Leaving Boys Behind: Gender Disparities in High Academic Achievement[1]

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Abstract

Using three decades of data from the "Monitoring the Future" cross-sectional surveys, this paper shows that, from the 1980s to the 2000s, the mode of girls' high school grade distribution has shifted from B to A, essentially "leaving boys behind" as the mode of boys' grade distribution stayed at B. We appeal to a "signaling" type model of academic achievement to argue that educational expectations should play a prominent role, given a level of aptitude, in an individual's choice of optimal GPA. In an extended Oaxaca-Blinder decomposition of academic achievement, we do indeed find the most important factor accounting for the growing gender gap in high academic achievement are gender differences in post-secondary expectations, in particular the growing proportion of girls who aim for a post-graduate degree. We also find that high achieving girls are "swimming upstream" relatively unfavorable family environments.

Keywords: Academic achievement, educational expectations, gender differences, high school grades, boys' problem.

JEL codes: I210 (Analysis of Education), J16 (Economics of Gender), J24 (Human Capital)

1. Introduction

Women now far outnumber men among recent college graduates in most industrialized countries (OECD, 2008). Their growing dominance in education attainment raises new questions about gender disparities arising throughout school-ages.[2] Girls have long obtained better grades, on average, in high school than boys.[3] As shown in Figure 1, the average gender gap in GPA among high school seniors (scaled out of 4 points) hovers steadily around 0.2 between 1976 and 2009.[4] But because historically these achievements never translated into higher levels of educational attainment or better labor market outcomes for women relative to men, earlier research has instead concentrated on explaining the remaining gaps in women's performance, particularly in mathematics (e.g. Guiso et al., 2008; Bedard and Cho, 2010, Niederle and Vesterlund, 2010). Conversely, the relative underperformance of males, especially in reading, has attracted little attention until recently (LoGerfo, Nichols, and Chaplin, 2006).

Interest in the academic performance gap favoring women is changing for a number of reasons. As the manufacturing sector is shrinking, the "good jobs" that men once obtained without a post-secondary education are becoming harder to find. The new gender enrollment imbalance in some university disciplines, such as medicine, has generated concerns about future labor shortage in some specialties that attract few women, such as orthopedic surgeons, and has lead to reverse affirmative action. Repercussions for the marriage prospects of college-educated women (Blank, 2011), and concerns among boys' parents about a "failure to launch" (Bell, Burtless, Gornick and Smeeding, 2007) are among the other preoccupations behind the growing interest for the issue. There are now numerous books and articles in the popular press discussing the relative underperformance and under motivation of boys, and their late entry into adulthood.[5]

The goal of this paper is to first document changes in gender disparities in academic performance of high school students (12^{th}, 10^{th}, and 8^{th} graders) over the last three decades using

[2] According to OECD (2008), the average share of the student population in tertiary education in OECD countries accounted for by women reached 55% in 2005. Only four countries are likely not to achieve at least parity between men and women by 2015: Korea, Turkey, Japan and Switzerland.
[3] This is observed in other countries as well. See Machin and McNally (2005) for Britain, Lai (2010) for China.
[4] The gender gap in GPA from the MTF match (within standard errors) the numbers from the NAEP High School Transcript Study for 1990, 2000, 2005 and 2009, also reported in NCES (2004), as well as the numbers reported in Cho (2007) for 1984 from the HS&B survey.
[5] See among others, Tyre (2008), Gurian and Stevens (2007), Sax (2008). By contrast, popular books in the 1990s were concerned about girls being disadvantaged by school system (e.g. Sadker and Sadker, 1994; AAUW,1992).

survey data from the "Monitoring the Future" (MTF) project.[6] We show, in particular, that the progressive erosion of "grading on the curve" has resulted in an increasing proportion of girls among the very top achievers. As the percentage of 12th grade students reporting in the MTF that they earn A's (93-100%) almost doubles, from 8.5% in the 1980s to 16.6. % in the 2000s, the difference between the fraction female to the fraction male in this category also doubles from 3.2% to 5.4%.[7] From 1990s to the 2000s, the female advantage in the proportion of 10th and 8th graders earning A's also increases, from 3.6% to 4.8% and from 4.9% to 5.5%, respectively.

The second aim of the paper to identify the relative importance of three sets of determining factors, which changed over time, in accounting for the growing gender disparities in high academic achievement.[8] These include family environment, working while in school, and future aspirations. The data does not allow us to consider the effect of the teachers' gender (Dee, 2005, 2006) or the effect of teaching styles (Algan, Cahuc, and Shleifer, 2010) which have attracted recent attention.[9] But some studies (Kramarz, Machin, and Ouazad, 2008) suggest that these effects are smaller in magnitude than those of student ability or family background variables, which we include in our analysis. Moreover, to the extent that teaching styles may be linked the teacher's gender, CPS data shows that the proportion female (ranging from 55% to 59%) among secondary school teachers has changed very little over the time period considered.

As first observed by Ben-Porath and Welch (1976) boys and girls are raised in different family environments. Our study also shows important differences in family composition. Families with girls are, on average, larger (in line with Angrist and Evans, 1998), have less educated parents, more absent fathers (Dahl and Moretti, 2008), and more working mothers, with the last two gender gaps in family characteristics increasing over time.[10] These time trends would seem to disadvantage girls, suggesting that high achieving girls are actually "swimming upstream" perhaps reacting to more difficult circumstances. Another changing factor is the decreasing labor force participation of boys during high school; among high school seniors, participation went from 85% in the 1980s to the 76% in the 2000s, when about three-quarters of

[6] To the best of our knowledge, Jacob and Wilder (2010) is the only other paper using the MTF to study educational expectations. They focus on their impact on educational attainment (college going).

[7] In the MTF, an A grade corresponds to a percentile grade in the 93-100% range. The exact years are 1976 to 1988 for the 1980s, and 2000 to 2009 for the 2000s for 12th graders, and 1991-1999 for the 1990s for 10th and 8th graders.

[8] See Buchmann, DiPrete, and McDaniel (2008) for a review.

[9] We are however able to assess the importance of the type of high school (academic, general, vocational, etc.).

[10] See Lundberg and Rose (2002) on the gendered effects of children on fathers' labor supply and wages.

both boys and girls had some sort of paid employment during school.[11] To the extent that negative effects of working during school are expected for a wide range of high school students (Tyler, 2003; Rothstein, 2007), the time trends should prevent boys from falling behind in high school grades. On the other hand, working during school in entry level jobs could play a role in motivating students to pursue higher education and may thus have different effects across the GPA distribution.

Finally and most importantly, another set of factors that changed over the last three decades are the post-secondary aspirations and expectations of high school students, as well as their choice of high school (from vocational to academic) to enact these career plans. Figure 2a shows the expectations facet of the well-known reversal in the gender gap in college enrollment analyzed by Goldin, Katz and Kuziemko (2006). It shows that from 1976 to 1983, boys and girls had similar expectations about going to college, but that a gap progressively opened thereafter stabilizing around 12% in the 2000s. Figure 2b presents that gender gap expressed as the proportion of females among students who say that they will definitively go to a four year college. Among 12th graders, that proportion was around parity up to the early 1980s, overshooting actual enrollment rates by a few percentage points in the 1990s to stabilize around 57% in the 2000s. Interestingly, the gender gap in expectations to attend a four year college is shown to emerge as early as grade 8, when it hovers around 55%. Goldin and Katz (2002) have argued that the 1970s "Pill Revolution" was crucial in allowing young women to formulate plans for higher education without the fear of interruptions for family reasons. We argue that in subsequent decades, the ongoing progress of women in the professions has continued to fuel young women's career plans involving graduate and professional schools. At the same time, with the advent of computerization and other office technologies, in the 2000s clerical work seems to have lost much of its appeal for young women.[12]

Our set of expectation variables includes a full range of career plans for life after high school, including vocational and graduate school as well as serving in the military. As explained below, the expectation variables are thought to subsume the effects of gender difference in the returns to college (Jacob, 2002; Cho, 2007) or the anticipated dispersion regarding those returns (Charles and Luoh, 2003). As pointed out by Manski (2004), when using expectations data, it is

[11] However as shown below, boys continue to work longer hours and earn more money.
[12] See Table A1.

important to clarify the assumptions held about the information used to form of these expectations. In context of educational expectations, whether youths condition these expectations on returns to college, ability or financial constraints could lead to different interpretations of the results. Fortunately, the MTF surveys also include data on educational aspirations and subjective school ability which allows us to condition, at least partially, for some potentially endogenous effects, and to present bounds on the effects of educational expectations with and without these controls.

As with most studies of changes in gender differentials, we cannot appeal to an experimental or quasi-experimental setting to explore how an individual assigned a gender at random would behave and how his/her environment would respond.[13] We have to construct counterfactual states of the world based on the observed responses and respective endowments of males and females. We then apply decomposition methodologies (Fortin, Lemieux, and Firpo, 2011) aimed at separating endowment effects from response effects under the assumption that the distribution of unobservables conditioning on observables is independent of gender. The goal of the exercise is to assess the relative importance of the potential explanatory factors in order to identify the ones that may warrant a more careful investigation of a causal link. We focus on a distributional approach to analyze changes over time in GPA because average gender differences in GPA have not changed over the past thirty years, while the gender ratio of students admitted to college, those with high GPA, has changed dramatically. In so doing, we also contribute a distributional understanding to increases in average GPA over time.[14]

The paper is organized as follows. Section 2 presents the simple "signaling" type model of academic achievement that motivates the estimation procedure. Section 3 introduces the MTF surveys and presents some descriptive statistics about gender disparities in academic achievement and in the explanatory factors, as well as changes over time therein. The decomposition methodologies are explained in Section 4. Section 5 presents the decomposition results and their interpretation. Finally, section 6 concludes.

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[13] Notable exceptions are audit studies where the gender of the individual is hidden (Goldin and Rouse, 2000), and the authors study how the environment responds without knowing the gender of the individual.

[14] By contrast, grade inflation should refer to changes in the price of grades (e.g decrease in study time). Because they compress the grade distribution, rising grades are different from rising nominal prices. The term "grade inflation" may be an imperfect analogy.

2. A Simple Model of High School Performance

We begin by presenting a simple model of academic performance to illustrate that, despite the fact that girls have long had better school ability than boys, it is their changing aspirations for the future that led girls to capture a larger proportion of high grades. The model also helps rationalize the relative underperformance of boys as the consequence of career choices that require lower levels of educational attainment. Models of high school performance in economics are usually set as derivatives of the Mincerian human capital investment model where individuals choose their level of schooling to maximize their life-cycle earnings. Here we want think of decisions taken earlier in life when labor market outcomes are not as concrete or narrow as returns to college, but would come out as the answer to the typical question: "What do you want to do when you grow up?"[15] At this stage, parents are likely still involved in the education of their children, perhaps actively assisting them with homework, helping them set goals, and manage their time. The model thus borrows from the model of intergenerational transmission of income status (Becker and Tomes, 1979), the idea that the other generation's utility, the parents in this case, enters the decision maker's objective function. The parents' utility from their offspring educational expectations depends on their own characteristics, such as their own level of education, as well as on the school ability or aptitude of each child. Over the last three decades, the exogenous changes in the opportunities for women in the labor market have led many parents to have higher educational expectations for their daughters. As shown in Chen, Fortin, Phipps, and Oreopoulos (2011), in the 2000s, parents of primary school students had higher educational expectations for their daughters than for their sons.

As in signaling models of educational choices (Spence, 1973), we want to allow for the fact that, given a level of aptitude, an individual may find it optimal to aim for the minimum GPA needed to reach a career or educational goal. Implicit in our framework is the fact that basic school ability is revealed quite early in the pupil's schooling experience and that the level of aptitude of the individual figures more prominently in educational/career choices than it does in human capital investment models.[16] This also contrasts with learning models (Stange, 2008)

[15] For example, DiPrete and Buchmann (2006) suggest that gender differences in college enrollment may arise because women's marriage market possibilities and social status may be enhanced by college going above and over the simple returns to college.
[16] There is an emerging consensus in the psychology literature that the grade level at which students form reliable perceptions of academic competency is around 5th grade (Herbert and Stipek, 2005).

where academic ability for college is revealed slowly over time and where individuals revised their schooling decisions. We think that both models are adequate representation of the behavior of some subsets of individuals. The updating of educational expectations is perhaps more salient among college/university students who face more fateful choices about which major to pursue or whether or not to pursue their studies (Zafar, 2011) than among high school students for whom the salient choice is once they reach minimum school leaving age. Despite updating by some individuals, results in Stange (2008) and Jacob and Wilder (2010) support the idea that a large proportion (40%-66%) of individuals is actually successful at enacting their early educational plans. More importantly, because we use cross-sectional data, the model is set in a static framework.[17]

A pupil comes to secondary school with a basic aptitude for school (A_i) that was largely revealed during elementary school and with plans for future education likely influenced by parental desires, and aims for a GPA (G_i) in the range $R_j(G_i) = I[l_j \leq G_i \leq u_j]$, where I is the indicator function, that will allow him/her to pursue further schooling/career plans ($S_j\, j = 1, \ldots, J$). As illustrated in Figure 3, this simplified functional form for $R_j(G_i)$ assumes that with probability one that a student with a GPA in the indicated range will be able to pursue her education plans.[18] The student chooses a level of effort and target GPA to maximize her utility from schooling plans minus costs, $C(G_i)$, plus an intergenerational utility component,

$$Max_{\{G,E\}}\, U_i\{S_j - C(G_i)\} + \alpha U_i^p(S_j, A_i),$$

$$\text{subject to } S_j(G_\text{i}) = I\big[l_j \leq G_i \leq u_j\big], \qquad j = 1, \ldots, J$$

$$C(G_i) = f(E_i, A_i).$$

The component $U_i^p(S_j, A_i)$ represents the utility to the parents of having an offspring of ability A_i in reach of educational level S_j, and α is the weight placed by the student on parental utility. This last parameter is potentially important is assessing gender differences, as psychologists argue that girls place more importance on pleasing adults than boys. Assuming separability of schooling plans and costs, however, parental utility merely acts to scale the rewards of a

[17] We do not exclude the possibility that some students revise their plans, but because we do not have access to the MTF longitudinal data, we cannot explore this avenue.
[18] In reality, the discontinuities do not need to be as sharp as illustrated in Figure 3.

schooling plan. The effect of parents' other characteristics might have similar rescaling effects on the cost function.[19]

Importantly, the cost of getting a particular grade, $C(G_i) = f(E_i, A_i)$, is decreasing non-linearly with ability, $\frac{\partial f(E_i,A_i)}{\partial A_i} < 0$, and $\frac{\partial^2 f(E_i,A_i)}{\partial A_i} > 0$. The cost of academic achievement is increasing with effort, but there may be some complex non-linear interactions between effort and ability, possibly different by gender, that we do not attempt to model directly here, but leave for future research.[20] The mapping $R_j(G_i)$ of GPA into educational plans may include a more complex step function than the one above, where there are different probabilities of attaining educational choice S_j by GPA level.[21] What is important in leading some students to optimally choose lower levels of GPA are the discontinuities in access to educational choice by GPA, as shown in Figure 3.

In Figure 3, the utility of three educational choices for student *i*, $U_i(S_j) = w_i * I[l_j \le G_i]$, are displayed as simple step functions, for *j*=two-year college ($w_i = 4, l_{2-yr} = 2$), four-year college ($w_i = 7.5, l_{4-yr} = 3$), and graduate school ($w_i = 10, l_{grad} = 4$). The cost functions illustrated in Figure 3, subsumed in their functional forms the level of effort needed for high, medium and low ability students to achieve that higher GPAs, showing that it is are more costly lower ability students to obtain high GPAs. Thus the choices of GPA, $G_i^*(A_i, S_j)$, which maximize the utility net of achievement cost for each ability level, are the lower bound of each educational choice. That is, the low ability student will target a GPA of 2 to access two-year colleges, the medium ability a GPA of 3 to access four-year colleges, and the high ability student a GPA of 4 aiming to attend graduate school. Letting $G_i^{max}(A_i) = G_i^*(A_i, S_J)$ be the highest grade that a student, with a given level of ability A_i, can attained when the student has the highest educational aspirations $j = J$ (e.g. graduate school), then a student's optimal choice of GPA may reflect potential educational under-achievement $G_i^*(A_i, S_k) < G_i^{max}(A_i)$. This potential educational underachievement may be of concern when students' educational aspirations are

[19] The role of teachers in this model would be similar to that of parents in lowering the cost of academic achievement and enhancing its benefits by motivating students to succeed.
[20] Bishop (2006) argues that there are different studying and homework cultures by gender, something like "smart boys get high marks without showing effort" or 'it is not cool for boys to work hard to get top grades".

limited by lack of information, borrowing constraints, time impatience, or other intertemporal optimization errors.

