HIGH SCHOOL LEADERSHIP, EDUCATIONAL ATTAINMENT AND POST-SCHOOLING EARNINGS

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ABSTRACT

KATHRYN ELIZABETH ROUSE: High School Leadership, Educational Attainment and Post-Schooling Earnings
(Under the direction of Professor Thomas Mroz)

Leadership skill is valued by both employers and academic institutions. Research suggests that such skill may be fostered or signaled through leadership experience while in high school, yet few economists have examined the role of such experience in determining future labor market outcomes. Moreover, in the limited research that exists, the studies have been limited to certain sub-populations and have focused on ordinary least squares specifications and results. In this dissertation, I fill these gaps in the literature using two datasets from the National Center for Education Statistics to assess the impact of high school leadership on subsequent educational attainment and post-schooling earnings. I address the non-random selection of students into leadership positions using three econometric approaches: ordinary least squares, propensity score matching and instrumental variables. In chapter II, using each of these methods and data from the National Education Longitudinal Study of 1988 (NELS), I find that high school leadership has a large, positive impact on post-secondary educational attainment. In chapter III, I replicate the analysis of chapter II using data from the sophomore cohort of the High School and Beyond (HS&B). The chapter III results are remarkably similar to the results reported in chapter II of this dissertation, suggesting that the results reported in chapter II are not simply an artifact of the NELS dataset. Finally, in chapter IV, I revisit Kuhn and Weinberger (2005) to provide further evidence on the impact of high school

leadership on post-schooling earnings. Using data from both the HS&B and NELS, I first replicate and extend their regression analyses. Then, I estimate the impact of high school leadership on earnings using the three empirical approaches used in chapters II and III. With one puzzling exception, every estimation method, dataset, and model specification examined indicates that high school leadership has a large, positive impact on post-schooling earnings. Taken as a whole, the research coming out of this dissertation corroborates the limited evidence put forth by other economists and implies that high school leadership is, in fact, an important determinant of both future educational and labor market success.

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CHAPTER I: INTRODUCTION

1. Motivation and Overview

Many employers and academic institutions rank "soft-skills" such as communication, motivation and leadership higher on their list of desirable employee/student attributes than traditional academic skills as demonstrated through a high grade point average or class rank.[1] Yet, until very recently, nearly all of the economic literature on the determinants of labor market and educational success has focused on the role of cognitive skills and has largely ignored the role that these other, "non-cognitive[2]," skills may play. Lately, however, there has been a growing interest among labor economists in examining the importance of non-cognitive skills in the labor market. In fact, the entire fall 2008 issue of the *Journal of Human Resources* is devoted to the subject [Fall 2008, Vol. 43, Issue 4]. The symposium includes papers that investigate the development of non-cognitive skills [Cuhna and Heckman (2008), Segal (2008)], studies that explore the role of non-cognitive skills in determining the assignment of workers [Borgans, ter Weel and Weinberg (2008), Krueger and Schkade (2008)], and papers that address the importance of non-cognitive skills in explaining observed gender and racial wage gaps [Fortin (2008), Urzua (2008)], among others.

[1] For instance, in a recent survey by the National Association of Colleges and Employers, employers rank communication, motivation, work ethic, and teamwork skills above academic credentials in their list of top skills they look for in job candidates.

[2] While there has been some discussion regarding the term "non-cognitive", here I follow Lee and Seng (2005), who define "non-cognitive" skills as those "intangible qualities not measurable by classroom learning attainment, cognitive tests, receipt of a diploma/degree, or acquisition of specific job skills through training (p. 2)."

Evidence arising from these papers and other related studies indicates that non-cognitive skills are, in fact, important contributors to labor market and behavioral outcomes.

One non-cognitive skill that has been given particular attention in the business world and in higher education is that of leadership. Kuhn and Weinberger (2005), for example, report that top MBA programs are sending their students to leadership boot camps and that Fortune 500 companies are paying for leadership training of their employees. Leading academic institutions are also emphasizing leadership skill in the college admissions process, and many universities have even implemented specific leadership courses or training seminars.[3] An examination of elite university web pages also shows that leadership skill is listed among top admission criteria. In fact, according to eHow.com, leadership is now "the hottest buzzword in college admissions." Oprah Winfrey has even emphasized the importance of leadership skill, recently opening a boarding school for girls in South Africa which she calls the *Oprah Winfrey Leadership Academy for Girls.*

A small related body of research by economists suggests that non-cognitive skills may be fostered through participation in extracurricular activities while in high school. Barron et al. (2000), for example, argue that athletic participation in high school may increase traits such as self-discipline, motivation and competition which are subsequently rewarded in the labor market in the form of higher wages. Likewise, undertaking a leadership position in high school, such as being a team captain or a class officer, may increase one's leadership skill. Universities also use evidence of leadership experience in high school as a selection mechanism in the admissions process. It is therefore likely that

[3] The University of North Carolina at Chapel Hill, for example, has the *Carolina Leadership Academy* for its student-athletes and recently hosted a *Student Leadership Summit* for area eighth graders.

students with leadership experience have a better chance of college admittance and more lucrative financial aid offers. In fact, according to Christine Stoddard, author of "How to Demonstrate Leadership for College Admissions[4]," earning a leadership position in high school is the number one way to demonstrate leadership skill to admissions committees.

The growing importance of leadership skill in the college admissions process and the labor market, together with the potential role of high school leadership in fostering and signaling such skill, motivates the following research questions: *Does high school leadership contribute to future educational attainment? Does holding a leadership position in high school lead to future earnings premiums?* Surprisingly, despite a growing emphasis on leadership skill in higher education and in the business world, few economists have studied the return to and the development of leadership skill. The limited economic evidence on this subject, however, suggests that the answer to both of these questions is yes.

First, looking at educational attainment, Lozano (2008) finds high school leadership is associated with a higher probability of college attendance for all demographic groups and is associated with a higher college graduation rate of Hispanic students whose first language is not English. Second, turning to earnings, Kuhn and Weinberger (2005) use self-reported measures of leadership skill and high school leadership positions to estimate wage returns to leadership skill of white men. Using data from three, large, nationally representative surveys, the authors find that leadership skill translates into future wage premiums ranging from 4 to 33%. Their results also suggest

[4] Stoddard, Christine. "How to Demonstrate Leadership for College Admissions." www.ehow.com/how_2129742_demonstrate-leadership-college-admissions.html

that men who were leaders in high school are more likely to be employed in managerial occupations later in life and that the wage returns are greatest in managerial occupations.

These findings are particularly important when one considers the fact that, despite the likely importance of high school leadership activities; many school systems across the nation have looked to cutting extracurricular activities to solve their budget crises. While some have gone as far as eliminating these activities all together, many other districts have implemented "pay-to-play" programs in which students are charged fees, typically ranging from $75 to $100 per activity.[5] Such actions have been met with considerable controversy. While proponents argue that extracurricular activities do not constitute part of a public student's free education and are therefore logical areas to cut expenses, opponents argue that programs such as pay-to-play are discriminatory against students from low income households. Opponents of program cuts also argue that reducing the availability of activities prohibits students from gaining valuable life skills that are best learned outside of the classroom.

While the evidence arising from Lozano (2008) and Kuhn and Weinberger (2005) is suggestive of a positive relationship between high school leadership and positive future educational and labor market outcomes, each paper focuses on one sub-group of students. More importantly, the reported estimates come from univariate probit or regression models that assume linearity and do not account for self-selection into high school leadership positions.[6] It is therefore difficult to determine the extent to which the

[5] See for example, "Pay to play is a shutout we can't afford." SFGate.com, May 2003. http://sfgate.com/cgi-bin/article.cgi?f=/c/a/2003/05/09/ED214390.DTL.

[6] In an earlier (unpublished) version of his paper, Lozano does use a two-stage least squares approach in his robustness checks; however, he is unable to test the validity of his instrument and his results are associated with large standard errors.

estimated relationships are causal. Further research on the causal consequences of a student's high school leadership experience is therefore essential to education policymakers involved in these debates.

In this dissertation, I contribute new evidence to this relatively recent topic of study in a series of three empirical essays. First, in chapter II, I use data from the National Education Longitudinal Study of 1988 (NELS) to estimate the impact of high school leadership on subsequent educational attainment. Using three econometric approaches to address the non-random selection of students into leadership positions, I find that high school leadership is, in fact, an important determinant of future educational success. Every estimation method and model specification examined implies that high school leadership has a large, positive impact on post-secondary educational attainment. The most conservative estimates suggest that students who are leaders in high school complete 0.35 more years of education than their non-leader peers. In addition, high school leadership is predicted to increase the probability of attending a post-secondary institution by at least five percent and to increase the probability of holding a college degree by 9.5 percent. These estimates are significant in both a statistical and an economic sense. Compared with the estimated impact of math ability on educational attainment, for instance, these effects are roughly equivalent to a 5.5 to 8 percentile point increase in a student's standardized math test score. The estimate of 0.35 years of education is also of similar magnitude to Altonji's (1995) <u>largest</u> point estimates of the effect of an additional year of science, foreign language and math class on total years of education (0.270, 0.416, 0.424, respectively).

Interestingly, the instrumental variables estimates, which control for selection on unobserved characteristics (by the econometrician), are two to three times the magnitude of these estimates. This result suggests that failure to control for unobserved heterogeneity leads to estimates that understate the true impact of leadership. An alternative interpretation put forth by Card (2001) is that the IV estimates reflect a relatively high return to leadership by the small group of students who are affected by the instruments. Regardless of the interpretation of the results, however, the evidence from this essay indicates that the causal impact of high school leadership is, at a minimum, non-trivial and suggests that the effect may be much larger for some students. Finally, I find evidence of a differential impact of leadership for students from low versus high income households. In terms of total years of education and post-secondary attendance, high school leadership appears to disproportionately benefit students from lower income households, while with respect to college graduation, leaders from high income households seem to derive at least as great or greater benefit from their leadership experience than their low-income peers. A similar pattern persists across gender, race and math ability lines. Males, blacks, and low math ability students appear to benefit more in terms of their post-secondary attendance; while their female, white, and high math ability counterparts benefit more in terms of college graduation.

