0950	0.105
6	0.104	0.0964	0.102	0.0977	0.0972	0.103	0.0909	0.109
7	0.103	0.0972	0.101	0.0994	0.108	0.0921	0.0767	0.123
8	0.107	0.934	0.100	0.100	0.117	0.0833	0.0747	0.125
9	0.115	0.0855	0.0941	0.106	0.132	0.0687	0.0723	0.127
Median percentile	53.4	46.9	50.1	49.8	55.7	44.8	41.3	58.4

Part B: Fraction obtaining BA by composite score decile, high school class rank decile, and sex

Composite reading and math deciles	*BA degree*		*High school grade deciles*	*BA degree*	
	Male	*Female*		*Male*	*Female*
0	0.0224	0.0254	0	0.0402	0.0338
1	0.0565	0.0545	1	0.108	0.0591
2	0.0786	0.0869	2	0.131	0.0866
3	0.148	0.139	3	0.197	0.116
4	0.204	0.179	4	0.234	0.138
5	0.241	0.247	5	0.375	0.213
6	0.381	0.327	6	0.422	0.242
7	0.439	0.433	7	0.501	0.304
8	0.541	0.503	8	0.615	0.423
9	0.668	0.681	9	0.778	0.627

[a] We computed the deciles by randomizing individuals around the breaks to get around the problem of heaping, since the aptitude tests included fewer than 30 questions.
[b] The "composite" aptitude score is a simple average of the twelfth grade reading and math scores for comparability with the Wisconsin Longitudinal Survey (WLS), which includes only IQ. There is little reason to believe that scores would have been much different by sex in 1957, and the composite scores created in 1972 for comparison with the WLS have distributions similar to those for IQ.
Source: National Longitudinal Survey (NLS) 1972.
Notes: The weighted means and number of observations for the tabulation samples are:

	Test scores		*High school rank*	
	Males	*Females*	*Males*	*Females*
Obtain BA	0.292	0.254	0.295	0.256
Number of observations:	4,828	5,277	4,712	5,131

Sample weights are used. The sample includes those who from graduated high school by 1974 and were present in the fourth NLS follow-up in 1979. "Obtain B.A." means to have graduated from a four-year college by 1979. Deciles are based on the entire (male and female) sample.

Appendix Table 3

National Education Longitudinal Survey, High School Graduating Class of 1992

Part A: Fraction in composite deciles, reading and math test score deciles, and high school rank deciles by sex

	Composite		*Reading*		*Math*		*High school rank*	
Decile	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
0	0.106	0.0946	0.121	0.0791	0.0881	0.112	0.130	0.0696
1	0.113	0.0889	0.119	0.0808	0.113	0.0872	0.120	0.0788
2	0.0993	0.0992	0.105	0.0955	0.0843	0.115	0.120	0.0797
3	0.102	0.0980	0.0990	0.101	0.0981	0.103	0.108	0.0921
4	0.0920	0.108	0.0911	0.109	0.0960	0.103	0.100	0.0996
5	0.0904	0.109	0.0931	0.109	0.0907	0.109	0.0937	0.107
6	0.0917	0.108	0.0954	0.106	0.105	0.0961	0.0800	0.121
7	0.104	0.0964	0.0886	0.108	0.0982	0.101	0.0859	0.115
8	0.964	0.103	0.103	0.100	0.108	0.0923	0.0797	0.120
9	0.105	0.0946	0.0875	0.112	0.119	0.0808	0.0822	0.118
Median percentile	49.0	51.0	46.6	53.5	53.2	48.3	42.1	57.8

Part B: Fraction obtaining BA by composite test score decile, high school class rank decile, and sex

Composite reading and math deciles	*BA degree*		*High school grade deciles*	*B.A. degree*	
	Male	*Female*		*Male*	*Female*
0	0.0895	0.0639	0	0.0562	0.0498
1	0.229	0.182	1	0.145	0.0990
2	0.171	0.199	2	0.184	0.163
3	0.301	0.265	3	0.232	0.210
4	0.370	0.325	4	0.314	0.209
5	0.347	0.393	5	0.394	0.353
6	0.399	0.538	6	0.424	0.495
7	0.465	0.613	7	0.582	0.579
8	0.540	0.671	8	0.624	0.714
9	0.718	0.762	9	0.752	0.863