In this study of gender gaps in academic achievement, we seek to identify how the distribution of student characteristics maps into the distribution of GPAs differently by gender, taking into account the different educational expectations of the students, controlling for student ability, students' aspirations, labor market work and for the family environment. We are primarily interested in how changes over time in these determinants help account for changes over time in gender differentials in academic achievement. To the extent that women's educational expectations and aspirations have changed over time for exogenous reasons, we will be able to argue that these changes explain the changes in gender achievement gaps. We will estimate the following academic achievement equation,

$$Prob[G_i = c] = h_g^c(S_i, A_i, L_i; X_i, X_i^p), \qquad c = 1, \dots, 9 , \tag{1}$$

where S_i denote the educational expectations and A_i denote the student' school ability, ideally measured in elementary school. Here, we combine choice of high school (academic, general, vocational), school expectations and aspirations to measure S_i, and A_i is proxied using either a subjective measure of school ability or measures of cigarette smoking and alcohol binging, which may relate to time impatience.[22] We include a derived measure of effort, following the tradition in labor economics of deriving non-market time, here study time, as the difference between total time (T) and labor market time (L_i): $E_i = T - L_i$. Some exogenous characteristics of students X_i, race and living in a SMSA, and as well as extended set of family characteristics, X_i^p, thought to be pre-determined variables, are included in the specification.[23]

We estimate a different linear probability model by gender for each level of GPA, which carries some advantages and disadvantages. The advantages of using a linear probability model are that we do not have to rely on the assumptions of normality of residuals and do not have to estimate the variance of residuals, a nuisance parameter, which limits the identification of the effects to relative effects. By comparison with an ordered probit model, this model allows the educational responses to be different by level of GPA. Given that the detailed decomposition of the gender differentials requires linear educational responses, this estimation procedure gives us

[22] Educational aspirations and subjective school ability measures are available only for the 12th graders.
[23] These family environment characteristics include absent father, absent mother, living in the same household as siblings, the number of siblings, whether the mother had a paid job while growing up (not at all, some of the time, most of the time, all the time), the level of education of the father and of the mother.

coefficients that can readily be used. By comparison with a multinomial logit, there is no need to compute the marginal effects at the mean of characteristics, which may not correspond to a representative student for some GPA levels. Among the disadvantages is the fact that the predicted probabilities are not bounded between 0 and 1. In practice, we will find some under-predictions (<0), but the predicted probabilities over GPA levels sum to 1.

3. Data and Descriptive Statistics

The data used are from the "Monitoring the Future" project, which for more than thirty-five years has been measuring behaviors, attitudes, and values of American secondary school students. These data have been collected by the Institute for Social Research, University of Michigan mainly to monitor substance abuse every year from 1976 onwards for 12th graders, and from 1991 onwards for students in Grades 8 and 10. Given higher male drop-out rates (Heckman and Lafontaine, 2008), the sample of boys in 12th grade is likely a positively selected sample of boys, which will lead to understate any gender gap favorable to girls by comparison to a wider sample of boys. It is thus useful to compare high school seniors with high school sophomores and 8th graders, who remain subject to minimum age school leaving laws. Because of the focus on drug use, those who use illicit drugs as seniors are oversampled, we are thus careful to use the sample weights provided to remove any bias resulting from that oversampling. We use the cross-sectional surveys, which comprise 10,000 to 16,000 observations per grade per year for the core questions, resulting in close to half-a-million observations over the entire period. There exists a seldom accessible longitudinal component, which surveys a small subset of the students (Bachman et al., 2002). Many more attitudes and behavioral questions are asked of students answering one of 6 modules.[24] We focus here on the core sample because of the larger sample sizes available, which allow us to perform the breakdown by gender and GPA.

Most variables from the MTF are coded categorically. For variables with non-ordinal categories (e.g. type of high school), we simply use categorical dummies. For ordinal variables that do not have a metric but are available in n categories (e.g. likeness of attending a 4-year

[24] The surveys contain a host of non-cognitive variables but they are asked only of a subset of students. Acknowledging that some psychologists (e.g. Duckworth and Seligman, 2006; Hicks, Johnson, Iacono and McGue, 2008) have argued that self-control and self-discipline give girls the "edge", and these issues are at the center of the ADHD debate (Elder and Lubotsky, 2009), we attempt to capture a similar notion with the "alcohol binging" variable, which is present in the core sample.

college, subjective school ability), we generally use the following formula to rescale the index from 0 to 1: Category $k = 1 - (n - k + 1)/(n + 1)$, when $k = n$ is highest category to be recoded into 1. This recoding presumes equal distance between the categories. For the decomposition analysis, these variables are further normalized to have a zero mean over the entire sample of boys and girls.

Our dependent variable is the self-reported school grade which is elicited from the following question: "Core 20: Which of the following best describes your average grade so far in high school? D (69 or below), C- (70-72), C (73-76) , C+ (77-79), B- (80-82), B (83-86) , B+ (87-89), A- (90-92), A (93-100)."[25] Obviously, grades from administrative data are preferable to self-reported grades because students with different characteristics may misreport their grades differently.[26] Self-reported grades from the MTF, however, are likely quite reliable for several reasons.

First, there are other questions in the survey of seniors asked before this one directed at getting subjective assessments of school ability (Core 16) and intelligence (Core 17) , which would allow students, so inclined, to boast about their abilities. We do, in fact, use the subjective school ability response to the question: "Core 16: Compared with others your age throughout the country how do you rate yourself on school ability? Far below average, below average, slightly below average, average, slightly above average, above average, far above average" as control variable in some specifications. Not surprisingly, a smaller proportion of students state that their ability is "far below average" than is found in the question about average GPA. We note that the raw correlation between subjective school ability and self-reported grades is only 58% among seniors.[27] Following the results of Stinebricker and Stinebricker (2008) who find that college students are generally overconfident about their school ability when they enter college, it seems reasonable to assume that students use the subjective measure when forming educational expectations.

Second, the wording of the question on self-reported grades in terms of an upward scale is similar to commonly used questions about self-reported income where individuals are asked to

[25] Following standard institutional practice, the self-reported grades in the 9 categories are translated in the numbers: A (93-100) 4.0, A- (90-92) 3.7, B+ (87-89) 3.3, B (83-86) 3.0, B- (80-82) 2.7, C+ (77-79) 2.3, C (73-76) 2, C- (70-72), 1.7, D (69 or below) 1, where 2.3 and 2.7 and so on, are the rounded versions of 2.333 and 2.666.

[26] See Balsaa, Giuliano, and French (2011) on grade misreporting by alcohol-binging students.

[27] Note that the questions about subjective school ability and educational aspirations were not asked of the 8th and 10th graders. For these students, we only have educational expectations.

declare in which income bracket their income falls and may be less prone to error than simple declarative questions. Finally, as mentioned in the introduction, when we compare the average grades of 12th graders from the MTF to those of the NAEP High School Transcript Surveys (HSTS), we find that the gender differences, as well as the grade inflation, do match within standard errors, even though the scales used are somewhat different.[28]

Table 1 reports simple difference-in-difference estimates of the changes over time and by gender in self-reported grades and in expectations about attending graduate or professional school of 12th graders. We study three time periods roughly corresponding to the 1980s (1976-1988), the 1990s (1989-1999) and the 2000s (2000-2009). Figure 1, Panel A of Table 1 shows little change over time in the significant female advantage of about 0.2 (on a 4 point scale) in average grades, if anything boys have made small gains (0.010-0.011) in relative grades. Panel B shows that the stability in average grades masks a significant increase in the female advantage in the proportion of students with the highest grades (A (93-100) students), which represent the pool of students who can be confident of being admitted to graduate school if they continue the good work in their undergraduate studies. Panel C shows an even greater and significant increase of the female advantage in expectations of attending graduate school. Indeed from the 1980s to 1990s, the proportion of women expecting to attend graduate school more than doubled from 10% to 21%, while the proportion of men increased by 50%, from 10% to 15%. The fact that the increase in the gender differential in expectations to attend graduate school was more sizeable (5.3%) from 1980s to 1990s, when women' progress in the labor market was sharpest, than from 1990s to the 2000s (2.6%) are in line with our conjecture that gender differences in plans for the future fuel gender differences in high academic achievement. Panel D provides additional descriptive evidence showing that the girls' higher educational expectations are driven by career choices that require graduate studies. In the smaller sample of seniors who answered module 4, the proportion of girls thinking that, at age 30, they will work as a professional with a doctoral degree (or equivalent) has grown by 11.5% from the 1980s to the 1990s, while the equivalent proportion of boys has grown only by 3.3%.[29] Moreover, when asked how likely it is that they

[28] The HSTS scale has 5 categories, which include a zero: A(90–100) 4.0, B(80–89) 3.0 , C(70–79) 2.0, D(60–69) 1.0, F (less than 60) 0.0.

[29] It is interesting to note that they were no significant increases from the 1990s to the 2000s in those proportions. The questionnaire explicitly lists a few of occupations, lawyer, physician, dentist, scientist, college professor, among those requiring a doctoral degree. Note that the following occupations, engineer, architect, and accountant are listed in the professional occupations without doctoral degree, possibly accounting for gender differences. Appendix Table

will get to do that type of work, 77.3% of girls vs. 71.2% of boys state that it is as least "very likely".[30]

A more complete picture of changes in academic achievement is presented in Figure 4 which displays histograms, corresponding to the actual data, overlaid with a kernel density of the self-reported grades of girls and boys in 12th grade. Figures 5a and 5b report the same data for 10th and 8th graders for the 1990s (1991-1999) and 2000s (2000-2009). The figures clearly show a progressive disaffection over the past thirty years with "grading on a curve" with the alternative "competency grading" gaining in importance. In the 1980s, the mode and median of the grades distribution roughly coincided in the B range. By the 2000s, the mode of girls' grade distribution had moved from B to A, while the mode of the boys' grade distribution stayed at B.[31] This is what we call "leaving boys behind" although the proportion of boys in the A range has increased over time; the gender gap in the proportion of students at the very top of the GPA distribution has increased.

Figure 6 displays the female/male difference in the percentage of seniors in each GPA level for each of the three decades of interest. The lines in the figure show the raw differences for the observations for which we have complete information, each corresponding bar previews our decomposition results, which we discuss in section 5 below. In Figure 6, the largest gender gap favorable to girls is in the percentage of students with A's has increased from 3.7% to 6.0 % from the 1980s to the 2000s. The largest gender gap favorable to boys is in the percent of students with C+'s, which has decreased from 4.4% to 3.2%. Similar gender gaps for 10th graders and 8th graders are displayed in Figures 7a and 7b.

The means of our main core variables for seniors are reported in Table 2 for each of the three decades of interest.[32] The first 9 rows of the table report the exact numbers behind Figure 4a. The next two rows display the average school grade index and the students own evaluation of their school ability. It shows that despite having lower grades, boys rate their own school ability

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A-1 reports the complete answers to the question by gender and time period. It shows a sharp decline in clerical office work as an intended occupation for girls, not match by as great of a decline in craftsman and protective services as intended occupations for boys, over the three decades.

[30] The various choices are "not very likely, somewhat likely, fairly likely, very likely, certain, already doing it".

[31] Similar gender differences can be found in the administrative grades available in the Add Health data.

[32] The statistics are computed on observations with no missing variables. This reduces the sample sizes by comparison with Table 1. Descriptive statistics for 10th and 8th graders are available as supplemental material.

higher than girls, although differences are not always statistically significant.[33] This would lend some support to the motto of effective gender-specific teaching: “build the girls up, break the boys down” (Sax, 2007). Similar male overconfidence has been reported among college students by Stinebricker and Stinebricker (2009). They argued that even when boys are admitted to college, because of their overall lower performance, they are less likely to succeed in spite of their overconfidence.[34]

Demographic characteristics are presented next. They show that the sample is composed of 8% black boys vs.10-11 % black girls; this largely reflects the differential drop-out rates by gender among Blacks. Among 8th graders, the sample is composed of 11 % black boys vs. 12 % black girls.[35] The subsequent rows tabulate cigarette smoking and alcohol binging (how frequently did one had more than 5 drinks over the last two weeks) recoded into 4 categories. Although smoking has fluctuated somewhat differently by gender over time, boys are still more likely than girls to report these risky behaviors. In the 2000s, about 25% of boys vs. 23% of girls smoked cigarettes, about 21% boys vs. 13% of girls report two or more instances of alcohol binging over the last two weeks.

As noted above, girls tend to live in families that on the surface might be less likely to foster high academic achievement. For example, although family size has decreased over time, by comparison to boys, girls are raised in larger families. [36] In the 2000s, 37% of girls vs. 33% of boys report living in families with 3 or more children. Similarly, 4% more girls than boys report having an absent father, 3% more girls than boys report that their mother works all the time and about 3% more boys than girls report than their father or mother has completed college. We note that the gender gaps in family characteristics are similar in the sample without Blacks. The proportions of mothers and fathers in the various educational attainment classes provide an additional way to assess the representativeness of the sample and they do in fact correspond to proportions reported elsewhere.

[33] Girls in 1976-1988 and boys in 2000-2009 having similar average GPA of 3, but the boys’ school ability index of 0.664 is significantly greater than the girls 0.651.
[34] Although grades by topic are not reported in the MTF, numerous studies (especially those using the National Education Longitudinal Study) show that boys continue to maintain an advantage in math test scores (but not in math grades), especially at the high end of the distribution. The boys’ overconfidence may build on these scores.
[35] Descriptive statistics for 10th and 8th graders are available as supplemental material.
[36] See Angrist and Evans (1998).

The means of paid work, hours of work and wages, reported next in Table 2, show that the gender gap in participating in paid work has closed over time, but boys continue to work more hours and get higher pay. About 3% more boys than girls work more that 30 hours a week during school and 7% more boys than girls earn at least $126 per week for that employment.[37]

The types of high school attended by seniors reported in Table 2 inform us about gender differences in the students' educational plans for the future. The number show that the gap in favor of girls in the proportion of students attending an academic high school has grown; while about 3 % more girls than boys attended an academic high school in the 1980s, that proportion increased to 7% in the 2000s, with 59% of girls vs. 52% of boys attending an academic high school. Conversely the gap in favor of girls in the proportion students attending a general high school has reversed. While 31% of girls vs. 30% of boys attended in general high school in the 1980s, in the 2000s, 30% of girls vs. 33% of boys attended a general high school. Among 8th graders, already 4% more girls than boys report that they attend a college preparatory school, although a large proportion of students (43% of both boys and girls) do not know the type of school attended.

Among 12th graders, two types of questions regarding post-secondary plans are asked. A first question asks about expectations: "Core 21: How likely (definitively won't, probably won't, probably will, definitively will) is it that you will do each of the following things after high school? a) Attend a technical or vocational school, b) Serve in the armed forces, c) graduate from a two-year college, d) graduate from college (four-year program), e) attend graduate or professional school after college?" A second question asks about aspirations: "Core 22: Suppose you could do just what you'd like and nothing stood in your way. How many of the following things would you WANT to do?" with the five options above being supplemented by none of the above. Among 8th and 10th graders, only the expectations questions are asked. Among 12th graders in particular, the expectations question raises issues of endogeneity with respect to GPA. Some students with low GPA may simply be aiming for a two-year college because of their anticipated career choices; others may have low expectations of graduating from a four-year college because of their GPA. The aspirations question attempts to circumvent that problem with the preamble if "nothing stood in your way". Controlling for subjective school ability (Core 16

[37] The categorical data on hours and pay does not allow us to compute a gender pay gap per se.

above) and aspirations (Core 22) may help alleviate these concerns. Among 8th graders, the issue of endogeneity of educational expectations is presumably less severe as there is more time to adjust one's level of effort.[38] The same could be said of 12th graders about their expectations to attend graduate or professional school.

Interestingly, Table 2 shows that in the 1980s, although seniors of both genders had similar expectations about graduating from college and attending graduate school, girls already have aspirations close to 2% higher about these choices. By the 2000s, the gender differences were sizeable; the expectations index for both college and graduate school was 8% higher for girls than boys[39]. Gender differences in aspirations for college and graduate school are respectively 8% and 11% in favor of girls. Also in line with higher drop out rate among boys, is the fact that 6% of boys vs. 3% of girls have declared no post-secondary aspirations.

4. Decomposition Methodology

We follow the literature on gender wage differentials (e.g. Fortin, 2008) in applying an Oaxaca-Blinder type of decomposition to the analysis of gender differences in academic achievement, but we extend the decomposition to the overall distribution of grades and follow the approach of Fortin, Lemieux, and Firpo (2011) to analyze more carefully the impact of gender differences in the educational response functions. We now give a short summary of the formulas behind the modified decomposition reviewed in Fortin, Lemieux, and Firpo (2011). With the aggregate decomposition, we seek to determine what portion of the gender gap in grades is attributable to differences in the characteristics of boys and girls and what portion is attributable to gender differences in the educational response to these characteristics. Traditionally, this latter portion has been called the "unexplained" part. Here, we argue that it corresponds to gender differences in the structural function $h_g^c(S_i, A_i, L_i; X_i, X_i^p)$ of equation (1). With the detailed decomposition, we apportion parts of the aggregate decomposition to particular explanatory factors and responses to determine which of these explanatory factors are relatively more important.