In chapter III, I re-visit the impact of high school leadership on subsequent educational attainment using data from the sophomore cohort of the High School and Beyond (HS&B). The students of the sophomore cohort of the HS&B survey represent a cohort of students who are exactly ten years older than the students of the NELS. Apart from the interest in checking the robustness of the results to the alternative dataset, use of the HS&B also provides an interesting cross-cohort comparison of estimated leadership/educational attainment effects. In addition, the HS&B asks questions about both school sponsored and non-school sponsored activities and also includes questions about alternative leadership activities, such as speaking in front of a group of 50 or more. These unique attributes of the HS&B allow me to test the robustness of the school sponsored leadership effects to these alternative measures of leadership.

Despite the data coming from surveys of two different cohorts of students ten years apart, the chapter III results from the HS&B data are remarkably similar to the NELS results found in chapter II of this dissertation. The smallest estimate coming from the HS&B, for instance, suggests that students who hold a high school leadership position complete roughly 0.480 more years of education than their non-leader peers. This estimate is actually somewhat larger than the comparable estimate of 0.35 years found with the NELS sample. The instrumental variables estimation results also mirror those found with the NELS data. With each educational outcome and model specification, the IV estimates of the impact of high school leadership are larger in magnitude than their corresponding ordinary least squares and propensity score estimates.

Importantly, the evidence provided by the robustness checks in chapter III reinforces the main results of the essay. The estimates on school sponsored leadership change little when dummy indicators for non-school sponsored leadership activities are included in the models. In addition, compared with leadership experience in non-school sponsored activities, leadership in school sponsored activities appears to be more beneficial. Finally, the results suggest that students also benefit from alternative leadership activities such as public speaking and leading group problem-solving sessions.

The evidence arising from the third chapter indicates that the results reported in chapter II are not only an artifact of the NELS dataset and suggest that high school leadership was also beneficial for students born a decade before the student of the NELS.

Last, in chapter IV, I revisit Kuhn and Weinberger (2005) to provide further evidence on the impact of high school leadership experience on post-schooling earnings. Using data from the sophomore cohort of the HS&B and the NELS, I first replicate Kuhn and Weinberger's major findings for white men of the HS&B. Then, I extend their analysis to include white women of the HS&B. This exercise allows me to examine the extent to which the leadership premiums reported by Kuhn and Weinberger (2005) for white male students differ from those estimated on a larger, more representative sample that includes women. Using data from the NELS, I then test the persistence of the Kuhn and Weinberger (2005) leadership effects for students from the later cohort. Next, I address the non-random selection of students into high school leadership positions using the same econometric approaches of chapters II and III. Finally, I examine gender differences in the return to high school leadership.

While my replication of Kuhn and Weinberger (2005) is not perfect, I am successful in replicating their major findings for white men in the sophomore cohort of the HS&B. The results indicate that high school leadership has a large, positive impact on the earnings of white men from the HS&B. When women are included in the HS&B sample, the estimated effects are somewhat smaller, indicating a relatively weaker relationship between high school leadership and earnings for white women of the HS&B. Similarly, compared with Kuhn and Weinberger's sample of white men of the HS&B, the estimated effects arising from the NELS dataset are smaller in magnitude. This result suggests that the earnings impact of high school leadership has dampened across the two cohorts. Nevertheless, estimates from each alternative sample and model specification used in the replication analysis indicate that students who were high school leaders do, in fact, earn more than their non-leader peers.

With one puzzling exception, the results coming from the empirical methods described in chapter II of this dissertation echo the Kuhn and Weinberger (2005) regression replication results. For both datasets, the OLS and PSM estimates indicate that high school leadership has a large, positive impact on post-schooling earnings. OLS estimates, for example, indicate that leaders in the HS&B sample earn 13.3 percent more than their non-leader peers, while leaders from the NELS are predicted to earn 10.6 percent more than non-leaders. Also consistent with the results reported in chapters II and III of this dissertation, the IV point estimate on high school leadership in the NELS dataset is much larger than the corresponding OLS and PSM estimates. In contrast, the IV estimate in the HS&B suggests leaders actually earn *less* than their non-leader peers nine years later. This perplexing result persists with alternative specifications. Finally, whereas men of the HS&B benefit to a larger extent from their leadership experience in high school than their female counterparts, the gender difference reverses sign for students of the NELS.

Taken as a whole, the research coming out of this dissertation corroborates the evidence put forth by Kuhn and Weinberger (2005) and Lozano (2008). With the exception of one puzzling result, each and every model specification and dataset examined indicates that high school leadership has a large, positive impact on future educational and labor market success. From a policy standpoint, this result suggests that extracurricular activities that offer students leadership opportunities are important contributors to their later-life success. Decisions regarding cutbacks of extracurricular activities should therefore not be taken lightly.

The remainder of this introductory chapter is intended to provide the reader with background knowledge surrounding this topic. I first describe the theoretical frameworks on which the three empirical essays are based. Then, I discuss the related literature and explain how the empirical research in this dissertation fills existing gaps and contributes to the field of labor economics.

2. Theoretical Motivation

The three empirical essays in this dissertation are motivated by two well known economic theories. I discuss these in turn.

First, undertaking a leadership position in high school may help develop a student's leadership skill and increase his stock of non-cognitive human capital, and may therefore be placed within the conceptual framework of Gary Becker's (1964) theory of human capital. The model hypothesizes that the role of education is as an investment in an individual's human capital stock, or his productive skills. The costs to the student include his forgone wage as well as any tuition or other pecuniary costs associated with his education. The "return" on this investment comes in the form of higher wages once the individual enters the labor market. Likewise, the experiences provided by a high school leadership position may help to increase an individual's leadership skill. Since this skill is sought out by employers and academic institutions and is considered a productive asset, taking on a leadership position in high school may be viewed as investment in psychological or non-cognitive human capital, which will lead the student to not only attend college, but may also make it more likely that the student will graduate and will eventually earn more than his non-leader peers upon completion of his schooling. The student's costs of high school leadership include the cost of time in terms of his forgone leisure, study time and/or high school employment, any pecuniary costs (such as participation fees), as well as the psychological costs (such as speaking in front of other students) associated with undertaking such a position.

Second, given the role that high school leadership activities play in the college admissions process, leadership may also be placed in the framework of Michael Spence's (1973) signaling model. In this model, education is thought to serve as a signal to employers of an individual's innate intelligence. Similarly, high school leadership serves as a signal of one's leadership ability to university admission committees. Individuals with innately higher leadership ability may take on leadership positions in order to separate themselves from their non-leader peers in the college admissions process. It is therefore more likely that high school leaders will attend college and will therefore attain a higher level of education than their non-leader peers. Similarly, employers may view the experience as a signal of innate leadership ability and subsequently reward these leaders with higher earnings in the labor market.

3. Literature Review

The empirical research in this dissertation contributes to three areas of the existing labor economics literature. First, most generally, it adds to the emerging literature on the importance of non-cognitive skills on labor market outcomes. Second, the research adds to a small body of literature that assesses the labor market and educational effects of high school athletic and extracurricular participation. Finally, the dissertation contributes to and is most closely related to a very narrow body of literature which specifically seeks to assess the relationship between leadership skills, educational attainment, and earnings. In the remainder of this section, I provide a discussion of the previous research in each of these areas.

While the theoretical relationships between schooling, cognitive skill development and resulting labor market outcomes have been empirically tested extensively in the labor economics literature, there have been far fewer empirical studies exploring the role of non-cognitive skills, such as leadership, in the labor market. However, the empirical evidence emerging from this growing body of literature suggests that non-cognitive skills are, indeed, important in the determination of later life labor market outcomes. Most of the early studies on the importance of non-cognitive skills focused on the wage impact of traits such as high self-esteem and an internal locus of control.[7] Results from these papers suggest that individuals with high self-esteem and an internal locus of control earn higher wages than their low self-esteem, external counterparts [Andrisanni and Nestel (1976), Andrisanni (1978), Duncan and Morgan (1981), Goldsmith, Veum and Darity (1997)]. Other researchers, who have defined non-cognitive skills more broadly, have shown that in addition to cognitive skills, non-cognitive skills also play an important role in wage determination [Heckman and Rubenstein (2001), Heckman, Stixrud and Urzua (2006), Flossman, Piatek and Wichert (2006)]. Differences in such skills have also been used to explain the growing gap between males and females in educational attainment [Jacob, 2002]. More recently,

[7] The term "locus of control" is "a theoretical construct designed to assess a person's perceived control over his or her own behavior. The classification internal locus indicates that the person feels in control of events; external locus indicates that others are perceived to have control." http://medical-dictionary.thefreedictionary.com

Fortin (2008) uses differences in four non-cognitive skills—self-esteem, external locus of control, the importance of money/work, and the importance of people/family—to explain the gender wage gap; and Urzua (2008) uses non-cognitive skills to explain observed racial wage gaps. Finally, in the recent symposium on non-cognitive skills, Borgans, ter Weel and Weinberg (2008) and Krueger and Schkade (2008) explore the role of non-cognitive skills in determining the assignment of workers.

As discussed by Kuhn and Weinberger (2005), leadership skill is different from these other, more general, non-cognitive skills in that employers specifically seek employees with demonstrated leadership skill and are even willing to pay for their employees' leadership training.[8] Despite this fact, there have been even fewer studies that explicitly investigate the importance of leadership skill in the labor market. Similar to the more general studies on non-cognitive skills, however, the limited economic studies on leadership suggest that this skill is also an important determinant of future labor market success. For example, while students perceive high grade point averages and interview preparation to be of highest value to potential employers, evidence suggests that employers actually seek students with work and leadership experience [Siebert, et al., 2002]. Examining the returns to military leadership of Vietnam generation young men, Lee and Yip (2005) also find a positive wage return to leadership skill through military rank.