Source: National Educational Longitudinal Survey (NELS) 1988, restricted-access sample.
Notes: The weighted means and number of observations for the tabulation samples are:

	Test scores		*High school rank*	
	Males	*Females*	*Males*	*Females*
Obtain BA:	0.349	0.420	0.338	0.417
Number of observations:	3,751	4,193	3,642	4,037

Sample weights are used. The sample includes on-time high school graduates of the class of 1992 who were present in the 2000 follow-up survey. Test score deciles are based on the entire (male and female) sample with nonmissing data for 12th grade math and reading test scores. The composite test score is the average of the math and reading normalized test scores. High school rank deciles are based on the entire sample with nonmissing high school rank data. "Obtain BA" means to have graduated from a four-year college by 2000.

Appendix Table 4
Courses Taken by High School Graduates: 1957 to 1992

	Semesters[a]						*Carnegie Units*[a]					
	1957 Graduates WLS			*1972 Graduates NLS*			*1982 Graduates*			*1992 Graduates NELS*		
	Males	*Female*	*M/F*	*Males*	*Females*	*M/F*	*Males*	*Females*	*M/F*	*Males*	*Females*	*M/F*
Total academic	22.79	21.30	1.07	21.61	20.52	1.05	12.82	13.00	0.99	15.17	15.76	0.96
Math	4.02	2.89	1.39	4.18	3.36	1.24	2.71	2.57	1.06	3.22	3.22	1.00
Algebra	2.27	1.78	1.27							1.55	1.59	0.97
Geometry	1.46	1.05	1.39							0.74	0.76	0.97
Trigonometry	0.29	0.063	4.57							0.18	0.17	1.04
Science[b]	3.76	2.90	1.30	3.82	3.18	1.20	2.27	2.13	1.07	2.99	2.94	1.02
Biology	1.62	1.73	0.93				0.91	0.97	0.94	1.14	1.23	0.93
Chemistry	1.14	0.87	1.32				0.36	0.33	1.09	0.63	0.65	0.97
Physics	1.01	0.30	3.39				0.23	0.12	1.92	0.33	0.23	1.43
Foreign lang.	1.25	1.72	0.73	1.87	2.36	0.79	0.80	1.17	0.68	1.55	1.99	0.78
Social studies[c]	6.42	6.28	1.02	5.48	5.35	1.02	3.16	3.15	1.00	3.39	3.50	0.97
English	7.33	7.50	0.98	6.27	6.26	1.00	3.88	3.98	0.97	4.02	4.12	0.98

[a] The WLS and NLS measure actual semesters, although the total number of semesters in the WLS may be understated somewhat by the absence of "other" academic subjects within the major categories. The NELS measures courses in Carnegie units, which are a standard of measurement that allots one credit for each one-year (full-time equivalent) course completed.
[b] Separate subjects do not sum to total.
[c] Social studies includes history.
Sources: Wisconsin Longitudinal Survey (WLS) for 1957, National Longitudinal Survey (NLS) for 1972, National Educational Longitudinal Survey (NELS) for 1992, and U.S. Department of Education (2004), Table 137, for 1982.
Notes: Only academic courses are listed. Semesters or units, depending on the study used, are not comparable across surveys. WLS: Missing values for courses are coded as zero. Only students with more than twelve total academic courses as seniors are counted. The restriction eliminates just 9 percent of all seniors in the survey. The resulting sample contains 4,545 males and 4,843 females. Data are from student self-reports. NLS: Missing values for courses are coded as zero. Only students with more than six total academic courses as seniors were counted. The restriction eliminates less than 2 percent of all seniors in the survey. The resulting sample contains 4,519 males and 4,878 females. Course data were extracted from high school records. NELS: Observations with missing values for courses are deleted. The sample contains 4,120 males and 4,593 females. Data are from transcript records.