[38] Note however that for 8th and 10th graders, the questions of subjective school ability and post-secondary aspirations were not asked.

[39] Comparing seniors in 1972 from the NLS72, in 1980 from the H&B, in 1992 from the NELS88, and in 2004 from the ELS2002, Ingels and Dalton (2008) also find that in 2004, more girls than boys expected to pursue graduate studies, whereas it was the opposite in 1972.

The classic Oaxaca-Blinder methodology is based on the construction of a counterfactual state of world. Assuming that grades (G) can be modeled as a linear (in the parameters) function of characteristics (X) that is different for girls ($F = 1$) and boys ($F = 0$)

$$\mathbb{E}(G|X, F = 1) = \mathbb{E}(X|F = 1)\beta_1 \text{ and } \mathbb{E}(G|X, F = 0) = \mathbb{E}(X|F = 0)\beta_0,$$

under the zero conditional mean assumption, $\mathbb{E}(\varepsilon|X, F) = 0$. We can ask "What would boys' grades be if they had the same characteristics as girls?" or "What would girls' grades be if they had the same educational response as boys?", $\mathbb{E}(G^c) = \mathbb{E}(X|F = 1)\beta_0$.

Using the counterfactual average grades, we could write the differences between the average grades of girls and boys as

$$\begin{aligned}\Delta_O^\mu &= \mathbb{E}(G|F = 1) - \mathbb{E}(G|F = 1) + \mathbb{E}(G^c) - \mathbb{E}(G^c) \\ &= \mathbb{E}(X|F = 1)\beta_1 - \mathbb{E}(X|F = 0)\beta_0 + \mathbb{E}(X|F = 1)\beta_0 - \mathbb{E}(X|F = 1) \\ &= [\mathbb{E}(X|F = 1) - \mathbb{E}(X|F = 0)]\beta_0 + \mathbb{E}(X|F = 1)(\beta_1 - \beta_0) \\ &= \qquad \Delta_X^\mu \qquad + \qquad \Delta_E^\mu\end{aligned}$$

where Δ_X^μ would represent the part of the gender differences in average grades due to gender differences in endowments or characteristics, also called composition effect, and where Δ_E^μ represent the part of the gender differences due to the fact that boys and girls respond differently to characteristics, this term is called the educational response effect.

If the true conditional expectation is not linear, the OB decomposition is biased (Barsky et al., 2002). As in Fortin, Lemieux, and Firpo (2011), this issue is addressed by using a modified decomposition. We reweight the sample of boys so that the distribution of their characteristics (X) is similar to that of girls, using the following reweighting function

$$\begin{aligned}\Psi(X) &= [(Prob(X \mid F = 1))/(Prob(X \mid F = 0))] \\ &= [(Prob(F = 1 \mid X))/(Prob(F = 0 \mid X))] \cdot [Prob(F = 0)/Prob(F = 1)].\end{aligned}$$

The counterfactual coefficients β_o^1 will be estimated on the sample of boys reweighted to look like girls $\{X_0, \Psi(X_0)\}$, then the difference $(\beta_1 - \beta_o^1)$ reflects the true gender gap in educational responses, and the counterfactual means are computed as $\bar{X}_0^1 = \sum\{i : F = 0\}\, \Psi(X_i) \cdot X_i$. The reweighted decomposition uses the terms from the reweighted sample as counterfactuals,

$$\begin{aligned}\Delta_{O,R}^\mu &= \mathbb{E}(X|F = 1)\beta_1 - \mathbb{E}(X_0|F = 1)\beta_o^1 + \mathbb{E}(X_0|F = 1)\beta_o^1 - \mathbb{E}(X|F = 0)\beta_0 \\ &= \qquad \Delta_{E,R}^\mu \qquad + \qquad \Delta_{X,R}^\mu\end{aligned}$$

to obtain an aggregate decomposition as the sum of an educational response effect, $\Delta^{\mu}_{E,R}$, and a composition effect, $\Delta^{\mu}_{X,R}$. Inasmuch as grade dummies can be averaged out, this decomposition relies on the additional assumptions of common support and ignorability $(F \perp \varepsilon | X)$, that is, conditioning of observables unobservables are assumed to be the same across gender.

Each term of the reweighted decomposition can be further broken down into the "pure" effect and a residual term. The composition effect, $\Delta^{\mu}_{X,R}$, is written as the sum of a pure composition effect, $\Delta^{\mu}_{X,p}$, and a specification error, $\Delta^{\mu}_{X,e}$,

$$\begin{aligned}\Delta^{\mu}_{X,R} &= \mathbb{E}(X_0|F=1)\beta^1_o - \mathbb{E}(X|F=0)\beta_0 + \mathbb{E}(X_0|F=1)\beta_0 - \mathbb{E}(X_0|F=1)\beta_0 \\ &= [\mathbb{E}(X_0|F=1) - \mathbb{E}(X|F=0)]\beta_0 + \mathbb{E}(X_0|F=1)(\beta^1_o - \beta_0) \\ &= \qquad \Delta^{\mu}_{X,p} \qquad + \qquad \Delta^{\mu}_{X,e}.\end{aligned}$$

Similarly, the educational response term, $\Delta^{\mu}_{E,R}$, can be written as the sum of a pure response effect $\Delta^{\mu}_{E,p}$ plus a reweighting error $\Delta^{\mu}_{E,p}$,

$$\begin{aligned}\Delta^{\mu}_{E,R} &= \mathbb{E}(X|F=1)\beta_1 - \mathbb{E}(X_0|F=1)]\beta^1_o - \mathbb{E}(X|F=1)\beta^1_o + \mathbb{E}(X|F=1)\beta^1_o \\ &= \mathbb{E}(X|F=1)(\beta_1 - \beta^1_o) \ + \ [\mathbb{E}(X|F=1) - \mathbb{E}(X_0|F=1)]\beta^1_o \\ &= \qquad \Delta^{\mu}_{E,p} \qquad + \qquad \Delta^{\mu}_{E,e} \qquad .\end{aligned}$$

The specification error $\Delta^{\mu}_{X,e} = \mathbb{E}(X_0|F=1)(\beta^1_o - \beta_0)$ corresponds to the difference in the composition effects estimated by reweighting and by using simple regressions, where $\mathbb{E}(X_0|F=1)$ is the mean of the reweighted sample. The reweighting error $\Delta^{\mu}_{E,e} = [\mathbb{E}(X|F=1) - \mathbb{E}(X_0|F=1)]\beta^1_o$ goes to zero in a large sample.

Because of the linearity of these expressions, the detailed decomposition or the apportionment of the composition and educational response effects to each explanatory variable is straightforward. In practice, this detailed reweighted decomposition can be obtained by running two Oaxaca-Blinder decompositions: OB1) use with sample of girls $(F = 1)$ and the reweighted sample of boys looking like girls to get the pure wage structure effect, OB2) uses with sample of boys $(F = 0)$ and the reweighted sample of boys looking like girls to get the pure composition effect.

5. Empirical Results

Before going on to the decomposition results as such, it is useful to show which of our explanatory variables are more significant and how the educational responses differ by gender. As explained earlier, we estimate models corresponding to equation (1) separately by gender, for each of the nine GPA levels and for each of the three decades to compute the decomposition results. However, to conserve space we report the detailed estimated coefficients for the 2000s only for the two GPA levels where the gender achievement gap were largest, that is for the A and C+ grades.

5.1 Determinants of Top and Below Average GPA

Tables 3a and 3b report the estimated coefficients of the explanatory variables listed in Table 2. In Table 3a, the dependent variable is equal to 100 if the student gets an A, and 0 otherwise, so that the coefficients indicate the added probability of getting an A associated with the explanatory variables. In Table 3b, we estimate the covariates of getting exactly a C+. We present the estimated coefficients from two specifications. Specification 1 includes educational expectations, assuming that students take their abilities and other limitations into account while formulating their expectations. With this specification, we thus anticipate that expectations will have considerable explanatory power. Specification 2 explicitly controls for subjective school ability and for educational aspirations formed without possible limitations resulting from ability or other constraints. We anticipate that the inclusion of these two set of variables will reduce the explanatory power of educational expectations. To the extent that teachers' assessments and study effort stand between one's subjective school ability assessment and one's actual grade, including subjective student ability as a regressor should be different from the proverbial regressing Y on Y, but this variable should still have considerable explanatory power. As shown in Table 3a and 3b, we find that both of these conjectures are realized.

Yet, even after controlling for student ability and student aspirations, educational expectations remain among the most significant explanatory variables. Getting an A is very significantly positively associated with wanting and expecting to attend graduate school, especially for boys, and negatively associated with expecting to go to a two-year college. Conversely, consistent with the model of section 2, expecting to go to a two-year college is positively associated with the probability of getting a C+, again especially for boys. Similar effects are found for the type of high school attended, much of the impact of the variable is captured by school ability going from Specification 1 to Specification 2, although it does remain a significant variable with effects in the 2% to 4% range. The types of high school attended, thought to be part of a student's plans for the future, do however show significant differences across genders. Girls are more likely to get A, and less likely to get C+ in academic high school than boys.

Among the other most significant variables, by comparison with non-Blacks, we find that black boys are 6-8% less likely to get an A and 6% more likely to get a C+, while black girls 9%-10% less likely to get an A and 5% more likely to get a C+. Along the lines of Balsa et al. (2011), alcohol binging is associated with a significantly lower the probability of getting an A, about -4%, and a higher probability of getting a C+, about 1-4%. Similarly effects are found for smoking variables, in the -3% to -6% range for getting an A and the +2% for a C+. We view these correlations as symptomatic of time impatience or caring less about the future.

Focusing on family background variables, we find that controlling for school ability (going from Specification 1 to 2) substantially reduces the impact of parental education on students' probabilities of getting an A or a C+, although that association remains significant for girls. To the extent that parental education is capturing the family socio-economic status, these results are consistent with the past research, Cameron and Heckman (2001) and Reynolds and Pemberton (2001), showing that the biggest influence of parental resources on the children's education operates through academic performance. Other important family influences, more impervious to addition of subjective school ability, are the actual presence of parents in the household. The absent father and the mother working have significant effects (about -1 to-4%) on the probability of getting an A, and positive effects on the probability of getting a C+ (about 1%-2%). Interestingly the effect of the absent father is somewhat greater for girls, and that of the mother working is somewhat greater for boys. As Buchmann and DiPrete (2006), we do find that these effects have increased from the 1980s to the 2000s.[40]

In comparison to the effects of expectations, aspirations, subjective school ability and family background, the effects of the variables related to working during school are generally less significant and show some of the non-linear pattern found in the literature. However, there are significant gender differences in the coefficients of the work variables. In Table 3a, the coefficient of "work during school" is negative in the range of -2% to -3% for boys and positive,

[40] Regression coefficients not shown, but this result will be clear in the Figures below.

but not significant for girls. Conversely, in Table 3b, it is positive in the 1% to 2% range for girls and not significant for boys. Thus changes over time in the gender differentials associated with working during school are likely to account for the change in the gender achievement gaps in the educational response portion of the decomposition.

5.2 Decomposition results

To succinctly summarize the decomposition results, we will mostly present them in the form of graphs in order to display the entire GPA distributions. Figure 6 displays the aggregate decomposition for 12th graders. Based on Specification 1, it shows how the female/male differences in percentage for each GPA levels, $\Delta^c_{O,R}, c = 1, \ldots 9$, can be decomposed into composition effects, $\Delta^c_{X,R}$, the portion "explained" by gender differences in characteristics, and educational response effects, $\Delta^c_{E,R}$, the portion "unexplained" but attributed to the fact that the relationship between characteristics and GPA levels differs by gender. For each of the three time periods, positive bars indicating the excess percentage of girls in a GPA level (negative bars indicating the excess percentage of boys) are divided into two; the bottom darker (blue) portion corresponds to the composition effects and the upper lighter (beige) portion corresponds to the educational response effects. We see that the portions attributable to composition effects have generally increased over the three time periods, especially at the top of the grade distribution. Averaging over all GPA levels, the "explained" part grew from a mere 10% of the total gender differential in the 1980s to 32% in the 1990s and to 37% in the 2000s.

Figures 7a and 7b show the results of the aggregate decomposition for 10th and 8th graders, respectively. The specification of the educational responses functions for these younger students is similar to the Specification 1 used for seniors, given that the questions about subjective school ability or educational aspirations were not asked of these younger students.[41] The figures show that a very sizeable share of the gender differences in the percentage of students attaining each GPA level is accounted by gender differences in the explanatory variables, the composition effects. Among 10th graders, averaging over all GPA levels, the

[41] The list of variables available for 10th graders and 8th graders is the following: dummies for race (white/non-white), SMSA, smoked cigarettes per day (4), alcohol binging last two weeks (4), sibling not same household, father not same household, mother not same household, mother working (3), father's education (7), mother's education (7), worked during school, average hours of work (6), average earnings (7), type of high school (4), educational expectations (army, vocational, go to college, complete 4 year college). So the main differences with Specification 1 for seniors are the absence of the number of siblings and of the expectations of going to graduate school.

"explained" part accounts for almost half of the total gender differential: more precisely 49.5% in the 1990s and 46.7% in the 2000s. Among 8th graders, the "explained" part also accounts for a large portion of the total gender differential, more precisely 33.9% in the 1990s and 51.1% in the 2000s.

For seniors, we also present a subset of results in a more classic tabular form, which includes standard errors.[42] As in Table 3a and 3b, Table 4a and 4b present the decomposition results for the two GPA levels where the gender differentials are the largest (A and C+) and for Specifications 1 and 2, but this time we present results for all three time periods. Table 4a presents the detailed decomposition of the composition effects and Table 4b the detailed decomposition of the educational response effects. Note that the specification errors $\Delta^{c}_{X,e}$ are reported in Table 4a and the reweighting errors $\Delta^{c}_{E,e}$ are reported in Table 4b. The specification and reweighting errors are generally found to be at least an order of magnitude smaller than the main effects $\Delta^{c}_{X,p}$ and $\Delta^{c}_{E,p}$.

First, going through column 1 of Table 4a shows the increasing female advantage in top grades, as the female/male difference in the percentage of students getting A's increases from 3.747 in the 1980s, to 4.711 in the 1990s to 6.063 in the 2000s.[43] At the same time, the male percentage advantage in column 3 in the C+ grade decreases from 4.429 in the 1980s, to 3.898 in the 1990s to 3.152 in the 2000s. Second, the decomposition shows that overall, until the 2000s, gender differences in the explanatory variables did little to account for gender differences in academic achievement. There is one important exception: From the 1980s through the 2000s, gender differences in smoking and alcohol binging consistently account for 0.560 to 0.602 in Specification 1, and robustly from 0.427 to 0.489 in Specification 2 (that is controlling for subjective school ability) of the gender gap in getting A's. Smoking and alcohol binging also account for gender differences in getting C+, reliably but declining over time from -0.402 to -0.198 in Specification 1 (from 0.300% to 0.163% in Specification 2).

Third, because of the boys' overconfidence about their school ability, the effect of subjective school ability goes in the wrong direction: the female/male difference in own school ability is negative and its coefficients are positive for top grades and negative for mediocre

[42] Because of the large number of observations statistical significance is never an issue in the decomposition results, the issue of economic significance becomes more important.
[43] These numbers are a bit different from the ones reported in Table 1, Panel B, row 3 (3.2, 4.4, and 5.4) because for the analysis, we restrict the sample to those observations for which we have complete data.

grades. In the aggregate decomposition, this reduces the part of the gender differentials, negative for top grades and positive for mediocre grades, accounted by the explanatory variables, that is, going from Specification 1 to Specification 2 the "Total Explained" is smaller.[44] In the 2000s, the Total Explained corresponds to more 40% of the gender achievement gap in Specification 1, but only 17% in Specification 2. We note that race, SMSA, and family background variables are other sets of "contrarian" or "swimming upstream" variables, whose effects increase over time: these variables work to the advantage of boys (because there are more black girls, more girls with absent father, etc.,) and reduce the percentage of girls with top grades and of boys with mediocre grades. That is, if girls were as confident as boys about their school ability, if they lived in similar families, if there were as few Black girls living in SMSA as boys, the girls' grades would be even higher. For example, in the 2000s, there would be from 0.641 to 0.928 percent more girls than boys earning A's.