The focus of this dissertation is on the specific impact of high school leadership experience. To date, there has been even less research on this specific topic. Several studies have, however, examined the later labor market effects of high school extracurricular *participation*. Barron et al. (2000) argue that participation in high school

[8] Kuhn and Weinberger (2005), p. 398.

may increase traits such as self-discipline, motivation and competition, which are subsequently rewarded in the labor market in the form of higher wages. Empirical estimates from a number of studies support this theory. Ewing (1995), for instance, uses the National Longitudinal Study of Youth 1979 (NLSY) to examine whether black high school athletes earn future wage premiums. Using the Heckman selection correction technique to account for sample selection bias, Ewing finds that high school athletic participation increases the wages of black males by 8 to 11 percent. Similarly, Barron, Ewing and Waddell (2000) use the NLSY and the National Longitudinal Study of 1972 (NLS-72) to examine the effects of high school athletic participation on education and labor market outcomes of males. Using a handful of school and individual health characteristics as instruments for athletic participation, the authors find some evidence of a positive impact of high school athletic participation on the wages and educational attainment of males; however the effects are small when instrumental variables are used. Using the 1980 sophomore cohort of the HS&B, Eide and Ronan (2001) use height as an instrument for athletic participation. Results indicate that high school athletic participation has a negative effect on the wages of white males, but has a positive effect on the wages of black males and females. More recently, Betsey Stevenson (2006) uses state variation in the athletic participation of males along with Title IX legislation to instrument for female athletic participation. Stevenson finds female high school athletic participation leads to numerous positive outcomes for females including higher educational attainment, increased labor force participation and increased participation of females in traditionally male-dominated careers. Participation in either clubs or sports has also been shown to increase students' high school math and science test scores as well as their Bachelor's degree expectations [Lipscomb, 2006].

High school leadership is a more involved level of participation. Moreover, in contrast to participation that may increase and signal a wide range of non-cognitive skills, holding a leadership position specifically fosters and signals the skill of leadership - a skill that is widely valued and specifically sought after by universities and employers. The connection between leadership and future outcomes may therefore be even stronger and more direct than simple participation. As mentioned earlier, the evidence from the two papers that estimate the impact of high school leadership experience on future outcomes suggests that this is, indeed, the case. Using data from Project TALENT, the NLS-72 and the sophomore cohort of HS&B, Kuhn and Weinberger (2005) use high school leadership as a proxy for leadership skill to assess whether leadership skill is associated with higher future wages of white males. Their results indicate that high school leadership leads to a wage premium ranging from 4% to 33% depending on the sample and measure of leadership used. The leadership premium also appears to be greatest in managerial occupations. Finally, using data from the NELS, Lozano (2008) assesses whether differences in high school leadership activities can explain observed Hispanic educational gaps. Results suggest that, after controlling for demographic and school variables, there is no significant difference in leadership propensities between Hispanics and non-Hispanics. In addition, high school leadership is estimated to increase college attendance of all demographic groups (by roughly 7%) and to increase college graduation probabilities of non-Hispanic and English speaking Hispanic high school leaders by 28 to 32 percent.

The empirical essays in this dissertation contribute to the existing literature in several ways. First, to my knowledge, to date, only two other papers by economists have examined the impacts of high school leadership on later-life outcomes. One paper estimates the impact on educational attainment and the other on earnings. Consequently, the results have not yet been validated by any other economists. This dissertation, therefore, marks the first study to test (and, in the end, to corroborate) the results published by Lozano (2008) and Kuhn and Weinberger (2005). Second, while the results coming from the earlier studies are suggestive of a positive relationship between high school leadership and future educational attainment and earnings, the focus of each paper is on only one sub-group. While focusing on one sub-group allows for a more homogenous sample, by estimating the effects for a more general population, this research presents the first evidence of the later-life impacts of high school leadership experience for the average student. Moreover, I am able to test the effects separately by sub-groups. Most importantly, the estimates reported in the previous studies come from univariate probit or regression models that assume linearity and do not account for self-selection into high school leadership positions.[9] It is therefore difficult to determine the extent to which the estimated relationships are causal. In each of the empirical essays, I estimate the impact of high school leadership using three econometric approaches that control for possible selection bias that arises due to the non-random selection of students into leadership positions in high school. Use of the three methods provides further evidence as to whether the estimated relationships between high school leadership and later-life outcomes are, in fact, causal.

[9] In an earlier (unpublished) version of his paper, Lozano does use a two-stage least squares approach in his robustness checks; however, he is unable to test the validity of his instrument and his results are associated with large standard errors.

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CHAPTER II: THE IMPACT OF HIGH SCHOOL LEADERSHIP ON SUBSEQUENT EDUCATIONAL ATTAINMENT

1. Introduction

In this chapter, I use data from the National Education Longitudinal Study of 1988 (NELS) to estimate the impact of high school leadership on one of its most probable direct consequences - subsequent educational attainment. In contrast to the limited literature on this subject, which relies on linear ordinary least squares and probit estimation, I use two additional estimation approaches to address the potential bias that arises from the non-random selection of students into high school leadership positions. As a baseline, I first control for selection on observable characteristics parametrically using ordinary least squares and probit estimation procedures. Then, I relax the linearity assumption and estimate the impact non-parametrically using a propensity score matching (PSM) approach. Finally, instrumental variables estimation methods, which rely on variation in school leadership opportunities, birth order and twin indicators for identification, are used to directly address the endogeneity of high school leadership that arises when there is selection on characteristics that are not observed (by the econometrician).

Every estimation method and model specification examined implies that high school leadership has a large, positive impact on post-secondary educational attainment. The most conservative estimates suggest that students who are leaders in high school complete 0.35 more years of education than their non-leader peers. In addition, high school leadership is predicted to increase the probability of attending a post-secondary institution by at least five percent and to increase the probability of holding a college degree by 9.5 percent. These estimates are significant in both a statistical and an economic sense. Compared with the estimated impact of math ability on educational attainment, for instance, these effects are roughly equivalent to a 5.5 to 8 percentile point increase in a student's standardized math test score. The estimate of 0.35 years of education is also of similar magnitude to Altonji's (1995) largest point estimates of the effect of an additional year of science, foreign language and math class on total years of education (0.270, 0.416, 0.424, respectively). The results are robust to the inclusion of school fixed effects and are not highly sensitive to the definition of high school leadership.

Interestingly, similar to many empirical studies on the return to schooling[10], the instrumental variables estimates of the impact of high school leadership are two to three times the magnitude of the ordinary least squares and propensity score estimates. IV estimates of the impact of high school leadership on total years of education, for instance, suggest the impact of high school leadership is roughly 0.9 (versus 0.35) years of additional education. The IV estimates on the probability of attending a post-secondary institution and college graduation are approximately 21 and 35 percent, respectively. These estimates are equivalent to a more than 15 percentile point increase in a student's math test score. The instruments used in the analysis pass multiple validity tests and the results change little when alternative specifications are employed.

[10] Card (2001) summarizes eleven studies where instrumental variables estimates of the return to education are larger than their corresponding ordinary least squares point estimates.

The most straightforward explanation for this result is that failure to control for unobserved heterogeneity arising from selection on unobserved characteristics biases the OLS and PSM estimates in the downward direction. However, in the context of the schooling literature, Card (2001) puts forth an alternative interpretation. Card suggests that, rather than recovering an average treatment effect, the IV estimation procedure recovers an estimate of a local average treatment effect (LATE); the high instrumental variables estimates may therefore be reflective of a relatively high marginal impact for a small sub-group of students who are affected by the instruments. Regardless of the interpretation of the results, however, the evidence in this essay indicates that the causal impact of high school leadership is, at a minimum, non-trivial and suggests that the effect may be much larger for some students.

Finally, I also find evidence that the impact of high school leadership varies by family income. High school leadership appears to disproportionately benefit students from low-income households in terms of total years of education and post-secondary attendance. With respect to college graduation, however, the benefit from leadership experience seems to be at least as great or greater for students from high income households. Interestingly, a similar pattern persists across gender, race and math ability lines. Males, blacks, and low math ability students appear to benefit more in terms of their post-secondary attendance; while their female, white, and high math ability counterparts benefit more in terms of college graduation.

2. Data

The data used in the empirical analysis come from the National Education Longitudinal Study of 1988-2000 (NELS). The NELS includes 12,144 individuals who were in eighth grade in 1988 and included in the fourth follow-up in 2000. The participants were re-interviewed in 1990, 1992, 1994 and 2000. In the survey, the students, their parents, their teachers and their school counselors were interviewed. The dataset contains a rich collection of both individual and school level characteristics. For the purposes of this research, this study is particularly well-suited as it asks a number of questions covering a wide range of extracurricular activities. Moreover, the responses include an indicator of whether the individual was a participant, a non-participant or if he was an officer or a captain in the particular activity. This allows me to construct a dummy indicator for high school leadership experience. I consider an individual to be a high school leader if there is evidence that he held any leadership position in either the tenth or twelfth grade.[11]

Since the effect of high school leadership is estimated using three different econometric approaches, a common analysis dataset is constructed so that each method is applied to the same sample of students. This is done in order to allow for meaningful comparisons across the econometric methods. Creation of a common analysis set reduces the original sample of 12,144 students who were included in the fourth follow-up survey to a sample of 9,665 students.[12] In the analysis sample, 4,179, or 43.2%, of students are leaders, while 5,486 students (56.8%) are non-leaders. Admittedly, 43.2% seems like a high proportion of student leaders. However, Kuhn and Weinberger (2005) find similar proportions of student leaders in all three of their datasets. In their Project Talent sample, for instance, 57.7% of students are leaders; and, in the High School Beyond sample that

[11] Table A1 in Appendix A provides a list of the tenth and twelfth grade extracurricular activities and responses used to construct the leadership indicator.

[12] Table A2 in Appendix A describes the sample selection criteria.

only considers twelfth grade leadership, 48% of the students are leaders. These high percentages may reflect student reporting error. Alternatively, they may simply be a result of the comprehensive list of activities that are used to construct the leadership indicators (see Table A1 in Appendix A). In addition, within a given activity, there may be multiple leadership positions. The National Honor Society, for example, likely has a president, vice president, secretary and a treasurer. Unfortunately, the data does not allow me to differentiate between a club president and a club treasurer. In robustness checks, I test the sensitivity of the reported results to the leadership definition by restricting high school leadership to leadership in the senior year only.

Compared with the full dataset, the analysis sample has a slightly larger proportion of leaders (43.2% versus 41.5%). Importantly, however, outcome and control variable mean differences across leaders and non-leaders do not vary largely between the full and restricted samples.[13] Table II.1 presents descriptive statistics of the full sample and disaggregated by leadership status.[14]

Three different measures are used to assess the impact of high school leadership on subsequent educational attainment: (1) years of education, (2) probability of attending any post-secondary institution, and (3) probability of holding a college degree. Each of these outcome variables is measured in the year 2000, approximately eight years after high school. Looking at the descriptive statistics, a simple comparison of the means of each measure of educational attainment supports the main hypotheses of the essay. Compared with non-leaders, for example, leaders have, on average, obtained roughly one

[13] For instance, in the full sample, leaders have a 24.6 mean percentage point advantage over non-leaders in terms of the proportion who are college graduates. In the restricted sample, this difference is nearly the same, 25.3. For more details, see Table A3 in Appendix A.

[14] Table A4 in Appendix A defines outcome and explanatory variables.

more year of education. In addition, over 90% of leaders have acquired some post-secondary education by 2000, while only 76% of non-leaders have attended. Finally, 50% of high school leaders are college graduates, compared with just 26% of non-leaders.[15] Each of these differences in means is statistically significant at the one percent level.

Evidence provided by the descriptive statistics suggests that there is also substantial heterogeneity in many individual, family, and school characteristics across the two groups. Compared with non-leaders, for instance, sampled high school leaders come from families with significantly greater levels of socioeconomic status and higher family incomes than their non-leader counterparts. In addition, leaders are more likely to come from schools that have smaller enrollments, a lower percentage of students receiving free lunch, and a smaller proportion of both Black and Hispanic students. Summary statistics also suggest that, compared with non-leaders, a smaller proportion of the leaders attend public schools, while a higher proportion of leaders attend both Catholic and private non-Catholic schools. On average, the high school leaders also have a statistically significant higher math test score percentile than the non-leaders, suggesting that leadership is positively correlated with cognitive ability.

In addition to more traditional controls, the NELS includes self-reported measures of athletic ability, popularity, and locus of control.[16] These variables may capture some traits such as self-esteem or other non-cognitive skills that are not captured by standard

[15] Descriptive statistics also suggest that, conditional on attendance, high school leaders are more likely to graduate than their non-leader peers.

[16] The term "locus of control" refers to a student's belief about the causes of the good or bad outcomes in his life. A student with a high locus of control is said to be *internal*. An internal student believes that he controls himself and his life, while an *external* student believes that his "environment, some higher power, or other people" control his decisions and his life. [http://en.wikipedia.org/wiki/Locus_of_control]

controls or by math ability. The descriptive statistics suggest that leaders and non-leaders do, in fact, differ along these dimensions. For instance, high school leaders are more likely to report that others see them as athletic and popular in eighth grade and high school. Additionally, they have a higher locus of control than their non-leader peers. This fact suggests that students who are high school leaders are more internal, meaning they perceive their actions to have an impact on their outcomes.

3. Empirical Approach

The primary econometric challenge I face in this study is the difficulty in distinguishing between the causal effect of high school leadership and observed correlation between high school leadership and subsequent educational attainment. If students were randomly placed into leadership positions, a simple difference in the mean educational outcomes of leader and non-leaders would give rise to the causal effect of leadership. However, selection into high school leadership positions is not random. Students either self-select into a high school leadership position or are elected into a leadership role based on their characteristics, which may or may not be directly observed in the data. Students from low-income households, for instance, may be less likely to hold a leadership position because they are not able to afford the fees required to participate (and subsequently lead) in an extracurricular activity. Similarly, students with lower academic ability may find leadership roles more costly than an otherwise identical high-ability student who can perform well academically with less study time. Since these characteristics are also likely to have a direct impact on post-secondary educational attainment, the empirical analysis must control for these and all other such leader/non-leader differences in order to recover an effect of high school leadership that is void of selection bias.

I address the selection problem by first exploiting the richness of the NELS data to control for selection on observable characteristics. This is done both parametrically using ordinary least squares and probit models and non-parametrically using propensity score matching. The assumption here is that the variables included in a vector of observed variables (X_i) are sufficient to eliminate any relationship between the leadership dummy variable (L_i) and unobserved characteristics or shocks impacting the educational outcome (ε_i). The second approach uses instrumental variables estimation to control for selection on unobserved characteristics under the assumption that there is a set of variables (Z_i) that are related to L_i but are uncorrelated with ε_i. I discuss these strategies below.

Selection on Observables

Provided selection into leadership is based on only the observed variables, X_i, the causal impact of high school leadership can be recovered by controlling for these variables in the estimation procedure. I therefore begin the empirical analysis by estimating the following linear equation:

$$Y_i = \beta_1 X_i + \beta_2 L_i + \varepsilon_i \qquad (1)$$

where Y_i is the educational outcome of interest, X_i is a vector of observed covariates that includes all measurable variables thought to either affect leadership or education, L_i is a dummy indicator for high school leadership, and ε_i is the error term. In the case of the continuous outcomes, the model is estimated by OLS, while univariate probit estimation is used when the outcome is discrete. With OLS estimation, the marginal effect of high school leadership is given by $\hat{\beta}_2$. It is interpreted as the effect of high school leadership for the average student (the average treatment effect or ATE) and is assumed to be equivalent to the average effect of high school leadership on the leaders (the average treatment effect on the treated or ATT). In the case of probit estimation, the marginal effect is calculated by averaging the differences between students' predicted outcomes when their leadership indicators are set to one and their predicted outcomes when their leadership indicators are set equal to zero.

The crucial identification assumption underlying the validity of the OLS approach is that of *conditional independence*, which states that conditional on the observed covariates, X_i, the educational outcome is independent of the leadership choice. Formally, the conditional independence assumption (CIA) is that $Y_i \perp L_i \mid X_i$. Provided the CIA holds, the inclusion of the vector X_i eliminates all possible correlation between L_i and ε_i, thus $E[\varepsilon_i \mid L_i, X_i] = 0$. The resulting OLS and probit estimates will therefore be free of selection bias and yield consistent estimators of the leadership effect.

When the regressor of interest is a dichotomous treatment indicator (such as high school leadership), propensity score matching (PSM) can also be used to control for selection on observable characteristics. This non-parametric econometric method has been has been widely applied by economists in the program evaluation literature [Heckman and Hotz (1989), Heckman et. al. (1997, 1998), Dehijia and Wahba (1999, 2002), Smith and Todd (2005), Diaz and Handa (2006)].[17] The basic methodology

[17] A recent example of the method is found in Morris (2007) and a detailed discussion of this method can be found in Becker and Inchino (2002) , Cameron and Trivedi (2005), or Caliendo and Kopeinig (2005).

consists of matching student leaders with a non-leader based on his and their estimated propensity scores, $pscore_i = p(L_i) = probability(L_i = 1 | X_i)$, and then comparing the education outcomes of students who have the same leadership propensity. PSM is arguably an improvement over simple OLS, because it is not constrained by the assumption that leadership or any of the covariates are linearly related to the outcome. Further, unlike OLS, propensity score matching ensures that for every set of characteristics, X_i, there exists both a treated and non-treated observation. Unlike OLS, PSM explicitly avoids extrapolation into areas of the causal effect distribution that are not on the common support.

Work by Heckman and other economists in the evaluation literature has shown that the PSM method works well when there are a rich set of variables on which to match and when outcomes of treated and control groups are measured from the same survey.[18] The regressor of interest in this study is a dichotomous indicator of leadership experience. I also have a rich set of control variables and the outcomes of leaders and non-leaders are taken from the same dataset. Since this study fits the conditions under which the method is likely to perform well, I also use PSM to control for observed characteristics.

I implement PSM by first calculating a leadership propensity score for each student from a probit regression of the leadership dummy variable on the vector X_i.[19]

[18] See, for instance, Heckman, Ichimura, and Todd (1997, 1998), Heckman et al. (1998) and Diaz and Handa (2006).

[19] In fact, any discrete choice model could be used to estimate the propensity score in the first stage. Since the purpose of the first stage is classification, the choice of model isn't likely to be a critical one. The robustness of the estimates to the choice of first-stage model is tests in Appendix D. Estimates from these tests are reported in Table D1. Use of the propensity score overcomes the so-called 'dimensionality problem' common in full matching procedures where, due to a large number of observable characteristics, it is difficult to find an exact match for each treated individual.

Next, I match the student leaders to the non-leader with the most similar propensity score (the 1-to-1 nearest neighbor estimator with replacement[20]). The ATT is then recovered by taking the mean of the leader/non-leader education differences across the entire set of N matched pairs:

$$ATT = \frac{1}{N_T} \sum_{i \in T} [Y_i - Y_{j(i)}] \tag{2}$$

where N_T represents the number of student leaders, Y_i is the educational outcome for a student leader, and $Y_{j(i)}$ is the educational outcome of the matched non-leader j for student i. Since the estimates rely on estimated propensity scores, the standard errors are estimated using the bootstrap method with 50 replications.[21] The resulting estimate is interpreted as the causal effect of high school leadership on the outcome for high school leaders (ATT).[22]

Like OLS, the validity of the PSM methodology rests on the assumption of CIA. Importantly, Rosenbaum and Rubin (1983) show that if the CIA holds such that education is independent of the leadership choice conditional on observed covariates X_i ($Y_i \perp L_i \mid X_i$), then it is also independent of the leadership choice conditional on the propensity score ($Y_i \perp L_i \mid p(X_i)$). Rather than using exact matching, in which individuals are matched on their observed characteristics, matching can therefore be done

[20] There are a number of alternative matching procedures. These include stratification, kernel, and radius matching, among others. In Appendix D, the models are also estimated using nearest neighbor matching without replacement, kernel matching with a Guassian kernel and radius matching with radius values of 0.1, 0.01 and 0.001. Results (Table D.3) are not highly sensitive to the matching approach.

[21] While there is some discussion regarding the validity of use of this method with matching, it is widely applied in the matching literature. Therefore, since I am faced with a lack of better alternatives, I follow the majority of the literature in using the bootstrapping method to address the issue of the estimated propensity score.