Fourth, from the 1980s to the 2000s, the portion of gender differences accounted for by educational expectations increased. Indeed, for the A grades, gender differences in expectations accounted for 1.132 in 1990s and 2.029 in the 2000s, or from 75% to 85% of the Total Explained in Specification 1, and more than 100% of the Total Explained in Specification 2. As the inclusion of subjective school ability removed some of the potential omitted variable bias from the educational expectations coefficients, it reduced the magnitude of the gender differentials accounted by educational expectations, but it did not reduce (actually increases in some cases) the relative portion that is accounted by educational expectations. For the C+ grades, only starting the 1990s do gender educational expectations get any bite at accounting for gender differences in academic performance; but in the 2000s, they essentially accounted for more than entire explained portion of the gender differential. Figure 6b displays the aggregate decomposition for Specification 2 and thus provides a lower bound for the effects of expectations. Nevertheless, overall the results from both Specification 1 and Specification 2 convey the same message as the one suggested by Table 1: Even after controlling for a host of other factors, changes in gender differences in educational expectations largely account for the more salient changes in gender differentials in academic achievement.

[44] This effect is similar to the gender differences in educational attainment on the gender pay gap. In recent years, gender differences in education reduce the explained part of the gender pay gap.

It is also interesting to consider the contribution of changes in gender differences in educational responses presented in Table 4b, noting that the interpretation of these differences crucially depends on the omitted category in each case. The most persistent factor from the 1980s to 2000s is the type of high school attended, where the omitted category is “other (not specified) high school”. As we saw in previous tables, not only are girls increasingly attending college preparatory high school, but they are benefiting more (in terms of grades) from it then boys. This differential educational response adds to the total effect of “plans for the future” factors in accounting for gender difference in academic achievement.

One factor that is increasingly important over the decades in accounting for gender differences in educational responses is “work during school”, where the omitted categories are not working, zero hours of work and zero wages. It shows that over the three decades, working during school seems to have increasingly acted as complement rather than a distraction for high achieving girls. Consistent with a non-linear effect of work, the educational responses linked to working during school contributed to the positive gender gap in favor of boys in getting a C+, although the magnitude of this effect is smaller than the previous effect.

The effects of gender differences in educational responses associated with family background is more difficult to interpret because departures from the omitted category (families with father present, mother present, one sibling, mother not working, both parents with high school education) are a more complex affair and the results are sensitive to which number of siblings is the omitted category (especially in the 1990s).[45] Nevertheless, they indicate that family background generally bolsters the response of high achieving girls by comparison with boys.

On the basis of these findings, we display the results of the detailed decomposition from Specification 1 for a reduced set of four factors: individual characteristics (race, SMSA, smoking and binging), family background, working during school, plans for the future (includes type of high school and educational expectations) in Figures 8 for 12th graders and Figure 9a and 9b for 10th graders and 8th graders. As in previous figures, the lines trace the magnitude of the gender gap in academic achievement to be explained across the GPA distribution, and the bars for each GPA levels are divided into two, the darker (blue) one capturing the composition effects and the

[45] Such sensitivity is not surprising given that even using an instrumental variable strategy that exploit exogenous variation in family size, Conley and Glauber (2006) find a strong effect of sibship size on second-born boys’ grade retention, but no effect on first-born boys.

lighter (beige) the educational response effects. In some instances, either effect can be negative, as the family effects above. The distance between the height of the bars and the symbol on the line corresponds to the portion of the gender differential accounted for by the other factors presented in the different panels.

The overall message emerging from Figure 8 is the same as the one we took away from Tables 4a and 4b. The effects of “Plans for the future” are by far the most important explanatory factors contributing to both the composition and educational response effects, generally with the right signs, except for the very low GPA levels. To the extent that they account for a sizeable share of the gender achievement gap, they provide some supporting evidence for the model presented in section 3 and for the idea that given their different plans for future, youths of both genders are optimizing their academic effort to fit these plans. More girls than boys are aiming for professions that require a graduate degree, more girls are getting A’s. More boys than girls are aiming for craftsman jobs and protective service occupations, more boys are getting C+’s.[46] Interestingly that message is even stronger among 10th graders and 8th graders. For these younger students, plans after high school are arguably further in the future and thus less likely endogenous (in the sense of resulting from cognitive dissonance issues). Youths with lower GPA are less likely to say that they will not go to college because of their lower GPA, given that many believe that there is still time for improvement. In Figures 9a and 9b, the composition effects associated with plans for the future are generally accounting for more than 50% of the gender differentials, both at the high and low end of the GPA distribution.

Figure 8 shows that the other factors of interest do contribute to a smaller extent to the gender differentials in achievement among seniors. The larger amounts of smoking and alcohol binging among boys than girls contribute to the explained part of the gender differential in getting high grades, but the girls’ response is far more negative than the boys’. Family background work to the advantage of boys, but girls’ response to unfavorable family backgrounds helps them achieve higher grades. The boys’ response to working during school appears to prevent them from moving from the B range to the A range, while it helps girls getting straight A’s. Overall, however the contribution of these other factors is very small.

The same message emerges from Figures 9a and 9b; aside from plans for the future, the other gender differences in characteristics explain only minute parts of the gender gap in

[46] See Table A1.

academic achievement. The effects of smoking and alcohol binging are also not surprisingly smaller among the young students, as are the effects of work during school. The phenomena of high achieving girls "swimming upstream" an unfavorable family background environment found among seniors, is also present among 10th and 8th graders, but the magnitude of the effect is small. Similarly, the effect of working during school among the younger students is negligible.

In summary, the aggregate decomposition results show a marked improvement, over three decades, in the model's ability to account for gender differences in academic achievement. Surprisingly, this finding applies equally well to the three grade levels (12th, 10th, and 8th graders) considered. The detailed decomposition results point out to changes in educational expectations as the main factor accounting for the added explanatory power of the model. Given the exogenous changes in the labor market opportunities of women over the last three decades, this is not completely unanticipated. The startling aspect comes from the fact that the explanatory power of the educational expectations is greater for 8th graders than for 12th graders. To the extent that educational expectations of 8th graders are less likely endogenous with respect to GPA levels than those of seniors, this is welcome news for the validation of the model. Certainly, among 12th graders, the specification 2, which controls for subjective school ability and educational aspirations, grants less lower explanatory power to the model and to educational expectations. But it still supports the idea that educational expectations, and changes in these expectations over the last three decades, is the most likely explanation for why girls are leaving boys behind in terms of earning top grades in high school.

6. Conclusion

Using a long-lived series of detailed cross-sectional surveys of high school students, this paper set out to identify which factors among a set of plausible culprits,—family environment, labor market work during school, and plans for the future—, would be more important in accounting for the changes over the past three decades in the gender achievement gap, especially at the top of the GPA distribution. The focus on the gender gap in top grades follows from the findings of previous studies (Jacob, 2002; Frenette and Zeman, 2007; Cho, 2007; Conger and Long, 2010) showing that the lower college admission rates of men can in large part be accounted for by their lower high school performance. We note that better high school performance explains "how" more girls are admitted to college but not "why". Frenette and

Zeman (2007) also find that parental expectations of the highest level of educational outcome of the child account for a notable share of gender differences in university attendance. Further the role of parental expectations could explain why first generation immigrant boys do not suffer from the boys' underachievement problem.[47]

Over the last three decades there has been sustained effort (Manski and Wise, 1983; Manski, 1993; Dominitz, Manski, and Fischhoff, 2001; Manski, 2004) to understand the formation of students' expectations and to ascertain the importance of these expectations in their decision to enroll in college. Recent studies (Stange, 2008; Jacob and Wilder, 2010; Zafar, 2011) set in longitudinal settings have focused on learning and beliefs updating, trying to address on the first part of the puzzle. Not having the luxury of longitudinal data, we bypass the first issue of expectations formation assuming that the majority of students, by the time they leave elementary school, have fashioned some expectations about college-going. Indeed, decisions to attend an academic (college preparatory) high school, to move to a neighborhood with a better high school, and to apply to enroll in a magnet school are made early in pupils' life. Then we rely on changes over time in the educational expectations of students to evaluate the importance of these expectations for the high academic achievement that opens the door to college-going. These changes are different by gender for reasons arguably exogenous to the early education process; rather they are rooted in changes in the labor market opportunities for women.[48]

These considerations lead us to propose a "signaling" type model of academic achievement where educational expectations, formed in elementary school and likely influenced by parental desires, play a prominent role in determining, given a level of aptitude, in an individual's choice of optimal GPA. Thus in this model, high school students can optimality choose a GPA level lower than their maximum attainable given their aptitude level, if their post-secondary education plans can be enacted with the lower GPA level. This model contrasts with both the early childhood development (ECD) branch and education production function (EPF) branch of the literature on cognitive achievement in children (Todd and Wolpin, 2003), where the goal is to maximize achievement under some cost constraints. Here, our model is set in the

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[47] Wilson, Burgess and Briggs (2011) have also suggested aspiration-based explanations to account for ethnic differences in academic performance. See also Zafar (2011).

[48] A caveat here is the disproportionate increase in ADHD among boys (Elder and Lubotsky, 2009; Chen, Fortin, Oreopoulos and Phipps, 2011). But the recent phenomena is likely affecting cohorts younger than the ones studied.

high school years after the revelation of basic school ability (literacy and numeracy) has taken place.

Our findings show that the predominance of girls at the top of the GPA distribution is rooted in their higher educational expectations, themselves linked to career plans that include a graduate degree (such a law or medical degree). More precisely, in the 2000s, "Plans for the Future" is most important set of explanatory factors accounting for the girls' higher share of A's at the three grade levels (12^{th}, 10^{th}, and 8^{th} graders).This set of factors is important enough to account for all of the increase of 2.3%, from 1980s to 2000s, in the gender difference in the percentage of students earnings A's. A more minor, but still interesting finding is that high achieving girls are "swimming upstream", being more likely from a disadvantageous family environment.

By comparison with girls, more boys think that they are likely to enter military service or to attend a vocational school. Because the career plans of boys include more predominantly male occupations (craftsmen, protective service and military service occupations, engineers and architects) that do not require advanced degrees, their lower share of high grades is consistent with the "signaling type" model that we propose. However, these findings should not alleviate all concerns about the possibility of academic underachievement by boys. To the extent that boys are overconfident about their school ability, they may fail to enact their expected education plans.

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Table 1. Difference-and-Differences Estimates in Academic Performance and Plans for the Future - 12th graders

Time period	1976-1988	1988-1999	Change over time (2)-(1)	2000-2009	Change over time (4)-(2)	Change over time (4)-(1)
	(1)	(2)	(3)	(4)	(5)	(6)
A: Average grades						
Girls	**3.004**	**3.106**	0.102	**3.218**	0.112	0.214
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Boys	**2.804**	**2.907**	0.103	**3.030**	0.123	0.225
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)
Difference	0.200	0.199	-0.001	0.189	-0.010	-0.011
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)
B: Proportion with A grade						
Girls	**0.100**	**0.143**	0.043	**0.192**	0.048	0.091
	(0.001)	(0.004)	(0.001)	(0.004)	(0.002)	(0.002)
Boys	**0.069**	**0.099**	0.030	**0.137**	0.038	0.068
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Difference	0.032	0.044	0.012	0.054	0.011	0.023
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
C: Proportion definitely will attend graduate or professional school[a]						
Girls	**0.101**	**0.205**	0.104	**0.249**	0.044	0.147
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Boys	**0.099**	**0.150**	0.051	**0.168**	0.018	0.069
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
Difference	0.003	0.055	0.053	0.081	0.026	0.078
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
Number of observations	207,152	160,403		118,173		
D: Proportion think that will work as a professional with doctoral degree (or equiv) when 30[b]						
Girls	**0.143**	**0.258**	0.115	**0.266**	0.008	0.123
	(0.003)	(0.004)	(0.004)	(0.004)	(0.006)	(0.005)
Boys	**0.136**	**0.169**	0.033	**0.165**	-0.005	0.028
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Difference	0.006	0.089	0.082	0.101	0.012	0.095
	(0.004)	(0.005)	(0.006)	(0.006)	(0.008)	(0.007)
Number of observations	36,699	23,592		19,168		

Note: Self-reported grades in 9 categories (D, C-,C,C+,B-,B,B+,A-,A) are translated into the numbers 1, 1.7,2,2.3,2.7,3,3.3,3.7 and 4 following standard institutional practice.

[a] The numbers for other post-secondary choices are reported in Table 2.

[b] The numbers for other intented occupations are reported in Table A-1.

Table 2. Means of Select Core Variables by Gender - 12th graders

Core Variables	1976-1988			1989-1999			2000-2009		
	Boys	Girls		Boys	Girls		Boys	Girls	
Self-reported Grades:									
D (69 or below): 1	0.014	0.006	*	0.015	0.006	*	0.014	0.005	*
C- (70-72): 1.7	0.045	0.022	*	0.036	0.018	*	0.031	0.016	*
C (73-76): 2	0.104	0.065	*	0.086	0.053	*	0.065	0.039	*
C+ (77-79): 2.3	0.146	0.101	*	0.126	0.087	*	0.099	0.068	*
B- (80-82): 2.7	0.165	0.133	*	0.149	0.120	*	0.129	0.103	*
B (83-86): 3	0.203	0.218	*	0.202	0.200		0.187	0.169	
B+ (87-89): 3.3	0.154	0.201	*	0.160	0.197	*	0.175	0.190	*
A- (90-92): 3.7	0.093	0.140	*	0.119	0.165	*	0.154	0.203	*
A (93-100): 4	0.076	0.113	*	0.108	0.155	*	0.147	0.207	*
School Grade Index	2.845	3.055	*	2.944	3.144	*	3.067	3.258	*
Subjective School Ability Index (scaled between 0 and 1)	0.652	0.651		0.658	0.654		0.664	0.658	*
Race: Black	0.083	0.097	*	0.085	0.105	*	0.084	0.107	*
Live in MSA	0.683	0.683		0.731	0.738	*	0.755	0.759	
Smoked cigarettes per day: None	0.715	0.673	*	0.678	0.694	*	0.749	0.774	*
Less than one-half pack	0.212	0.260	*	0.258	0.260		0.217	0.201	*
One to 1½ pack	0.070	0.064	*	0.060	0.044	*	0.030	0.023	*
Two packs or more	0.003	0.002	*	0.005	0.002	*	0.004	0.002	*
Alcohol binging last 2 weeks: None	0.534	0.713	*	0.635	0.775	*	0.686	0.780	*
Once	0.129	0.111	*	0.109	0.092	*	0.100	0.094	*
Two to nine times	0.307	0.167	*	0.231	0.127	*	0.197	0.121	*
Ten or more times	0.030	0.008	*	0.025	0.006	*	0.017	0.006	*
Siblings not same household	0.243	0.235	*	0.326	0.312	*	0.329	0.311	*
Siblings: None	0.046	0.042		0.056	0.051	*	0.060	0.052	
One	0.268	0.256	*	0.326	0.311	*	0.323	0.300	*
Two	0.262	0.254		0.271	0.270		0.282	0.272	*
Three or more	0.424	0.449	*	0.344	0.365	*	0.332	0.374	*
Father not same household	0.169	0.185	*	0.201	0.228	*	0.207	0.244	*
Mother not same household	0.075	0.066	*	0.098	0.084	*	0.096	0.089	*
Mom working: No	0.312	0.299	*	0.198	0.184	*	0.146	0.140	*
Some of the time	0.312	0.302	*	0.254	0.242	*	0.206	0.196	*
Most of the time	0.175	0.164	*	0.195	0.176	*	0.185	0.170	*
All the time	0.201	0.234	*	0.353	0.398	*	0.462	0.495	*
Father education: less than primary	0.062	0.076	*	0.034	0.046	*	0.031	0.041	*
Some high school	0.145	0.154	*	0.101	0.110	*	0.098	0.108	*
Completed high school	0.320	0.320		0.285	0.298	*	0.288	0.304	*
Some college	0.156	0.153		0.195	0.191		0.182	0.180	
Completed College	0.190	0.176	*	0.230	0.214	*	0.253	0.225	*
Graduate or professional	0.127	0.121	*	0.155	0.141	*	0.147	0.142	

Note: Asterisk indicates statistically significant gender difference at the 5% level.