[22] It is also possible to estimate the average treatment effect and the average treatment effect on the untreated. In this discussion, I focus on the ATT since it is the effect most commonly estimated by PSM.

on the propensity score without violating the CIA. Perfect matching on the propensity score eliminates any selection bias arising from the differences in observed covariates on average. If the CIA holds, the PSM approach will recover an unbiased estimate of the causal effect of leadership that does not depend on the functional form of the leadership/education relationship.

Selection on Unobservables

If, after conditioning all on measurable differences between leaders and non-leaders, there is still unobserved heterogeneity, $E[\varepsilon_i \mid L_i, X_i] \neq 0$, then the CIA will be violated. In this case, the OLS and PSM estimates will be biased. *A priori*, the direction of the selection bias is ambiguous. Following arguments drawn from the education literature, where the traditional unobserved variable is "ability," which causes the so-called "ability bias," one would think that a factor such as unobserved student ability or motivation would be positively correlated with both leadership and the educational outcomes, leading to upward biased OLS and PSM estimates. High school leadership, however, is different from education in the following way. High school leadership involves tasks such as managing other students and speaking in front of other people. Such experiences are likely to be more costly for students who are less social, bookworms or, for lack of better term, "nerdy." These students may therefore not undertake leadership positions, but may still acquire more education if their time is better spent at home, in the library, or at their computer. In this case, the estimated impact of leadership with OLS or PSM will be understated. Measurement error in the high school leadership variable will also bias the OLS and PSM estimates toward zero.

In the presence of unobserved heterogeneity, identification of the high school leadership effect requires an explicit leadership selection equation. In addition to the vector of observed variables thought to impact leadership and education (e.g., family income, school controls, etc.), the selection equation must include at least one instrumental variable that only impacts educational outcomes through its impact on leadership. Formally, selection into a leadership position can be described by the following equation:

$$L_i^* = \alpha_1 X_i + \alpha_2 Z_i + u_i \quad [L_i = 1 \mid L_i^* > 0] \tag{3}$$

where L_i^* is a latent leadership indicator variable, X_i is the defined as in equation (1) , Z_i is the vector of instruments, and u_i is the error term.

The NELS contains several students from many high schools. This allows me to construct a school-level measure of leadership opportunities to instrument the individual's leadership choice. Specifically, I use the percent of peer leaders in a student's school.[23] For additional identification, I also include dummy indicators of whether the student is the oldest child in his family and whether or not he is a twin as well as the interaction of these variables. I discuss these in turn.

The use of school leadership opportunities as an instrument for the individual choice follows from previous work in this area and is capturing two things. First, it can be viewed as a measure of peer effects, where a student who has a larger proportion of

[23] The variable is constructed by taking the number of leaders, excluding the student, divided by all of the individuals in a student's school. Importantly, while the NELS 1988-2000 sample includes only individuals who were included in the fourth follow-up survey, the peer leadership measure is constructed from the NELS 1988-1994 dataset which has a much larger sample of students. Specifically, the NELS 1988-1994 has 27,394 students. On average, there are 21 students per school (excluding the student) in the sample used to construct the peer measure.

leader classmates is thought to be more inclined to take on similar positions.[24] Second, the variable is also capturing a measure of school-level leadership opportunities.[25] As long this measure is unrelated to school quality or student characteristics, it should be a valid instrument. The inclusion of observed school characteristics such as the school-level average math score, the percent of students who receive free lunch, school enrollment, and public/Catholic status should proxy for school and student quality[26] and therefore help mitigate these concerns, however, if the instrument is related to some unobserved measure of school quality or student characteristics, the resulting IV estimates may be suspect. In particular, if the instrument is positively correlated with either unobserved school quality or student characteristics then the resulting IV estimates will be biased upward.

The use of the eldest child indicator follows from the observation that being a first born child may make it more likely that the student is a leader than an otherwise identical student who is a second or third born and who may be used to following the actions of his elder siblings and be more content serving in a "follower" role. The use of a twin indicator follows from research drawn from the sociology field that suggests students with siblings are more likely to participate in sports [Wold and Anderson, 1992]. Since being a twin is an exogenous factor that provides a student with a sibling and constant

[24] Anderson (2002) relies on a similar instrument.

[25] Altonji (1995) relies on a similar instrument. Looking at the impact of school curriculum on post-secondary educational attainment and wages, he uses average school curriculum to instrument the individual's curriculum choice. In unpublished versions of their papers, both Kuhn & Weinberger (2005) and Lozano (2008) also rely on similar instruments.

[26] Earlier model specifications included a much wider range of school and teacher characteristics such as student/teacher ratio, lowest salary of teacher, average education level of teachers, among others. These variables did little to the estimates and were not statistically significant at conventional levels. Moreover, many of these variables came from counselor or teacher surveys and were missing for many students. Therefore, due to their negligible effects and in order to maintain a large sample size, these variables were ultimately dropped from final model specifications.

playmate of the same age, being a twin may be particularly strong predictor of participation and, subsequently, leadership. The oldest child and twin dummy indicators will be valid instruments provided they do not have a direct impact on the educational outcomes.

Admittedly, with respect to oldest child and twin indicators, there is reason to question the plausibility of the exclusion restrictions. A body of research, for instance, suggests that birth order and family size are related to a child's educational outcomes through the child quantity/quality tradeoff.[27] If parents do disproportionately invest in their oldest child in activities other than high school extracurricular activities that lead to more education, then the oldest child indicator should not be validly excluded from the outcome equation. If this investment is both positively related to high school leadership and to educational attainment, the resulting IV estimates will be biased upward. However, if the observed correlation between being the oldest child and educational outcomes is not due to differences in parental resources, but is instead related to an oldest child's propensity to be a leader, then being an oldest child would only have an indirect impact on educational attainment. The variable would therefore be validly excluded from the outcome equation.

Similarly, if being a twin rather than a singleton reduces the resources devoted to a child and has a direct impact on his educational attainment, then the twin indicator is not a valid exclusion restriction. If twins are more likely to be leaders, but are less likely to attain further education, the estimates will be downward biased. Alternatively, if twin births result in fewer resources, both making a twin less likely to be a leader and less

[27] See, for instance, Black, Devereux and Salvanes (2005), Booth and Kee (2006), Conley and Glauber (2005) and Angrist, Lavy, and Schlosser (2006).

likely to go to college, then the IV estimates will be biased upward. While some researchers have found family size to be negatively related to a child's education, recent studies using twin births as a source of exogenous variation in family size suggest that when family size is made endogenous, the estimated impact of family size on educational attainment is actually negligible [Caceres-Delpiano (2006); Black, Devereux, and Salvanes (2005)]. This evidence suggests that the twin indicator may, in fact, be validly excluded from the outcome equation.

To help mitigate the concerns with the oldest child and twin indicators, controls for family income and family socioeconomic status are included in all of the model specifications. In addition, controls such as the Catholic and public school dummy variables should help pick up differential investments in first-born children and potential differences in resources induced by twin births if, for example, first-born children are more likely to attend private or Catholic schools. The plausibility of the exclusion restrictions is also tested statistically with a Sargan-Hansen over-identification test. Additional tests are provided in the robustness checks (section 6). In every case, the instruments pass the statistical tests and are shown to be validly excluded from the outcome equations.

Table II.2 summarizes the variables used as instruments. Simple descriptive statistics (panel A) suggest that each of these variables does, in fact, differ by leadership status in the expected direction. For instance, whereas, on average, roughly 40 percent of the leaders' classmates are also leaders, just 35 percent of the non-leaders' classmates are leaders. Moreover, 33.8 percent of the student leaders are first born children compared with 30 percent of non-leaders and a larger proportion of leaders are twins (4.6 versus 3.7

percent). Each of these differences in means is statistically significant at the 5 percent level. In panel B, the leadership probabilities are given for each of the following four combinations: (1) twin only, (2) eldest child only, (3) neither twin nor eldest child, and (4) twin and eldest child. From the table it is apparent that, compared with the students who are neither twins nor eldest children, both the "twin only" and "eldest child only" groups have a larger proportion of leaders (roughly 45 versus 42%). Finally, nearly 60% of the students who are both a twin and an eldest child are leaders. This is substantially higher than the other groups. This evidence suggests that these variables are, in fact, correlated with high school leadership. As mentioned earlier, the instrument validity is discussed in further detail in section 4. Further evidence from robustness checks is also provided in section 6.

In the case of the continuous outcome variable (years of education), the IV strategy is implemented using two-stage least squares estimation where the leadership dummy indicator in equation (1) is replaced by its predicted value from ordinary least squares regression on equation (3). For the discrete outcome variables (probability of college attendance and college degree), I estimate a recursive bivariate probit model of the following form[28]:

$$L_i^* = \alpha_1 Z_i + \alpha_2 X_i + u_i \text{ such that } L_i = 1[L_i^* > 0]$$

$$Y_i^* = \delta_1 X_i + \delta_2 L_i + \omega_i \text{ such that } Y_i = 1[Y_i^* > 0] \tag{4}$$

$$E[\nu_i] = E[\omega_i] = 0$$

$$Var[\nu_i] = Var[\omega_i] = 1$$

$$Cov[\nu_i, \omega_i] = \rho,$$

[28] The models were also estimates via IV linear probability models. Estimates were largely unchanged.

where L_i and X_i, are defined as in equation (1), Z_i is the vector of instruments, Y_i is an indicator variable that equals one if the student attended (or graduated from) college and zero otherwise, ν_i and ω_i are $N(0,1)$ error terms, and ρ is the coefficient of correlation between the errors in the leadership selection equation and the education outcome equation. If $\rho \neq 0$ and is statistically significant, this can be interpreted as evidence of endogeneity bias present in the reduced-form univariate probit model. The marginal effects of high school leadership are calculated in the same way as they were in the univariate probit model. The standard errors on the marginal effects are calculated using a bootstrapping procedure with 500 replications.

Under the restrictive assumption that the treatment effect is constant within the population, the ATE is assumed to be equivalent to the ATT and can be directly compared to the OLS and PSM estimates. Under the more realistic case in which the treatment effect is not constant and under additional assumptions[29], Angrist, Imbens and Rubins (1996) show that IV estimation provides an estimate of the local average treatment effect (LATE). The LATE is the average effect of the treatment for those students who, due to a change in the value of the instrument, are induced to select themselves into a high school leadership position.

4. Results

Results from each estimation approach are reported in Table II.3. All of the model specifications include controls for standard demographic characteristics (gender, race, age); family background characteristics (family income and socioeconomic status); school characteristics (public, Catholic, enrollment, percent of students with free lunch,

[29] These assumptions are (1) stable unit treatment values, (2) random assignment to treatment, (3) valid exclusion restriction, (4) nonzero causal effect of the IV on treatment status and (5) monotonicity.

and the percent of Black and Hispanic students); and regional differences (northeast, midwest, and west). I also control for differences in endowed cognitive ability by including standardized math test scores in each specification.[30] Self-reported measures of popularity, athletic ability and locus of control may be endogenous with respect to high school leadership. However, the inclusion of these additional characteristics in the set of observed conditioning variables may, in fact, capture some characteristics that are often "unobserved" (motivation, confidence, etc.) and may therefore help to control for selection bias. All of the models are therefore estimated with and without these controls. Columns (a), (c) and (e) contain results from Model 1, which does not include controls for popularity, athletic ability and locus of control. Columns (b), (d) and (e) are from Model 2, in which these controls are included. Coefficients on math scores are also reported in Table II.3 to provide a reference of relative magnitude of the leadership effects.

Selection on observables

OLS and univariate probit results are reported in columns (a) and (b). Results from each model specification are precisely estimated and indicate that, ceteris paribus, students who are leaders in high school attain 0.39 to 0.44 years more education than their non-leader counterparts. These estimates are not small. Compared with the effect of cognitive ability, for instance, they are roughly equivalent to a 6.5 to 7 percentile point increase in math test score.[31] In fact, these effects are also of similar magnitude to

[30] Previous model specifications included controls for reading, history and science test scores. Once the math score was included, these other test scores did not affect the results. In order to maximize sample size, only math scores are included in the final specifications.

[31] This is calculated by taking the coefficient on leadership divided by the coefficient on math score (which represents the effect of a 10 percentile increase in math score) multiplied by 10.

Altonji's (1995) largest estimates of an additional year of science, foreign language or math class on total years of education (0.270, 0.416, 0.424, respectively). High school leadership is also predicted to have a positive impact on both the probability of college attendance and college graduation that is significant in both a statistical and an economic sense. The univariate probit estimates suggest that high school leadership increases the probability of attending a post-secondary institution by 6.3 to 6.8% and increases the probability of obtaining a bachelor's degree by 12.4 to 14.1%. These estimates are comparable to math score increases of approximately 5.5 to 8 percentile points. As shown in section 6, these results change little when school fixed effects are included in the specifications.

PSM estimates are reported in columns (c) and (d). Compared with the OLS and probit estimates, the corresponding PSM estimates are slightly smaller but are of similar order of magnitude. PSM estimates indicate that high school leadership leads to a 0.35 to 0.391 (versus 0.443 and 0.397) year increase in education, increases the probability of post-secondary attendance by 4.9 to 5.7% (versus 7.0 and 6.4%) and increases the probability of obtaining a college degree by 9.5 to 10.4% (versus 14.1 and 12.4%).[32] The similarity of the PSM and OLS estimates suggests that the OLS results are not highly sensitive to the linearity assumption. In contrast to the OLS estimates, which fall once the additional controls are included in Model 2, the PSM estimates increase slightly in magnitude when controls for popularity, athletic ability and locus of control are included in the specification. If selection bias is reduced by controlling for this wider set of

[32] In fact, if estimated via linear probability models, the OLS and PSM estimates of high school leadership on college attendance and graduation are even more similar. In model 2, for instance, the estimate on high school leadership in the college attendance equation from linear probability model is 6.3% (versus 5.7% with PSM). In the college graduation model, the OLS estimate is 10% (versus PSM estimate of 10.4%).

observed variables, this suggests that failure to include the additional controls leads to downward biased PSM estimates.[33]

Selection on unobservables

Before discussing the instrumental variables estimates, it is important to demonstrate the validity of the instruments. In each model specification, the p-value on the F-statistic (see Table II.3) for the null hypothesis that the instruments can be omitted from the first stage equation is essentially zero, providing evidence that the instruments are strong predictors of high school leadership and are therefore sufficiently powerful. First stage results, presented in Table II.4, also show that both school leadership opportunities and the interaction between twin and oldest child variables have an independent statistically significant impact on high school leadership. In addition, in Table II.3, I report p-values from a Sargan-Hansen test of over-identifying restrictions for the education outcome equations in models 1 and 2. The joint null hypothesis for this test is that all but one of the instruments are uncorrelated with the error term and are therefore properly excluded from the outcome equation. The Sargan p-values are 0.852 and 0.836. Consequently, the null hypothesis cannot be rejected at conventional confidence levels.[34] Taken together, this evidence indicates that the instruments are, in fact, valid.

[33] In Appendix D, I test the sensitivity of the PSM estimates to potential selection bias arising from unobserved heterogeneity using the Rosenbaum Bounds (2004) approach. This bounding approach essentially allows the researcher to test the extent to which unobserved heterogeneity would have to impact the leadership propensity within a matched pair to suggest that high school leadership has no causal impact on educational attainment. The results from this procedure suggest that an unobserved factor would have to have an impact equivalent to a difference of nearly two to three standard deviations in math test scores within a matched pair to suggest a non-positive causal effect. Despite the limitations of OLS and PSM, it is therefore highly unlikely that high school leadership has a non-positive causal effect on educational attainment.

[34] The plausibility of the exclusion restrictions is further tested in robustness checks (section 6).

Interestingly, the IV estimates are all larger than their corresponding OLS/probit and PSM point estimates. Compared with the OLS and PSM estimates, both of which suggest a return to high school leadership of about a half-year increase in educational attainment, the corresponding IV estimates are over twice the size, or roughly 0.85 to 0.96 years. The corresponding math test score estimates suggest that high school leadership is equivalent to a 15 to 16 percentile increase in math test scores. There is also a large difference in magnitude between with respect to the probability of attending and graduating from a post-secondary institution. Whereas probit and PSM estimates suggest a 5 to 7% impact of leadership on college attendance, the IV estimate suggests this magnitude is over 20%. Finally, both IV estimates of the impact of leadership on college graduation are around 37%. This estimate is much larger than the corresponding OLS and PSM estimates, which range from roughly 9.5 to 14%.

Discussion

At first glance, the finding that IV estimates are much larger than their OLS and PSM counterparts may seem counter-intuitive. If the unobserved variable affecting assignment to leadership and educational attainment is something such as the traditional 'ability' bias associated with the education literature, for example, IV estimation which correctly controls for such bias should result in estimates that are of smaller magnitude than their corresponding OLS or PSM estimates. Yet, here I find the opposite. It is worth noting, however, that while the theoretical literature on the return on education frequently suggests that OLS results will be biased in the upward direction, empirical researchers who rely on supply side features of the education system often find IV estimates that are at least as large as or larger than their corresponding OLS estimates.[35] In this sense, the results reported in this paper are consistent with much of the empirical literature on education. Why would this be the case?

The most straight forward explanation is that, rather than being upward biased, the OLS and PSM estimates are actually biased downward. The relatively high proportion of student leaders in the sample, for instance, may be suggestive of student reporting error. In this case, the true leadership variable is measured with error, and consequently, the OLS and PSM estimates are biased towards zero. As mentioned earlier, this result could also be due to the fact that the source of selection bias is not the traditional ability bias, but rather is an unobserved characteristic, such as being a bookworm, that makes a student less likely to be a leader but more likely to attain further education. In this case, the instrumental variables estimation procedure is appropriately correcting for the negative bias. Results from the bivariate probit models suggest that this explanation is, in fact, likely. In both model specifications for both discrete outcomes, the correlation coefficient rho is quite large, negative and, with the exception of any post-secondary education model 2, is statistically significant at the one percent level.[36] This indicates that high school leadership is endogenous and that the direction of the endogeneity bias is downward.

Card (2001) puts forth an alternative interpretation for similar results found in the returns to schooling literature. If the impact of leadership is not constant across the

[35] Card (2001), for instance, summarizes results from eleven studies that find IV estimates that are larger than their corresponding OLS estimates.

[36] This also holds true for simple bivariate probit models that do not have exclusion restrictions. When the two equations are estimated jointly (without exclusion restrictions) allowing for correlation in the error terms, the coefficient of correlation is also large, negative, and statistically significant.

student population (as is likely), then the LATE, the estimated effect with IV, may differ from the ATT or ATE. In the case of education and wages, Card (2001) suggests that instrumental variables estimates may be larger than OLS estimates because the IV method, which uses supply-side features of the educational system, is measuring a treatment effect for a small low-education group with a higher marginal return to education than their more highly educated counterparts. In this case, the LATE will be greater than ATE or ATT. Likewise, in the case of leadership, the IV estimates could be larger because the students who are induced into a leadership position due to a change in the instruments have a much greater marginal return to their leadership experience than the students who chose to be leaders. Consider school leadership activities, for instance. An increase in the instrumental variable indicates a greater availability of school activities. Following Card's argument, if the students with initially higher marginal costs of high school leadership (those who will be more affected by the cost reduction imposed by greater availability of activities) also have a greater marginal return to leadership experience, then the IV estimates will overstate the average impact of high school leadership.

Regardless of the interpretation of these results, every estimation method and model specification examined suggests the impact of high school leadership is large, positive, and significant in both an economic and statistical sense. The smallest estimates found are non-trivial and the evidence implies the impact may be much larger for some students.

5. Results by Sub-Groups

In this section, I investigate the relative importance of high school leadership by sub-groups of students. First, I estimate the impacts separately for low income and high income students. In doing so, I address one of the primary concerns of pay-to-play programs—that they discriminate against low income students who benefit most from the activities. Then, I estimate the effects by gender, race, and math ability.

High School Leadership and Family Income

As discussed in the introduction, one policy question surrounding this topic concerns the potential impact of the so-called pay-to-play programs in which students are required to pay fees to participate in school activities. Opponents argue that these programs are discriminatory against students from low income households. In addition, many people argue that these students are the very same students who may benefit most from the availability of school activities. Joan Ryan of the SFgate.com, for instance, argues that many low income students have parents who work long hours or live in a single-parent home and that, consequently, these students may benefit more from participation in school activities than their higher income peers.[37] While I do not have enough information to directly test the first claim (pay-to-play programs discriminate against low-income students), by estimating high school leadership separately for low and high family income students, I am able to provide some evidence as to whether leadership experience does, in fact, benefit students from lower income households to a larger extent than their higher income peers.