(continued next page)

Table 2. Means of Select Core Variables by Gender - 12th graders (continued)

Core Variables	1976-1988			1989-1999			2000-2009		
	Boys	Girls		Boys	Girls		Boys	Girls	
Mother education: less than primary	0.032	0.042	*	0.027	0.035	*	0.027	0.034	*
Some high school	0.126	0.149	*	0.082	0.101	*	0.071	0.082	*
Completed high school	0.441	0.416	*	0.339	0.333		0.277	0.280	
Some college	0.166	0.175	*	0.210	0.215		0.210	0.222	
Completed College	0.164	0.146	*	0.234	0.211	*	0.290	0.257	*
Graduate or professional	0.071	0.072		0.108	0.104		0.125	0.124	
Works over school year	0.848	0.798	*	0.801	0.792	*	0.755	0.756	
Average hours of work: None	0.177	0.222	*	0.223	0.223		0.271	0.260	*
5 or less hours	0.101	0.101		0.097	0.095		0.097	0.096	
6 to 10 hours	0.099	0.103		0.095	0.107		0.097	0.107	*
11 to 20 hours	0.262	0.300	*	0.260	0.303	*	0.252	0.281	*
21 to 30 hours	0.234	0.203	*	0.220	0.205	*	0.194	0.191	
More than 30 hours	0.128	0.071	*	0.104	0.067	*	0.090	0.065	*
Average earnings per week from job:									
None	0.227	0.281	*	0.269	0.283	*	0.311	0.314	
$1-5	0.037	0.046		0.018	0.022		0.010	0.010	
$6-10	0.040	0.045		0.025	0.028		0.036	0.044	*
$11-50	0.289	0.326	*	0.176	0.215	*	0.114	0.140	*
$51-75	0.253	0.200	*	0.128	0.151	*	0.086	0.106	*
$76-125	0.106	0.080	*	0.222	0.209	*	0.197	0.213	*
$126+	0.047	0.022	*	0.162	0.092	*	0.246	0.174	*
Type of high school: Academic	0.487	0.514	*	0.550	0.611	*	0.518	0.589	*
General	0.300	0.307	*	0.283	0.272	*	0.328	0.298	*
Vocational	0.155	0.120	*	0.107	0.068	*	0.081	0.049	*
Other	0.059	0.060		0.059	0.049	*	0.073	0.065	*
Education Expectations: index of likeness to attend (scaled between 0 and 1)									
Army	0.281	0.102	*	0.215	0.078	*	0.202	0.079	*
Vocational	0.319	0.264	*	0.268	0.210	*	0.274	0.208	*
Two-year college	0.338	0.364	*	0.362	0.370	*	0.383	0.386	
Four-year college	0.584	0.585		0.702	0.758	*	0.737	0.816	*
Graduate or professional	0.389	0.385	*	0.471	0.530	*	0.490	0.571	*
Education Aspirations: want to attend (binary dummy)									
Army	0.203	0.092	*	0.177	0.079	*	0.179	0.078	*
Vocational	0.284	0.219	*	0.207	0.141	*	0.203	0.124	*
Two-year college	0.206	0.293	*	0.214	0.256	*	0.240	0.266	*
Four-year college	0.635	0.650	*	0.744	0.810	*	0.773	0.850	*
Graduate or professional	0.416	0.432	*	0.529	0.613	*	0.519	0.625	*
Number of observations	74230	79942		60469	66875		50549	57202	

Note: Asterisk indicates statistically significant gender difference at the 5% level.

Table 3a. Coefficients of LPM on Specific Grades - 12th graders - 2000-2009

Dependent variable: A (93-100)	Specification 1				Specification 2			
Explanatory Variables	Boys		Girls		Boys		Girls	
Race: Black	-7.534	(-13.06)	-10.330	(-18.51)	-5.828	(-10.37)	-8.729	(-16.35)
SMSA	-5.404	(-14.96)	-8.525	(-22.02)	-5.270	(-15.02)	-8.227	(-22.23)
Subjective School Ability					44.457	(53.75)	70.881	(72.68)
Smoked cigarettes per day: None (base)								
Less than one-half pack	-4.928	(-12.39)	-7.789	(-17.68)	-3.635	(-9.39)	-6.107	(-14.48)
One to 1½ pack	-3.911	(-4.23)	-7.383	(-6.64)	-2.513	(-2.79)	-5.382	(-5.06)
Two packs or more	13.153	(5.27)	-1.031	(-0.25)	14.792	(6.09)	2.882	(0.74)
Alcohol binging last 2 weeks: None (base)								
Once	-4.087	(-7.92)	-4.502	(-7.94)	-3.991	(-7.96)	-3.864	(-7.13)
Two to nine times	-4.984	(-12.01)	-5.247	(-9.81)	-4.664	(-11.57)	-4.007	(-7.83)
Ten or more times	-4.409	(-3.68)	-6.093	(-2.77)	-3.398	(-2.92)	-3.150	(-1.50)
Siblings not same household	0.078	(0.21)	0.243	(0.62)	0.382	(1.08)	0.295	(0.78)
Siblings: One (base)								
None	1.491	(2.10)	-1.119	(-1.38)	1.166	(1.69)	-1.847	(-2.39)
Two	-0.796	(-2.04)	-1.107	(-2.59)	-0.624	(-1.65)	-0.914	(-2.24)
Three or more	-1.615	(-4.17)	-1.797	(-4.36)	-1.493	(-3.96)	-1.476	(-3.75)
Don't know	-0.909	(-0.32)	-8.712	(-2.53)	1.816	(0.65)	-5.119	(-1.55)
Father not same household	-1.228	(-3.07)	-2.319	(-5.69)	-0.870	(-2.24)	-1.895	(-4.87)
Mother not same household	0.169	(0.31)	-1.853	(-3.05)	0.620	(1.16)	-1.460	(-2.51)
Mom working: No (base)								
Some of the time	-3.779	(-7.32)	-2.718	(-4.81)	-3.433	(-6.84)	-2.360	(-4.37)
Most of the time	-4.192	(-7.87)	-4.730	(-8.07)	-3.593	(-6.94)	-3.742	(-6.68)
All the time	-3.855	(-8.26)	-4.764	(-9.46)	-3.513	(-7.75)	-3.844	(-7.98)
Father education: less than primar	0.170	(0.16)	-2.468	(-2.52)	1.407	(1.36)	-0.826	(-0.88)
Some high school	-1.731	(-2.98)	-1.728	(-2.92)	-1.265	(-2.24)	-0.959	(-1.69)
Completed high school (base)								
Some college	0.358	(0.78)	0.581	(1.19)	0.003	(0.01)	-0.201	(-0.43)
Completed College	0.910	(2.04)	2.883	(6.00)	0.133	(0.31)	1.708	(3.72)
Graduate or professional	2.635	(4.66)	2.917	(4.88)	1.074	(1.95)	0.408	(0.71)
Mother education: less than prima	-1.717	(-1.50)	-3.926	(-3.63)	-0.144	(-0.13)	-2.827	(-2.73)
Some high school	-2.298	(-3.45)	-2.685	(-4.02)	-1.876	(-2.90)	-2.068	(-3.24)
Completed high school (base)								
Some college	-1.215	(-2.73)	0.310	(0.67)	-1.480	(-3.42)	-0.169	(-0.38)
Completed College	1.420	(3.30)	2.945	(6.27)	0.662	(1.58)	1.445	(3.22)
Graduate or professional	0.789	(1.34)	1.973	(3.16)	-0.178	(-0.31)	0.408	(0.68)

Note: Dependent variables is set to 100 if the student has a GPA of 4, and to 0 otherwise. T-statistics are in parentheses.

(continued next page)

Table 3a. Coefficients of LPM on Specific Grades - 12th graders - 2000-2009 (continued)

Dependent variable: A (93-100)	Specification 1				Specification 2			
Explanatory Variables	Boys		Girls		Boys		Girls	
Works over school year	-3.092	(-2.55)	0.325	(0.22)	-2.206	(-1.87)	2.141	(1.50)
Average hours of work: None								
5 or less hours	4.386	(3.96)	5.993	(4.26)	2.817	(2.62)	3.205	(2.39)
6 to 10 hours	1.529	(1.39)	2.543	(1.84)	0.687	(0.64)	0.744	(0.56)
11 to 20 hours	-0.607	(-0.58)	0.227	(0.17)	-1.310	(-1.29)	-0.955	(-0.74)
21 to 30 hours	-0.279	(-0.26)	-0.261	(-0.19)	-0.758	(-0.73)	-1.564	(-1.19)
More than 30 hours	2.062	(1.82)	-0.511	(-0.35)	1.061	(0.97)	-1.793	(-1.28)
Average earnings per week from job: None								
$1-5	4.664	(2.82)	3.866	(2.20)	5.648	(3.52)	3.473	(2.07)
$6-10	2.625	(2.60)	-2.200	(-2.20)	3.175	(3.23)	-1.550	(-1.62)
$11-50	2.002	(2.67)	0.192	(0.25)	1.724	(2.37)	-0.249	(-0.34)
$51-75	1.681	(2.04)	-1.556	(-1.86)	1.057	(1.32)	-2.085	(-2.60)
$76-125	0.242	(0.32)	-2.103	(-2.69)	-0.054	(-0.07)	-2.744	(-3.67)
$126+	-0.238	(-0.32)	-2.172	(-2.65)	-0.743	(-1.02)	-2.915	(-3.72)
Type of high school: Academic	5.905	(9.39)	9.090	(12.99)	1.287	(2.08)	2.010	(2.97)
General	-1.433	(-2.30)	-0.288	(-0.41)	-2.827	(-4.65)	-1.885	(-2.78)
Vocational	2.468	(3.12)	4.776	(4.87)	-0.251	(-0.33)	1.334	(1.42)
Other (base)								
Education Aspirations: want to attend (binary dummy)								
Army					-2.522	(-5.06)	-2.214	(-3.11)
Vocational					-0.138	(-0.29)	1.152	(1.89)
Two-year college					0.235	(0.54)	-0.198	(-0.42)
Four-year college					-1.739	(-3.98)	-1.321	(-2.50)
Graduate or professional					1.644	(4.34)	2.071	(5.04)
Educational Expectations: index of likeness to attend								
Army	-2.328	(-4.47)	-0.132	(-0.16)	0.310	(0.47)	2.342	(2.40)
Vocational	-3.945	(-7.18)	-3.929	(-6.52)	-3.522	(-5.62)	-3.938	(-5.67)
Two-year college	-9.946	(-21.99)	-11.409	(-24.47)	-7.536	(-14.45)	-7.042	(-12.68)
Four-year college	3.672	(6.07)	4.384	(6.40)	0.150	(0.23)	0.572	(0.77)
Graduate or professional	13.711	(24.63)	10.543	(18.49)	8.660	(14.07)	4.102	(6.43)
Constant	25.242	(28.44)	28.758	(29.58)	-1.310	(-1.25)	-13.363	(-11.36)
R-squared	0.116		0.126		0.166		0.202	
Number of observations	49328		56156		49328		56156	

Note: Dependent variables is set to 100 if the student has a GPA of 4, and to 0 otherwise. T-statistics are in parentheses.

Table 3b. Coefficients of LPM (100%) on Specific Grades - 12th graders - 2000-2009

Dependent variable: C+(77-79)	Specification 1				Specification 2			
Explanatory Variables	Boys		Girls		Boys		Girls	
Race: Black	6.870	(13.71)	5.158	(14.46)	6.020	(12.08)	4.699	(13.28)
SMSA	2.864	(9.13)	2.512	(10.15)	2.792	(8.97)	2.454	(10.00)
Subjective School Ability					-20.698	(-28.22)	-20.586	(-31.84)
Smoked cigarettes per day: None (base)								
Less than one-half pack	1.865	(5.40)	2.941	(10.44)	1.275	(3.71)	2.431	(8.69)
One to 1½ pack	2.579	(3.21)	2.612	(3.67)	1.949	(2.44)	1.992	(2.82)
Two packs or more	-0.091	(-0.04)	-0.064	(-0.02)	-0.840	(-0.39)	-1.334	(-0.52)
Alcohol binging last 2 weeks: None (base)								
Once	0.752	(1.68)	0.703	(1.94)	0.698	(1.57)	0.525	(1.46)
Two to nine times	1.533	(4.26)	1.709	(5.00)	1.373	(3.84)	1.362	(4.02)
Ten or more times	1.828	(1.75)	4.423	(3.14)	1.381	(1.34)	3.540	(2.54)
Siblings not same household	0.019	(0.06)	-0.294	(-1.17)	-0.118	(-0.38)	-0.318	(-1.27)
Siblings: One (base)								
None	-0.701	(-1.14)	0.175	(0.34)	-0.556	(-0.91)	0.372	(0.73)
Two	0.308	(0.91)	0.349	(1.28)	0.222	(0.66)	0.306	(1.13)
Three or more	0.497	(1.48)	0.440	(1.67)	0.443	(1.33)	0.350	(1.34)
Don't know	1.196	(0.48)	-0.202	(-0.09)	-0.051	(-0.02)	-1.239	(-0.57)
Father not same household	1.044	(3.00)	1.728	(6.64)	0.870	(2.52)	1.587	(6.15)
Mother not same household	0.579	(1.21)	-0.051	(-0.13)	0.392	(0.83)	-0.175	(-0.45)
Mom working: No (base)								
Some of the time	0.068	(0.15)	0.841	(2.33)	-0.095	(-0.21)	0.750	(2.10)
Most of the time	1.148	(2.48)	1.641	(4.38)	0.861	(1.87)	1.373	(3.70)
All the time	1.542	(3.81)	1.509	(4.69)	1.380	(3.43)	1.269	(3.97)
Father education: less than primar	1.164	(1.26)	1.444	(2.31)	0.616	(0.67)	0.945	(1.52)
Some high school	0.826	(1.64)	2.117	(5.59)	0.624	(1.25)	1.876	(5.00)
Completed high school (base)								
Some college	0.153	(0.38)	-0.223	(-0.71)	0.311	(0.78)	0.015	(0.05)
Completed College	-0.302	(-0.78)	-0.222	(-0.72)	0.062	(0.16)	0.123	(0.40)
Graduate or professional	-0.444	(-0.90)	-0.382	(-1.00)	0.296	(0.61)	0.331	(0.87)
Mother education: less than prima	-0.387	(-0.39)	0.172	(0.25)	-1.139	(-1.16)	-0.191	(-0.28)
Some high school	1.500	(2.59)	0.712	(1.67)	1.290	(2.25)	0.547	(1.29)
Completed high school (base)								
Some college	-0.717	(-1.86)	-0.675	(-2.27)	-0.593	(-1.55)	-0.529	(-1.79)
Completed College	-0.977	(-2.61)	-1.504	(-5.01)	-0.631	(-1.70)	-1.073	(-3.60)
Graduate or professional	-1.299	(-2.55)	-1.062	(-2.66)	-0.852	(-1.69)	-0.620	(-1.57)

Note: Dependent variables is set to 100 if the student has a GPA of 2.3, and to 0 otherwise. T-statistics are in parentheses.

(continued next page)

Table 3b. Coefficients of LPM on Specific Grades - 12th graders - 2000-2009 (continued)

Dependent variable: C+(77-79)	Specification 1				Specification 2			
Explanatory Variables	Boys		Girls		Boys		Girls	
Works over school year	0.996	(0.95)	2.283	(2.40)	0.601	(0.58)	1.713	(1.82)
Average hours of work: None								
5 or less hours	-2.086	(-2.17)	-3.144	(-3.50)	-1.362	(-1.43)	-2.317	(-2.60)
6 to 10 hours	-2.198	(-2.31)	-3.021	(-3.41)	-1.796	(-1.90)	-2.481	(-2.82)
11 to 20 hours	-1.714	(-1.89)	-2.463	(-2.87)	-1.383	(-1.53)	-2.084	(-2.45)
21 to 30 hours	-1.678	(-1.81)	-2.115	(-2.42)	-1.437	(-1.56)	-1.700	(-1.96)
More than 30 hours	-0.746	(-0.76)	-2.652	(-2.83)	-0.263	(-0.27)	-2.229	(-2.40)
Average earnings per week from job: None								
$1-5	1.578	(1.10)	-0.816	(-0.73)	1.111	(0.78)	-0.637	(-0.57)
$6-10	-0.270	(-0.31)	-0.211	(-0.33)	-0.507	(-0.58)	-0.404	(-0.64)
$11-50	-0.367	(-0.56)	-0.483	(-1.00)	-0.244	(-0.38)	-0.343	(-0.71)
$51-75	0.031	(0.04)	-0.546	(-1.02)	0.288	(0.41)	-0.392	(-0.74)
$76-125	-0.350	(-0.54)	-0.605	(-1.21)	-0.225	(-0.35)	-0.407	(-0.82)
$126+	-0.406	(-0.62)	-0.205	(-0.39)	-0.159	(-0.25)	-0.002	(0.00)
Type of high school: Academic	-4.472	(-8.19)	-5.978	(-13.36)	-2.344	(-4.28)	-3.900	(-8.69)
General	-0.181	(-0.33)	-1.912	(-4.21)	0.450	(0.83)	-1.421	(-3.16)
Vocational	-1.720	(-2.50)	-1.507	(-2.41)	-0.456	(-0.67)	-0.635	(-1.02)
Other (base)								
Education Aspirations: want to attend (binary dummy)								
Army					-0.290	(-0.66)	0.287	(0.61)
Vocational					0.241	(0.56)	0.733	(1.81)
Two-year college					-0.285	(-0.75)	0.488	(1.56)
Four-year college					1.298	(3.35)	-0.761	(-2.17)
Graduate or professional					-0.773	(-2.30)	-0.147	(-0.54)
Educational Expectations: index of likeness to attend								
Army	2.328	(5.15)	0.469	(0.89)	2.296	(3.96)	0.134	(0.21)
Vocational	0.473	(0.99)	0.876	(2.27)	0.125	(0.23)	0.175	(0.38)
Two-year college	5.951	(15.15)	3.446	(11.57)	4.884	(10.56)	1.995	(5.42)
Four-year college	-5.343	(-10.17)	-3.373	(-7.70)	-4.019	(-6.92)	-1.387	(-2.82)
Graduate or professional	-5.101	(-10.55)	-3.123	(-8.57)	-2.762	(-5.06)	-1.606	(-3.80)
Constant	7.884	(10.23)	6.896	(11.10)	20.066	(21.54)	19.544	(25.05)
R-squared	0.051		0.051		0.066		0.069	
Number of observations	49328		56156		49328		56156	

Note: Dependent variables is set to 100 if the student has a GPA of 2.3, and to 0 otherwise. T-statistics are in parentheses.