[37] "Pay to play is a shutout we can't afford." SFGate.com, May 2003. http://sfgate.com/cgi-bin/article.cgi?f=/c/a/2003/05/09/ED214390.DTL.

I separate the students into two groups based on median family income. Students below the median income category are considered "low income," while students at or above the median are considered part of the "high income" group. Results (Table II.5) suggest that high school leadership has a differential impact on students from low income households than it does on their high income peers. In terms of post-secondary attendance and total years of education, high school leadership appears to benefit students from low-income households to a larger extent. The OLS estimates, for example, suggest that high school leadership increases the probability of post-secondary attendance by 11.2%, while for high income students the experience increases their probability by just 3.6%. A similar trend is seen with total years of education. In terms of college graduation, however, the benefit of leadership for students from high income households is at least as great as or greater than it is for low income students.

One explanation for this difference may lie within the importance of leadership skill in the college admissions and financial aid decision process. If high school leadership activities increase the probability of financial aid or scholarships, for instance, then they may play a larger role in the post-secondary attendance of students from lower income households. Students from higher income families, on the other hand, may not have the same need for scholarships and may therefore not benefit from their leadership experience to the same extent as students from low income households whose college attendance rests on their ability to obtain a scholarship or a more lucrative financial aid package.

High School Leadership, Gender, Race, and Math Ability

In Table II.6, I report estimates of the impact of high school leadership on subsequent educational attainment by gender (Panel A) and race (Panel B). I also separate the students into two groups based on math ability. Students below the median math score are considered "low math ability," while students at or above the median are considered part of the "high math ability" group. Results by these math ability groups are presented in Panel C.

First, looking at gender differences, both the OLS and IV estimates imply that in terms of years of education and college graduation, women benefit more from their high school leadership experience high school leadership than their male counterparts. In terms of post-secondary education, however, male students appear to benefit more than their female peers. Turning to racial differences, the OLS results indicate that, with respect to years of education and any post-secondary attendance, black students benefit more from their leadership experience; however, with respect to college graduation, white students benefit to a larger extent. In contrast, the IV results suggest high school leadership is much more important for white students. However, the sample size of black students is very small (859). Consequently, the coefficients on high school leadership of black students are not statistically different from zero. Finally, the OLS estimates of the impact of high school leadership on educational attainment for high and low math ability students suggest that, compared with their high math ability counterparts, students of low math ability benefit from their leadership experience more in terms of years of education and any post-secondary attendance. With respect to college graduation, however, high math ability students appear to benefit more than their low math ability peers. With the exception of years of education, a similar pattern persists for the IV results.[38]

Interestingly, a similar trend emerges across these various sub-groups. For family income, gender, and math ability, for example, both the OLS and IV estimates suggest that one group benefits more in terms of any post-secondary attendance (low income, males, low math ability), while the other benefits more in terms of college graduation (high income, women, high math ability). While the estimated difference is small, the OLS results reflect a similar pattern for white versus black students. Black students appear to benefit more in terms of any post-secondary attendance, while white students benefit more in terms of college graduation. As discussed above, one explanation for this difference may lie within the importance of leadership skill in the college admissions and financial aid decision process. With respect to athletic involvement, for example, being a team captain may be a more important determinant of college attendance for male and black students due to the higher probability of an athletic scholarship. Being a leader in a high school activity may also keep male and black students out of trouble or give them a reason to maintain a passing grade point average, both of which may lead to a higher probability of attending college. With respect to low math ability students, taking a leadership position may help compensate for a poor academic performance and increase their chance of college admission. These trends present an interesting avenue for future research.

[38] However, with respect to years of education and college graduation, the estimates for the low math ability group are not statistically different from zero.

6. Robustness Checks

In this section, I perform a series of robustness checks. First, I examine the instrument validity in more detail and test the sensitivity of the reported estimates to alternative identification assumptions. Then, I evaluate whether the estimated leadership effects are capturing differences in school quality by including school fixed effects. Finally, I address whether the effects reported here are sensitive the definition of leadership by first defining leaders by their twelfth grade leadership experience only and then examining whether the leadership effects differ by athletic versus non-athletic leadership roles.

Instrument validity and specifications

Another possible explanation for the wide discrepancy between the OLS and PSM results compared with the IV results is that the instruments are either (a) weak or are (b) correlated with the education outcome. While the analysis discussed above shows that the instruments pass the standard first-stage and over-identification tests, for robustness, I test the instrument validity in further detail.

The problems associated with weak instruments have been well-documented. Research has shown that weak instruments will tend to bias the instrumental variables results toward the OLS results. Weak instruments would therefore lead the instrumental variables estimates reported here to be understated. To test the sensitivity of the results to the instrumental variables, I employ alternative model specifications. Table II.7 presents results from alternative specifications. In column (b), the first stage F-statistic increases from just above 8 to 13.72, which is above 10, the commonly cited threshold for weak instruments. In this model specification, the coefficients on high school leadership increase compared with the original specification. Columns (b) and (c) of Table II.7 show that a similar pattern is found when the model is exactly identified using either of these two variables.

An alternative explanation for the results is that the IV estimates are upward biased. If, for instance, school leadership opportunities are positively correlated with unobserved school quality or student characteristics, then the IV estimates may be biased upward. However, when the model estimated using only the oldest child and twin dummy variable interaction for identification (Table II.7, column (d)), the IV estimate is still considerably larger than the OLS and PSM estimates. However, as mentioned earlier, both oldest child and twin dummy variables may be directly correlated with educational attainment. To further test the robustness of the exclusion restrictions, I therefore also run separate regressions where each instrument is directly entered into the outcome equation. Table II.8 shows the leadership coefficients and instrumental variable coefficients as well as their standard errors and z-values from these regressions. In each case, and in both model specifications, none of the coefficients on the instrumental variable is statistically different from zero. Moreover, the coefficient on the leadership variable is always larger than any of the OLS or PSM coefficients. This provides further evidence that the instruments are correctly excluded from the outcome equation.

While there are reasons to question the plausibility of the instruments, the variables pass multiple tests for validity. Moreover, the results are not sensitive to the model specification. In each case, the estimates are at least two to three times the size of the OLS and PSM estimates.

School Fixed Effects

While I have included observable school characteristics in the model specifications, if there are differences in school quality that are not being adequately captured by the included variables, the estimates reported in the paper may be attributing a portion of the impact of school quality to high school leadership. To test this, I include school fixed effects in the OLS estimation.[39] The resulting estimates can be interpreted as the impact of high school leadership relative to non-leaders in the same school. Results are presented in Table II.9. From the table, it is apparent that fixed effects do little to the OLS estimates. This suggests that the impact of high school leadership is not being confounded by the effect of school quality.

Alternative measures of high school leadership

In this essay, I have broadly defined high school leadership as leadership experience in either the tenth or twelfth grade. In this section, I test the sensitivity of the results in two ways. First, I refine the definition of leadership to include only twelfth grade leadership experience. Then, I estimate the effects of athletic leadership and non-athletic leadership separately to assess the extent to which the impact of high school leadership depends on the nature of the leadership experience.

Table II.10 illustrates the sensitivity of the OLS[40] and IV results to the more restricted definition of high school leadership. With this restriction imposed, the proportion of leaders in the sample falls to 37.4 (versus 43.2) percent.[41] Columns (a) and

[39] Since the OLS estimates are not largely different from the PSM estimates, for simplicity, I focus on the OLS estimates with fixed effects.

[40] Since the OLS estimates are not largely different the PSM estimates, I only report OLS and IV results here.

[41] The sample also falls by 566 students when this definition is used.

(c) display the original OLS and IV results, respectively. Columns (b) and (d) display the results where high school leadership is measured as twelfth grade leadership only. A comparison of the estimates shows that the results are not highly sensitive to the measurement of leadership. While the OLS and probit estimates fall slightly in the total years of education and post-secondary college attendance models, the marginal effect from the probit model on college graduation increases. The IV estimates are also of similar magnitude.[42]

Table IV.11 reports estimates from separate OLS and IV regressions in which the leadership activities are divided into athletic and non-athletic leadership roles. Results for the "team captain" indicator are reported in row one; while results for "club officer" are given in row two. Looking first at the OLS results, the estimates suggest that, compared with club officers, students who are team captain benefit from their leadership experience to a larger extent. With respect to college graduation, however, the difference is negligible. A similar trend is seen for the IV estimate on years of education. However, the IV estimates for any post-secondary education and college graduation models imply club officers benefit from their leadership experience to a larger extent than their team captain peers. With respect to the team captain indicator, however, the instruments are very weak first stage predictors and the resulting estimates are not statistically different from zero. The differences in the IV estimates are therefore not statistically different from zero and should be interpreted with caution.

[42] This result is not all that surprising given that many students who are leaders in the tenth grade are also likely to be a leader in the twelfth grade. In fact, the correlation between the two measures of leadership is 0.8458.

7. Conclusion

In this essay, I estimate the impact of high school leadership on subsequent educational attainment using three estimation methods to address the non-random selection of students into leadership positions. The contribution of the paper is to provide the first evidence that high school leadership does, in fact, have a large positive causal impact on the future educational attainment of the average student. Rather than providing specific estimates that can be relied upon for policy recommendations, this essay illustrates that even the smallest estimated effects are non-trivial and provides evidence that suggests the true causal impact for some students may be much larger.

I find students who are leaders in high school share at least a 0.35 year advantage over their non-leader peers in terms of total years of education. This estimate is of similar magnitude to Altonji's (1995) largest estimates of an additional year of science, foreign language and math class on total years of education; it is roughly equivalent to a 5.5 percentile point increase in standardized math test score. High school leadership is also predicted to increase the probability of attending a post-secondary institution by a minimum of 5 percent and to increase the probability of holding a college degree by 9.5 percent. These estimates are equivalent to a 5.5 to 8 percentile point increase in standardized math test score. Similar to many empirical studies on the return to schooling, the instrumental variables estimates are two to three times larger than these magnitudes. Finally, I also find evidence of a differential impact of leadership for students from low versus high income households. In terms of total years of education and post-secondary attendance, high school leadership appears to disproportionately benefit students from lower income households, while with respect to college graduation, leaders from high income households seem to derive at least as great or greater benefit from their leadership experience than their low-income peers. A similar pattern persists across gender, race and math ability lines. Males, blacks and low math ability students benefit more in terms of their post-secondary attendance; while their female, white and high math ability counterparts benefit more in terms of college graduation.