Table 4a. Detailed Decomposition Results - Composition Effects
Percentage Female/Male Difference for Selected GPA Levels

12th graders	Specification 1				Specification 2			
A: 1976-1988	A (93-100): 4		C+ (77-79): 2.3		A (93-100): 4		C+ (77-79): 2.3	
Total Differential	3.747	(0.005)	-4.429	(0.007)	3.747	(0.005)	-4.429	(0.007)
Total Explained	0.787	(0.003)	-0.321	(0.004)	0.549	(0.003)	-0.097	(0.004)
Race, SMSA	-0.151	(0.000)	0.234	(0.001)	-0.095	(0.000)	0.190	(0.001)
Own School Ability					-0.081	(0.001)	0.068	(0.001)
Smoking, Binging	0.602	(0.001)	-0.402	(0.002)	0.479	(0.001)	-0.300	(0.002)
Family Background	-0.083	(0.001)	0.004	(0.001)	-0.032	(0.001)	-0.033	(0.001)
Work	0.143	(0.001)	0.024	(0.001)	0.149	(0.001)	0.025	(0.001)
Type of High School	0.065	(0.001)	-0.098	(0.001)	0.006	(0.000)	-0.044	(0.001)
Educ. Expectations	0.211	(0.002)	-0.083	(0.003)	0.123	(0.002)	-0.004	(0.003)
Specification Error	0.001	(0.005)	0.152	(0.007)	-0.011	(0.005)	0.172	(0.007)
B: 1989-1999	A (93-100): 4		C+ (77-79): 2.3		A (93-100): 4		C+ (77-79): 2.3	
Total Differential	4.711	(0.006)	-3.898	(0.005)	4.711	(0.006)	-3.898	(0.005)
Total Explained	1.499	(0.003)	-0.713	(0.003)	0.517	(0.003)	-0.103	(0.003)
Race, SMSA	-0.258	(0.001)	0.284	(0.001)	-0.212	(0.001)	0.257	(0.001)
Own School Ability					-0.355	(0.002)	0.209	(0.001)
Smoking, Binging	0.560	(0.001)	-0.246	(0.001)	0.427	(0.001)	-0.167	(0.001)
Family Background	-0.145	(0.001)	0.062	(0.001)	-0.058	(0.001)	0.013	(0.001)
Work	-0.010	(0.001)	0.002	(0.001)	0.019	(0.001)	-0.016	(0.001)
Type of High School	0.220	(0.001)	-0.237	(0.001)	0.031	(0.001)	-0.121	(0.001)
Educ. Expectations	1.132	(0.002)	-0.579	(0.002)	0.665	(0.002)	-0.279	(0.002)
Specification Error	0.114	(0.006)	-0.085	(0.007)	0.030	(0.006)	0.021	(0.006)
C: 2000-2009	A (93-100): 4		C+ (77-79): 2.3		A (93-100): 4		C+ (77-79): 2.3	
Total Differential	6.063	(0.007)	-3.152	(0.005)	6.063	(0.007)	-3.152	(0.005)
Total Explained	2.395	(0.004)	-1.224	(0.003)	1.034	(0.004)	-0.590	(0.003)
Race, SMSA	-0.293	(0.001)	0.254	(0.001)	-0.232	(0.001)	0.224	(0.001)
Own School Ability					-0.463	(0.002)	0.215	(0.001)
Smoking, Binging	0.562	(0.001)	-0.198	(0.001)	0.489	(0.001)	-0.163	(0.001)
Family Background	-0.348	(0.001)	0.194	(0.001)	-0.233	(0.001)	0.143	(0.001)
Work	0.060	(0.001)	-0.026	(0.001)	0.079	(0.001)	-0.038	(0.001)
Type of High School	0.385	(0.001)	-0.257	(0.001)	0.185	(0.001)	-0.163	(0.001)
Educ. Expectations	2.029	(0.003)	-1.192	(0.003)	1.207	(0.003)	-0.809	(0.003)
Specification Error	-0.005	(0.008)	0.102	(0.006)	-0.048	(0.007)	0.112	(0.006)

Note: Standard errors are in parentheses. Reweighted decomposition follows methodology of section 4. In specification 2, educational aspirations are included among the variables in the educational expectations category.

Table 4b. Detailed Decomposition Results - Educational Response Effects
Percentage Female/Male Difference for Selected GPA Levels

12th graders	Specification 1				Specification 2			
A: 1976-1988	A (93-100): 4		C+ (77-79): 2.3		A (93-100): 4		C+ (77-79): 2.3	
Total Differential	3.747	(0.005)	-4.429	(0.007)	3.747	(0.005)	-4.429	(0.007)
Total Unexplained	3.099	(0.005)	-4.294	(0.005)	3.200	(0.004)	-4.435	(0.005)
Race, SMSA	-1.243	(0.007)	0.222	(0.008)	-1.290	(0.013)	0.064	(0.008)
Own School Ability					0.493	(0.001)	0.002	(0.000)
Smoking, Binging	-0.701	(0.004)	0.166	(0.004)	-0.240	(0.005)	0.106	(0.004)
Family Background	1.119	(0.018)	-1.830	(0.021)	1.196	(0.026)	-1.549	(0.021)
Work	0.412	(0.009)	0.766	(0.011)	1.569	(0.012)	0.899	(0.010)
Type of High School	1.700	(0.019)	-1.618	(0.021)	1.381	(0.027)	-1.758	(0.021)
Educ. Expectations	0.006	(0.002)	-0.179	(0.002)	0.796	(0.022)	0.660	(0.012)
Constant	1.807	(0.029)	-1.821	(0.033)	1.501	(0.046)	-2.859	(0.035)
Reweighting Error	-0.139	(0.001)	0.034	(0.001)	-0.009	(0.002)	-0.068	(0.001)
B: 1989-1999	A (93-100): 4		C+ (77-79): 2.3		A (93-100): 4		C+ (77-79): 2.3	
Total Differential	4.711	(0.006)	-3.898	(0.005)	4.711	(0.006)	-3.898	(0.005)
Total Unexplained	3.035	(0.006)	-3.204	(0.005)	3.885	(0.005)	-3.627	(0.005)
Race, SMSA	-1.772	(0.010)	-0.419	(0.009)	-2.250	(0.010)	-0.342	(0.009)
Own School Ability					-0.046	(0.000)	0.008	(0.000)
Smoking, Binging	-0.582	(0.004)	-0.020	(0.004)	-0.378	(0.004)	-0.123	(0.004)
Family Background	-0.493	(0.019)	-0.996	(0.018)	-0.470	(0.018)	-0.937	(0.018)
Work	0.998	(0.011)	0.081	(0.010)	0.583	(0.011)	0.195	(0.010)
Type of High School	1.001	(0.026)	-2.365	(0.024)	0.862	(0.025)	-2.819	(0.024)
Educ. Expectations	0.036	(0.002)	-0.247	(0.002)	0.887	(0.016)	-0.080	(0.015)
Constant	3.845	(0.036)	0.762	(0.033)	4.695	(0.037)	0.471	(0.036)
Reweighting Error	0.062	(0.002)	-0.057	(0.001)	0.279	(0.002)	-0.189	(0.001)
C: 2000-2009	A (93-100): 4		C+ (77-79): 2.3		A (93-100): 4		C+ (77-79): 2.3	
Total Differential	6.063	(0.007)	-3.152	(0.005)	6.063	(0.007)	-3.152	(0.005)
Total Unexplained	3.593	(0.007)	-1.933	(0.005)	4.802	(0.007)	-2.489	(0.005)
Race, SMSA	-1.414	(0.013)	-0.493	(0.009)	-1.509	(0.013)	-0.507	(0.009)
Own School Ability					-0.089	(0.001)	0.005	(0.000)
Smoking, Binging	-0.467	(0.005)	0.335	(0.003)	-0.333	(0.005)	0.320	(0.003)
Family Background	1.591	(0.027)	0.313	(0.019)	1.086	(0.025)	0.706	(0.019)
Work	1.590	(0.013)	0.303	(0.009)	1.616	(0.012)	0.087	(0.009)
Type of High School	2.646	(0.028)	-0.905	(0.020)	1.406	(0.027)	-1.503	(0.020)
Educ. Expectations	-0.117	(0.002)	0.153	(0.002)	1.081	(0.021)	-1.331	(0.016)
Constant	-0.236	(0.043)	-1.639	(0.030)	1.542	(0.045)	-0.267	(0.034)
Reweighting Error	0.080	(0.003)	-0.097	(0.001)	0.276	(0.003)	-0.185	(0.001)

Note: Standard errors are in parentheses. Reweighted decomposition follows methodology of section 4. In specification 2, educational aspirations are included among the variables in the educational expectations category.

Table A1. Means of Non-Core Variable by Gender - 12th graders

Module 4 Variable	1976-1988		1989-1999		2000-2009	
Kind of work respondent thinks will be doing when 30	Boys	Girls	Boys	Girls	Boys	Girls
Laborer (Car Washer, Sanitary Worker, Farm Laborer)	0.63	0.09	0.50	0.06	0.64	0.08
Service worker (Cook, Waiter, Barber, Janitor, Gas Station Attendand, Practical Nurse, Beautician)	0.76	4.72	0.74	3.38	1.23	3.48
Operative or semi-skilled worker (Garage Worker, Taxicab, Bus or Truck Driver, Assembly Line Worker, Welder)	5.01	0.37	2.29	0.20	1.82	0.14
Sales clerk in a retail store (Shoe Salesperson, Department Store Clerk, Drug Store Clerk)	0.66	2.13	0.33	0.56	0.41	0.57
Clerical or office worker (Bank Teller, Bookkeeper, Secretary, Typist, Postal Clerk or Carrier, Ticket Agent)	1.69	19.51	1.17	8.69	0.84	2.60
Protective Service (Police Officer, Fireman, Detective)	4.73	1.16	7.43	2.00	6.65	2.48
Military Service	5.95	1.17	5.55	1.38	5.91	1.13
Craftsman or skilled worker (Carpenter, Electrician, Brick Layer, Mechanic, Machinist, Tool and Die Maker, Telephone Installer)	18.83	0.70	13.37	0.56	11.43	0.48
Farmer owner or manager	2.72	0.64	1.54	0.52	1.39	0.68
Owner of small business (Restaurant Owner, Shop Owner)	7.15	4.49	8.08	4.79	8.37	6.63
Sales presentative (Insurance Agent, Real Estate Broker, Bond Salesman)	2.21	1.28	2.51	1.31	2.25	1.31
Manager or administrator (Office Manager, Sales Manager, School Administrator, Government Official)	7.91	7.67	7.25	7.07	6.16	4.59
Professional without doctoral degree (Registered Nurse, Librarian, Engineer, Architect, Social Worker, Technician, Accountant, Actor, Artist, Musician)	28.04	34.99	32.09	41.42	36.07	47.58
Professional with doctoral degree (or equiv) (Lawyer, Physician, Dentist, Scientist, College Professor)	13.64	14.29	16.94	25.80	16.46	26.56
Full-time homemaker or housewife	0.06	6.80	0.22	2.25	0.36	1.68
Number of observations	17731	18968	11293	12299	8970	10198

Figure 1. Average Self-Reported Grades of High School Seniors by Gender and Gender Gap

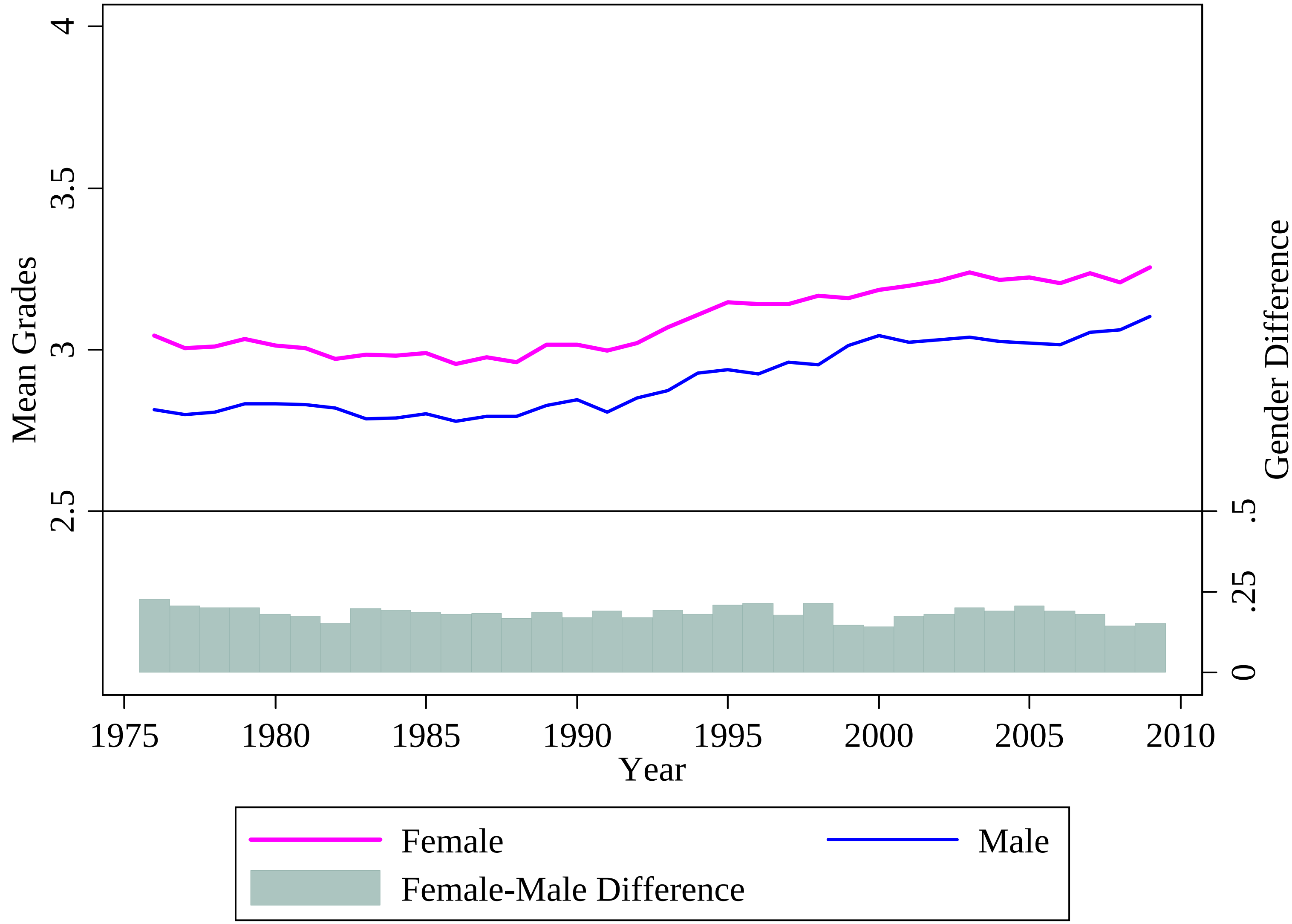
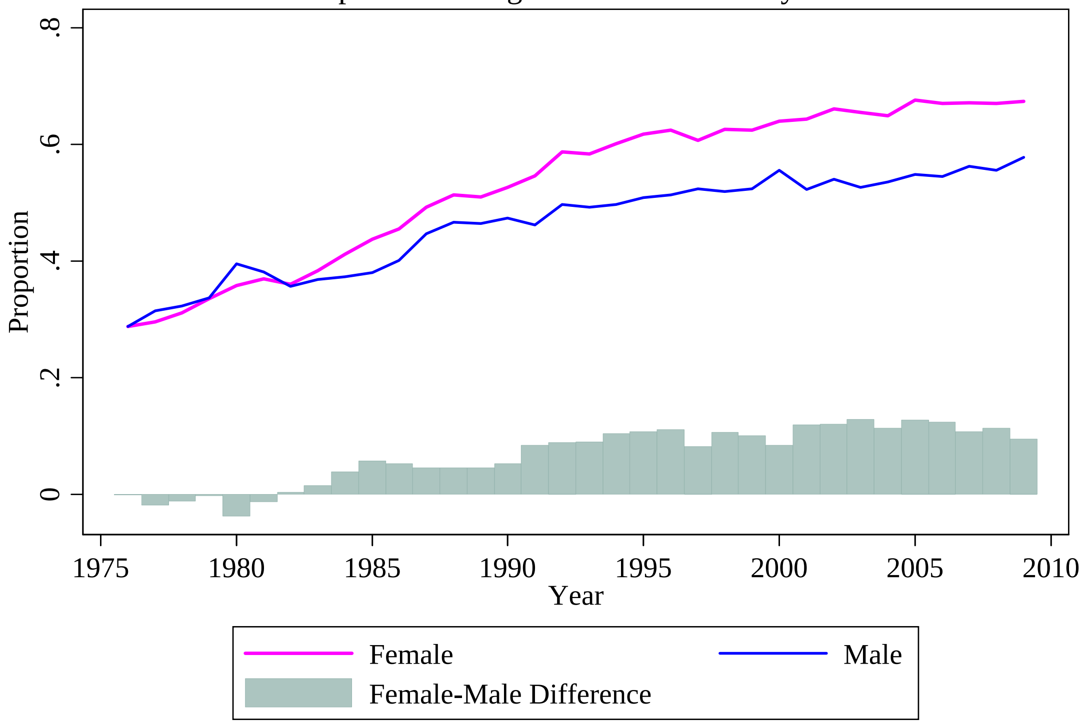


Figure 2. High School Students who say they "Will Definitively Go to College"

A. Proportion among U.S. 12th Graders by Gender



B. Relative Proportion of Female Students

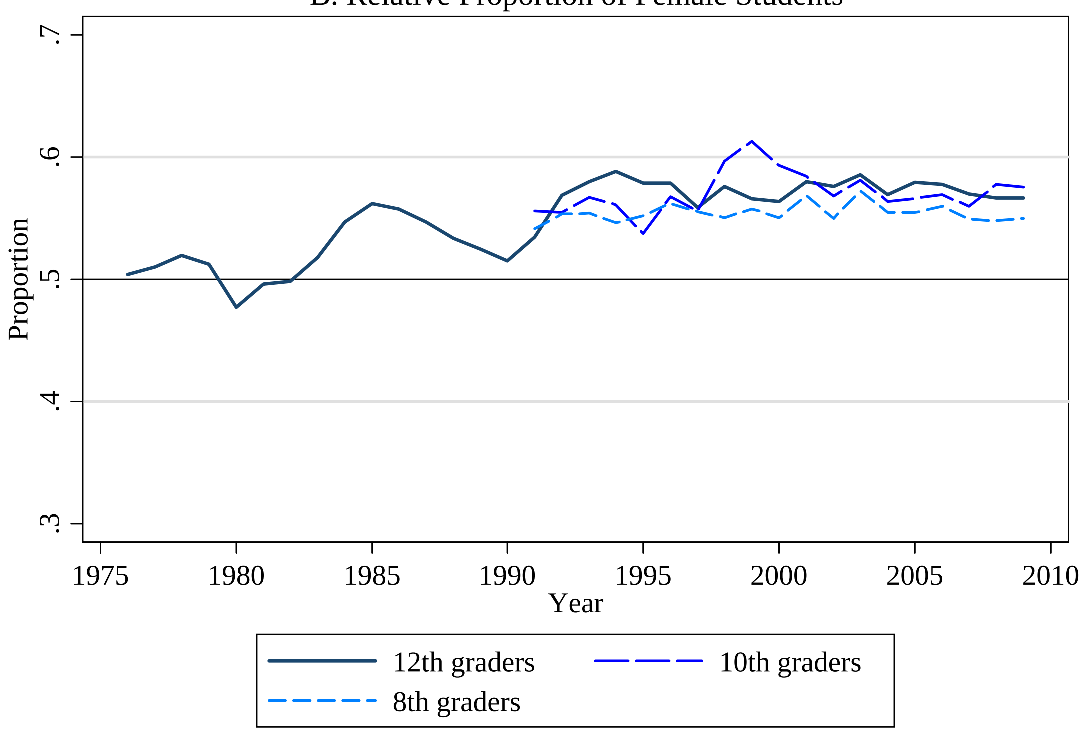


Figure 3. Utility and Cost of Academic Achievement

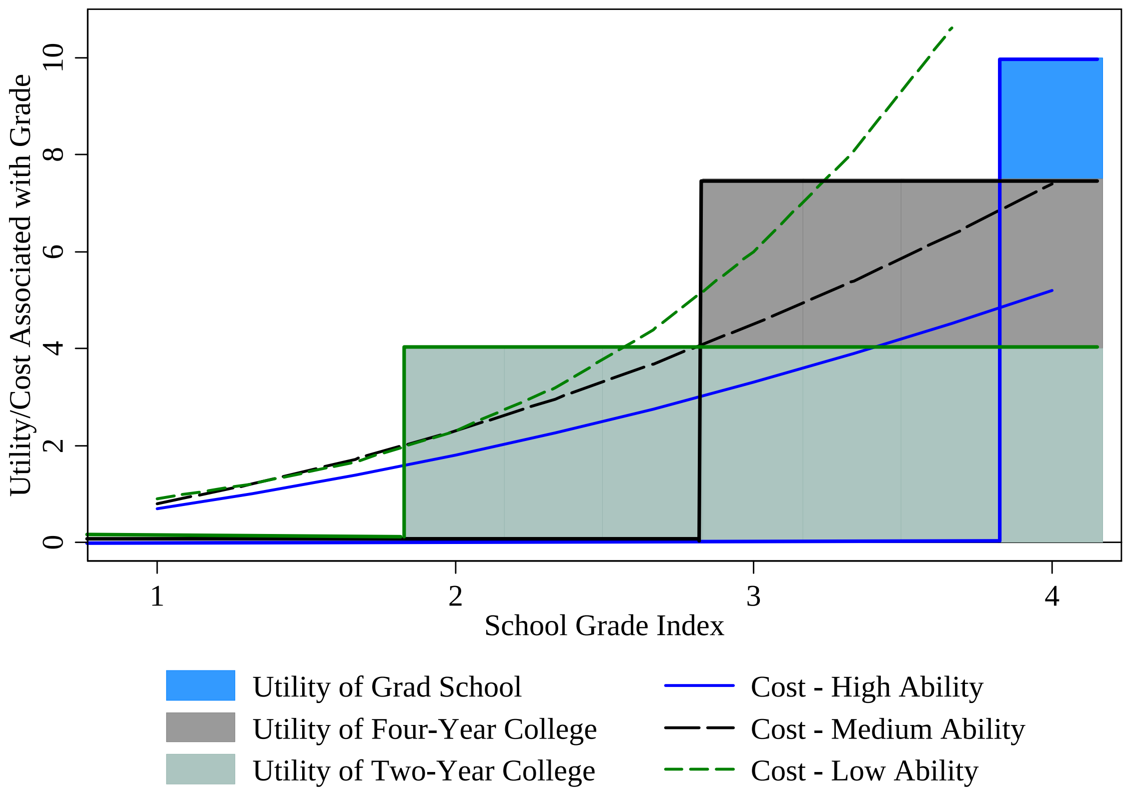
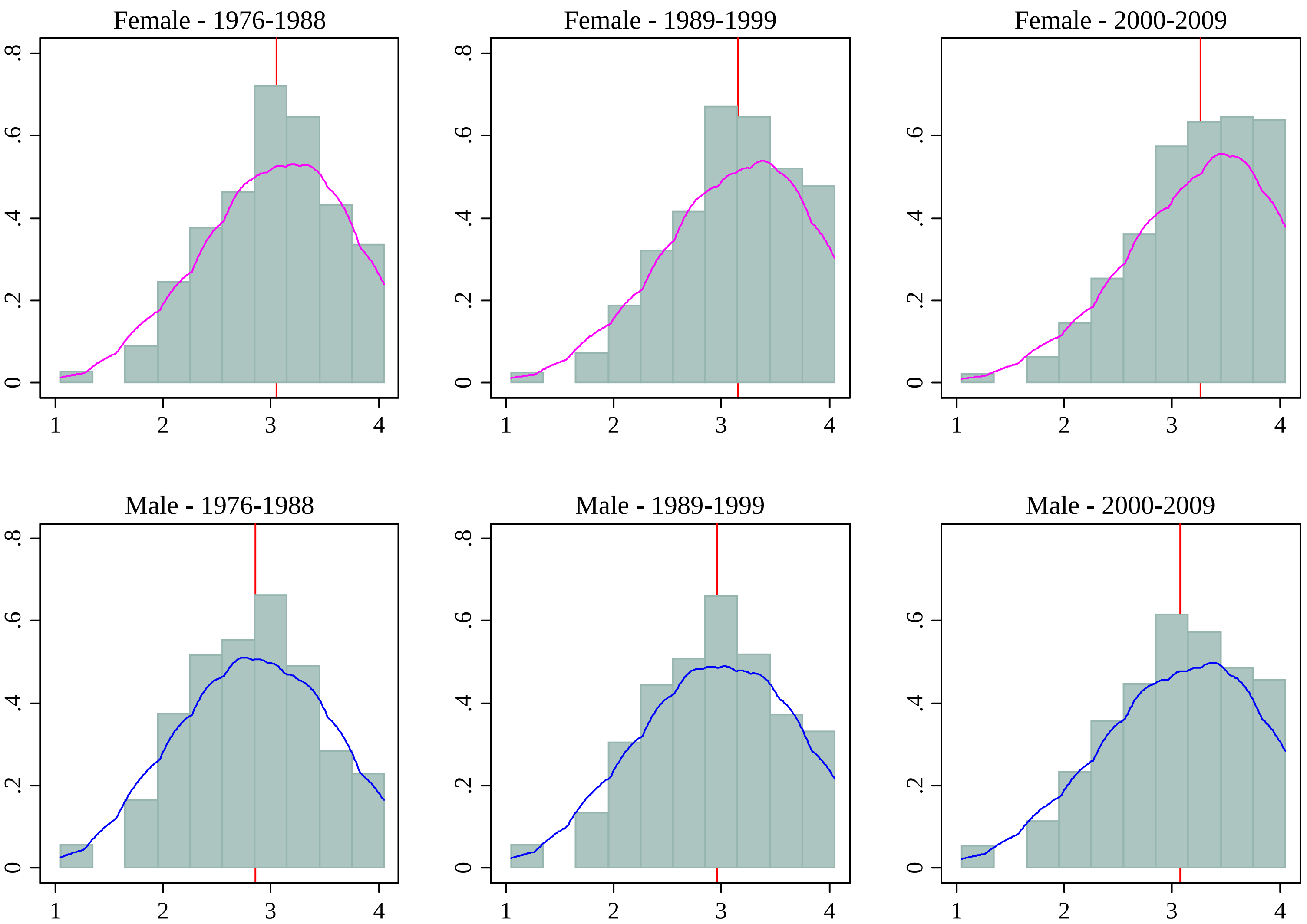
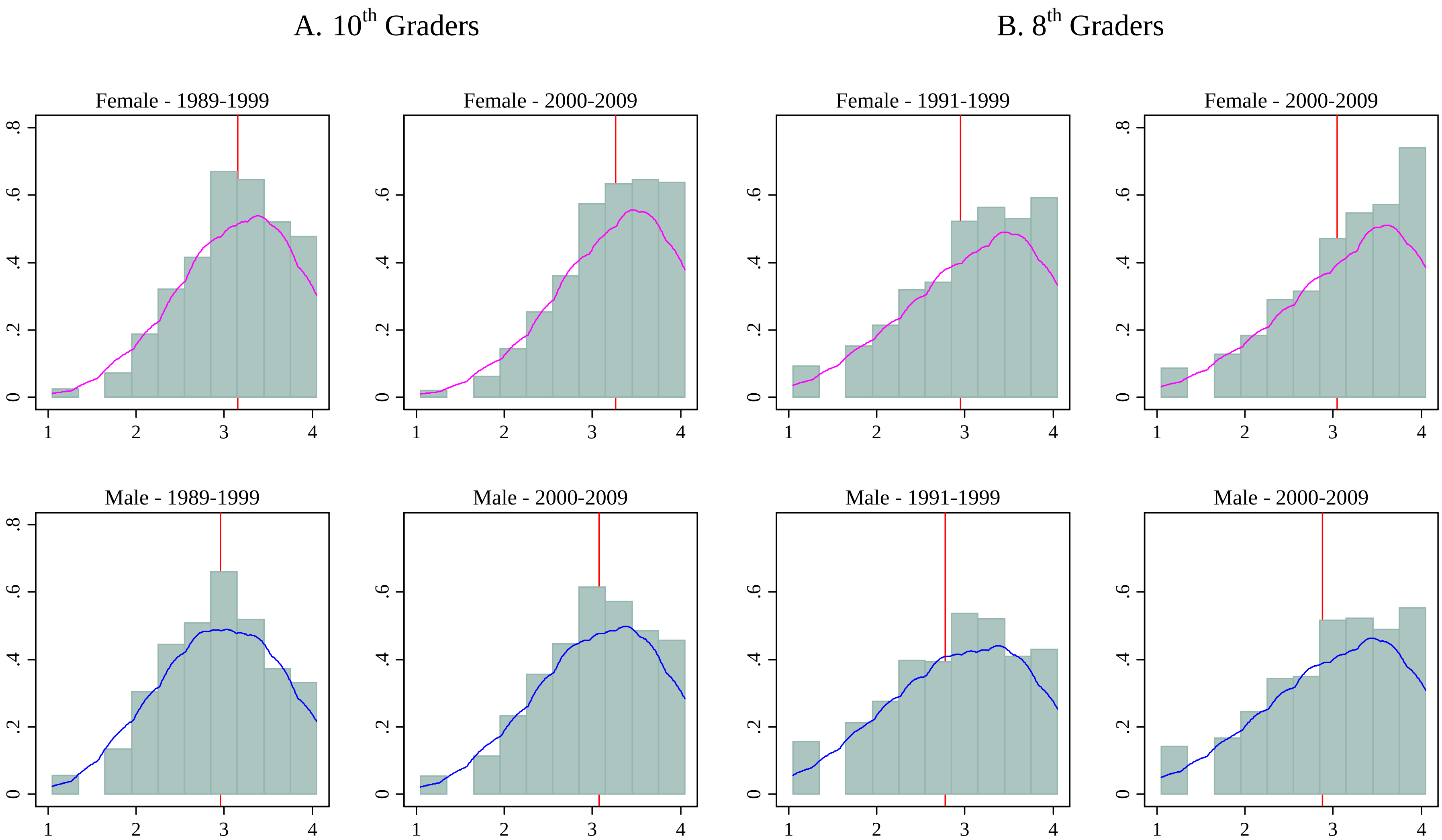


Figure 4. Male and Female Densities of Self-Reported Grades among 12th Graders



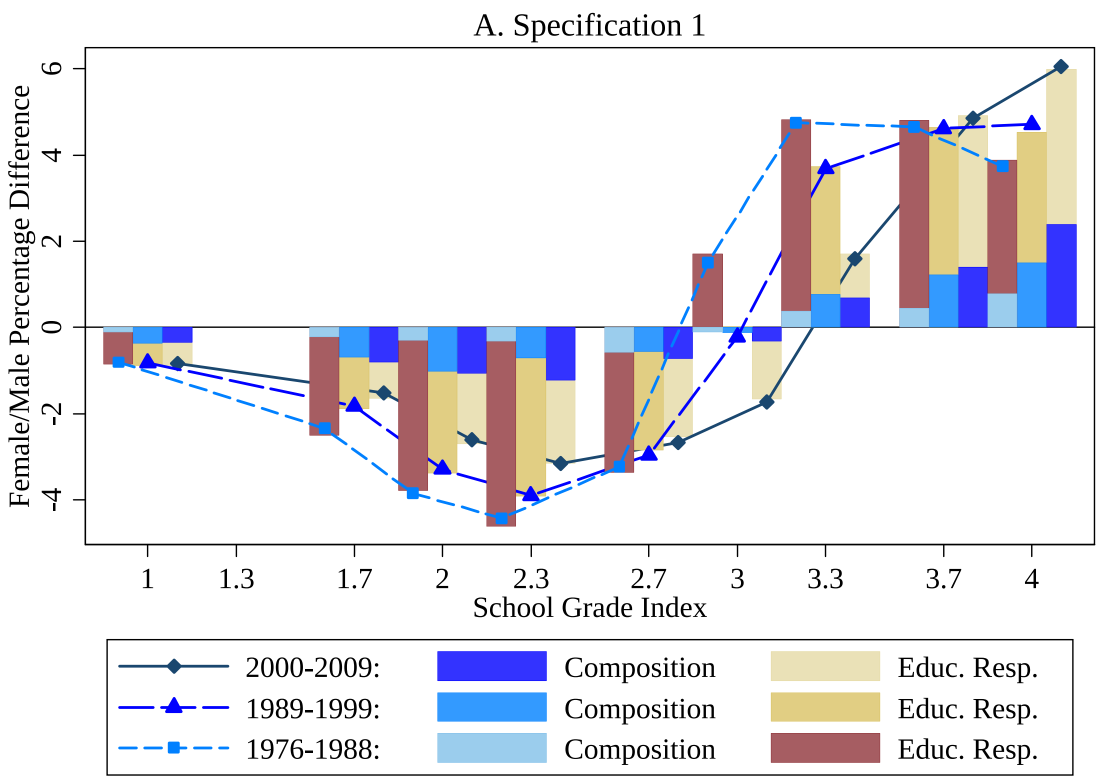
Note: Average grades is indicated by vertical line. Histogram which corresponds to actual data is overlaid with a kernel density.

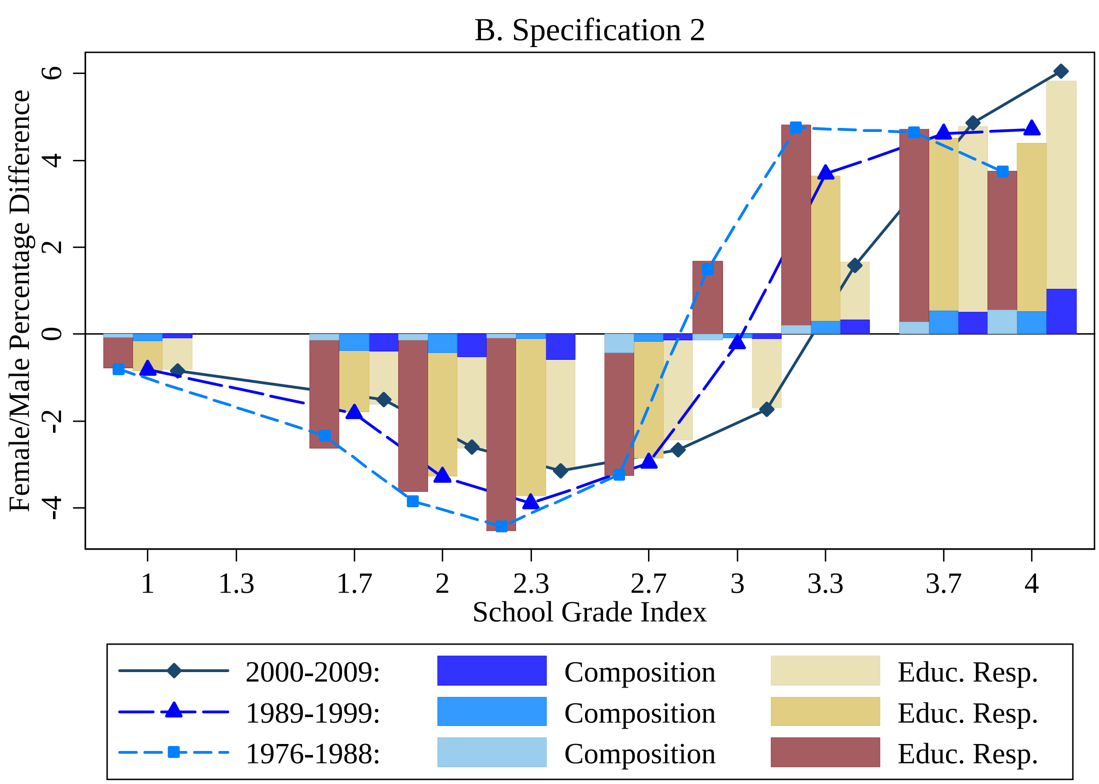
Figure 5. Male and Female Densities of Self-Reported Grades among 10th and 8th Graders



Note: Average grades is indicated by vertical line. Histogram which corresponds to actual data is overlaid with a kernel density.

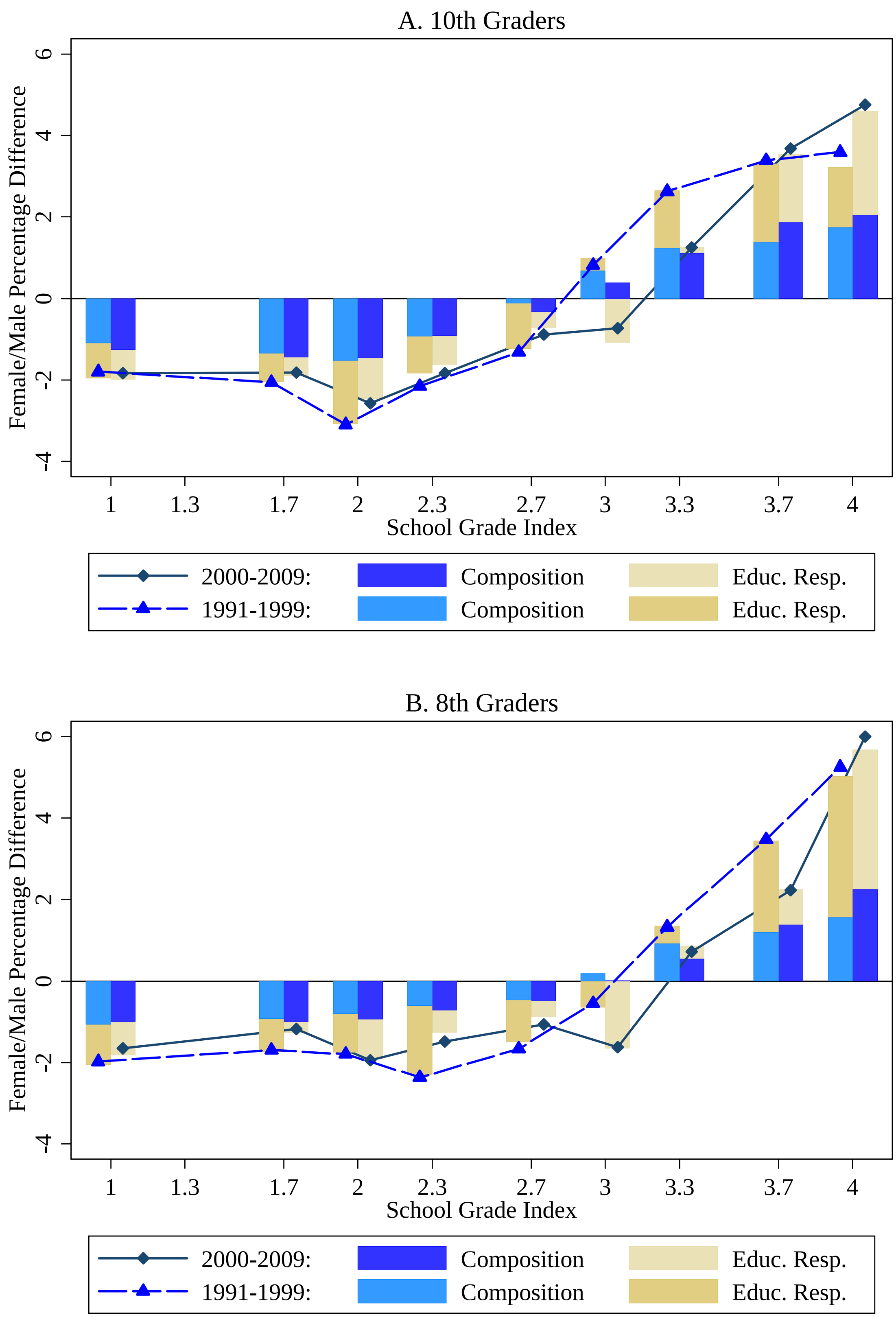
Figure 6. Female/Male Differences in School Grades of 12th Graders





Note: Self-reported grades in 9 categories (D, C-,C,C+,B-,B,B+,A-,A) are translated into the numbers 1, 1.7,2,2.3,2.7,3,3.3,3.7 and 4 following standard institutional practice.

Figure 7. Female/Male Differences in School Grades of 10th and 8th Graders



Note: Self-reported grades in 9 categories (D, C-,C,C+,B-,B,B+,A-,A) are translated into the numbers 1, 1.7,2,2.3,2.7,3,3.3,3.7 and 4 following standard institutional practice.

Figure 8. Detailed Decomposition of Female/Male Differences in School Grades of 12th Graders

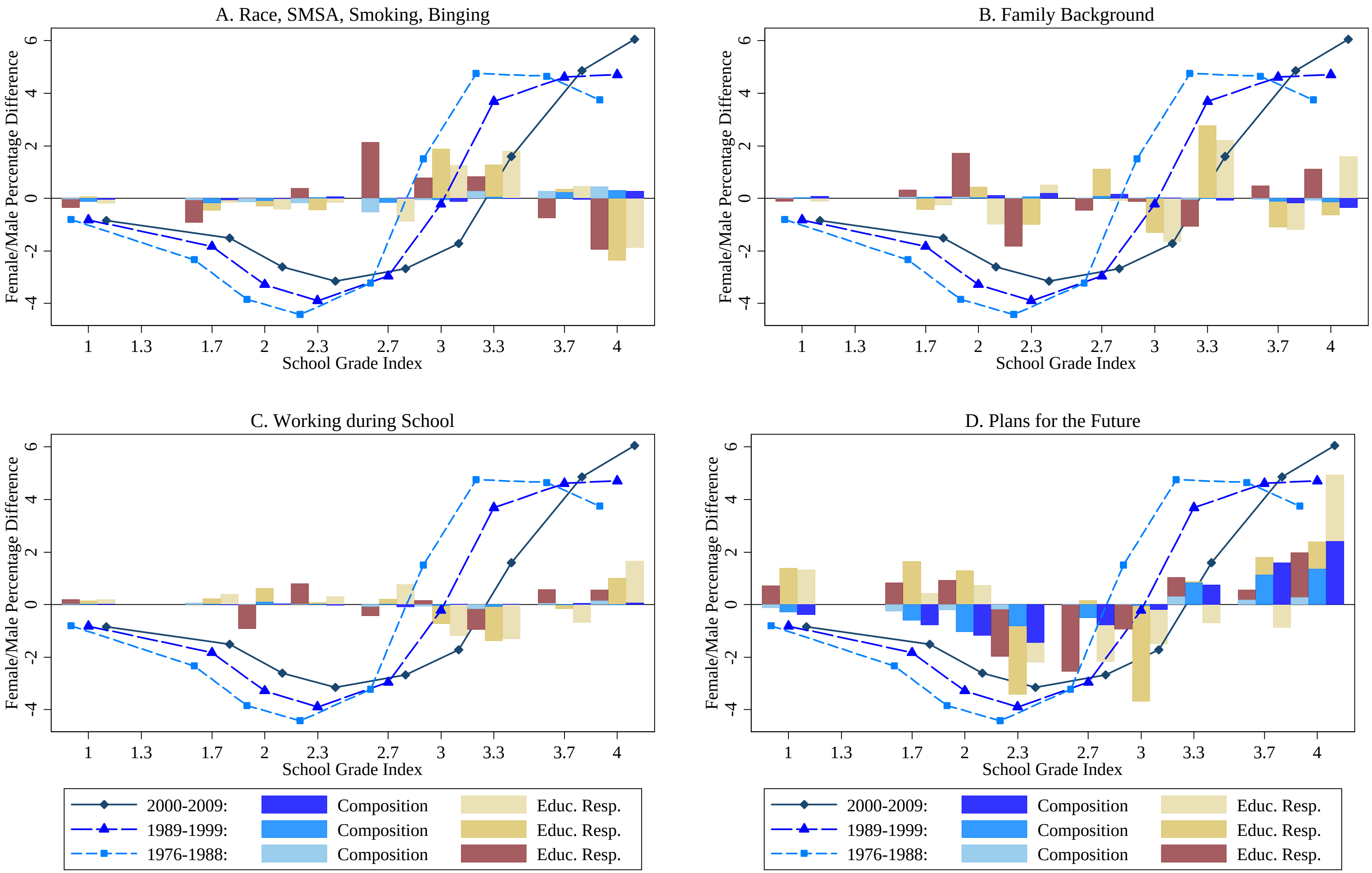


Figure 9a. Detailed Decomposition of Female/Male Differences in School Grades of 10th Graders

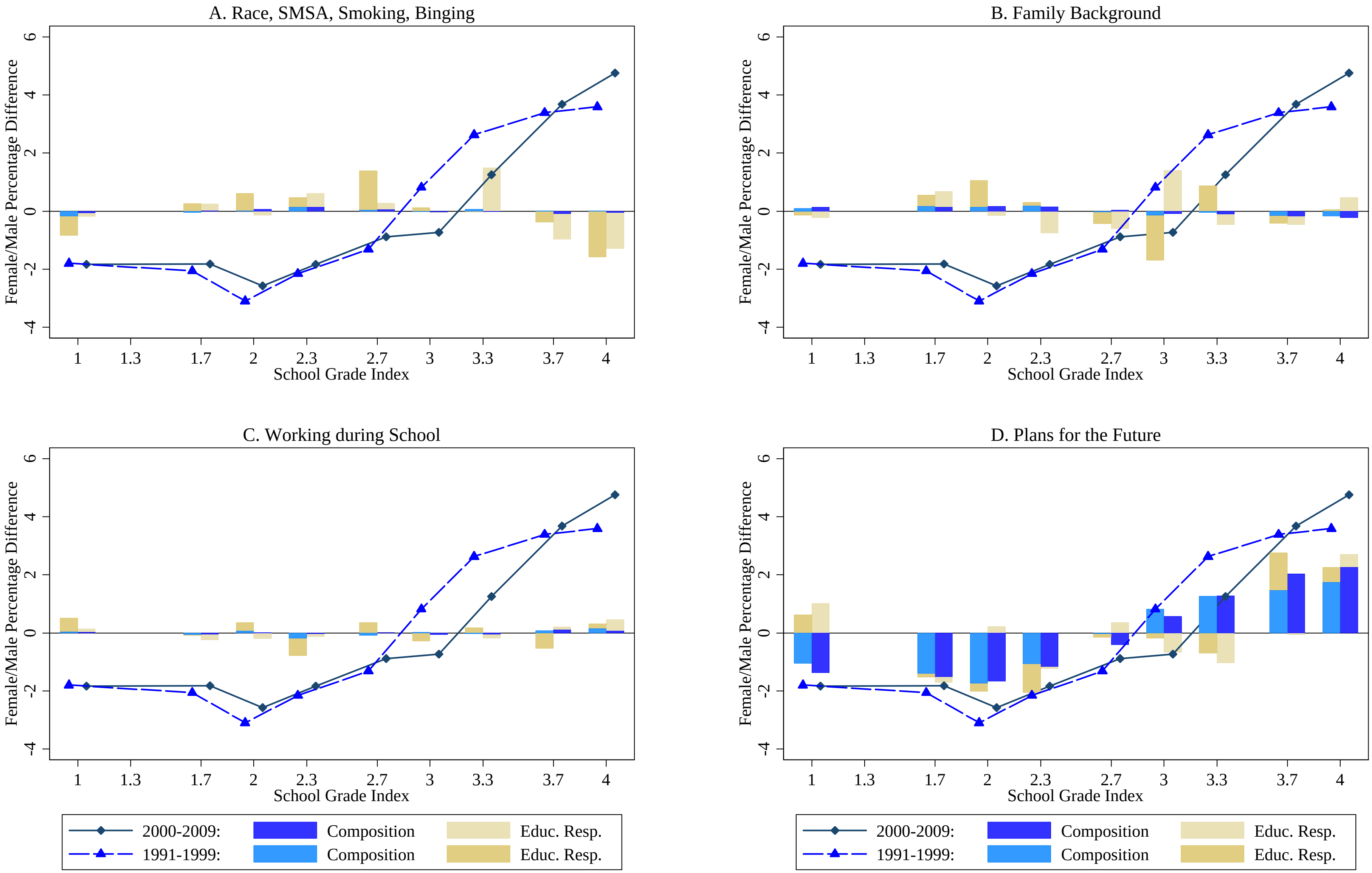


Figure 9b. Detailed Decomposition of Female/Male Differences in School Grades of 8th Graders