Since the availability of leadership positions depends upon the existence of school activities that provide such leadership opportunities, the results presented in this essay suggest that decisions regarding financial cutbacks for extracurricular activities should not be taken lightly.

Table II.1. Descriptive Statistics

	Full Sample		Leaders		Non-Leaders		Difference[a]		
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev.	Mean	Std. Error	
Outcomes:									
Years of education	14.415	1.700	14.968	1.540	13.994	1.687	0.974	(0.033)	***
Any post-secondary education	0.827	0.378	0.911	0.285	0.763	0.425	0.148	(0.008)	***
College graduate	0.371	0.483	0.514	0.500	0.262	0.440	0.253	(0.010)	***
College graduate, conditional on attendance[b]	0.449	0.497	0.565	0.500	0.343	0.475	0.222	(0.011)	***
Controls:									
Male	0.474	0.500	0.468	0.499	0.478	0.500	-0.011	(0.010)	
Black	0.089	0.285	0.088	0.284	0.089	0.285	-0.001	(0.006)	
Hispanic	0.118	0.003	0.094	0.292	0.137	0.344	-0.043	(0.007)	***
Age (years)	25.842	0.541	25.800	0.505	25.877	0.564	-0.077	(0.011)	***
8th grade socioeconomic status indice	-0.040	0.008	0.147	0.754	-0.182	0.759	0.329	(0.016)	***
High school socioeconomic status indice	0.017	0.793	0.209	0.773	-0.129	0.776	0.338	(0.016)	***
8th grade family income indice	9.882	2.530	10.378	2.364	9.504	2.579	0.874	(0.051)	***
High school family income indice	10.223	2.537	10.674	2.413	9.880	2.575	0.794	(0.051)	***
High school enrollment	267.592	181.001	234.769	173.726	292.595	182.456	-57.826	(3.670)	***
% free lunch in high school	20.280	20.823	19.067	20.300	21.205	21.168	-2.138	(0.427)	***
% Black in high school	10.355	20.355	9.084	19.122	11.323	21.196	-2.239	(0.417)	***
% Hispanic in high School	10.424	18.883	9.955	18.684	10.782	19.028	-0.827	(0.388)	**
Public high school	0.830	0.375	0.792	0.406	0.859	0.348	-0.067	(0.008)	***
Catholic high school	0.065	0.246	0.073	0.259	0.059	0.236	0.013	(0.005)	***
Private (non-Catholic) high school	0.105	0.306	0.135	0.342	0.081	0.273	0.054	(0.006)	***
High school math score percentile	5.172	0.996	5.443	0.965	4.966	0.969	0.477	(0.020)	***
8th grade math score percentile	5.213	1.020	5.480	1.029	5.009	0.964	0.472	(0.020)	***
8th grade: athletic	0.258	0.438	0.340	0.474	0.195	0.397	0.145	(0.009)	***
High school: athletic	0.151	0.358	0.226	0.418	0.094	0.292	0.131	(0.007)	***
8th grade: popular	0.159	0.366	0.201	0.401	0.127	0.333	0.074	(0.007)	***
High school: popular	0.128	0.334	0.185	0.388	0.085	0.279	0.099	(0.007)	***
8th grade: locus of control	0.066	0.695	0.173	0.674	-0.015	0.699	0.188	(0.014)	***
High school: locus of control	0.065	0.751	0.184	0.750	-0.026	0.740	0.210	(0.015)	***
Northeast	0.191	0.383	0.191	0.393	0.190	0.393	0.001	(0.008)	
Midwest	0.281	0.449	0.287	0.452	0.276	0.447	0.010	(0.009)	
West	0.195	0.396	0.180	0.384	0.207	0.405	-0.026	(0.008)	***
South	0.332	0.471	0.341	0.474	0.325	0.469	0.015	(0.010)	
	N= 9,665		N= 4,179		N= 5,486				

Notes:

a. Difference is calculated as mean(leaders) - mean(non-leaders). *,**, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

b. N= 3,807 leaders and 4,188 non-leaders.

Table II.2. Descriptive Statistics for Instruments

A. Means by leadership status	Leader	Non-Leader	Difference
% HS peers in leadership positions	0.400	0.356	0.043 ***
Twin	0.046	0.037	0.009 **
Oldest child	0.338	0.304	0.034 ***
Twin * Oldest child	0.014	0.007	0.007 ***

B. Proportion leader	High School Leader
Neither twin nor oldest child	0.419
Twin only	0.453
Oldest child only	0.454
Twin & oldest child	0.590

Notes:

a. Difference is calculated as mean(leaders) - mean(non-leaders). *,**, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

b. N= 4,179 leaders and 5,486 non-leaders.

Table II.3. The Impact of High School Leadership on Subsequent Educational Attainment

	OLS & Probit		Propensity Score Matching		Instrumental Variables[c]	
	(a)	(b)	(c)	(d)	(e)	(f)
A. Years of Education						
High School Leadership	0.443 ***	0.397 ***	0.346 ***	0.391 ***	0.963 *	0.835 *
	(0.028)	(0.028)	(0.038)	(0.046)	(0.512)	(0.502)
High School Math Score	0.639 ***	0.605 ***			0.586 ***	0.559 ***
	(0.026)	(0.027)			(0.047)	(0.045)
R-squared	0.411	0.419				
F-statistic (p-value)					0.0000	0.0000
Sargan Statistic (p-value)					0.852	0.836
B. Any Post-Secondary Education[b]						
High School Leadership	0.070 ***	0.064 ***	0.050 ***	0.059 ***	0.243 ***	0.213 ***
	(0.006)	(0.007)	(0.011)	(0.009)	(0.074)	(0.044)
High School Math Score	0.085 ***	0.080 ***				
	(0.006)	(0.006)				
R-squared	0.261	0.267				
Rho					-0.503 ***	-0.396 ***
					(0.157)	(0.184)
College Graduate[b]						
High School Leadership	0.141 ***	0.124 ***	0.095 ***	0.104 ***	0.341 ***	0.357 ***
	(0.011)	(0.011)	(0.015)	(0.015)	(0.116)	(0.115)
High School Math Score	0.229 ***	0.219 ***				
	(0.011)	(0.011)				
R-squared	0.320	0.328				
Rho					-0.490 ***	-0.568 ***
					(0.063)	(0.089)
Popular, Athletic, Locus of Control	No	Yes	No	Yes	No	Yes
N=9,665 individuals						

Notes:

a. Robust standard errors are reported in parenthesis. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, and cognitive ability (math scores).

b. Reported coefficients in columns (a) and (b) on Any Post-Secondary and College Graduate are marginal effects from probit models.

c. Instruments include twin, oldest child, twin*oldest child and school leadership opportunities.

Table II.4. First Stage Instrumental Variables Results

	Model 1 (a)	Model 2 (b)
School Leadership Opportunities	0.134 ***	0.122 ***
	(0.034)	(0.034)
Oldest Child*Twin	0.119 **	0.113 **
	(0.055)	(0.054)
Twin	0.040	0.048 *
	(0.027)	(0.027)
Oldest Child	0.009	0.016
	(0.010)	(0.010)
Popular, Athletic, Locus of Control	**No**	**Yes**
First Stage f-statistic	**7.62**	**8.07**
P-value	**0.0000**	**0.0000**

Notes:

a. *,**,*** denotes statistical significance at the 10, 5, and 1% level, respectively.

b. All specifications include controls for demographic, family, region, school, and cognitive ability (math scores).

Table II.5. The Impact of High School Leadership by Family Income Level

	(a)	(b)
A. Years of Education	OLS	IV
Low Income	0.504 ***	1.545
	(0.043)	(1.042)
High Income	0.392 ***	1.417 *
	(0.036)	(0.755)
Difference	0.112	0.128
B. Any Post-Secondary Education	Probit	IV
Low Income	0.112 ***	0.400
	(0.013)	(0.308)
High Income	0.036 ***	0.125
	(0.005)	(0.155)
Difference	0.076	0.275
C. College Graduate	Probit	IV
Low Income	0.104 ***	0.203
	(0.013)	(0.260)
High Income	0.150 ***	0.442 *
	(0.016)	(0.248)
Difference	-0.046	-0.239

Notes:

a. Students in the low income group are those students below the 50 percentile in the family income indicator (N= 4,493).
Students included in the high income group include those students at or above the 50% in family income (N=5,172).

b. Robust standard errors are reported in parenthesis. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, cognitive ability (math scores), popularity, athletic ability and locus of control.

c. Reported coefficients on Any Post-Secondary and College Graduate are marginal effects.

d. Instruments include twin, oldest child, twin*oldest child and school leadership opportunities.

Table II.6. The Impact of High School Leadership on Subsequent Educational Attainment by Gender, Race and Math Ability[a]

	Education		Any Post-Secondary Education[b]		College Graduation[b]	
	OLS	IV[c]	OLS	IV[c]	OLS	IV[c]
A. Gender						
Males (N=4,580)	0.353 ***	0.739	0.070 ***	0.271 ***	0.097 ***	0.298 ***
	(0.040)	(0.996)	(0.010)	(0.121)	(0.016)	(0.099)
Females (N=5,085)	0.432 ***	1.800 *	0.056 ***	0.162	0.147 ***	0.415 ***
	(0.037)	(0.934)	(0.008)	(0.140)	(0.016)	(0.089)
Gender Difference (males-females)	-0.079	-1.061	0.014	0.110	-0.050	-0.117
B. Race						
White (N=6,797)	0.393 ***	1.313 **	0.060 ***	0.232 ***	0.132 ***	0.394 ***
	(0.033)	(0.632)	(0.008)	(0.075)	(0.014)	(0.077)
Black (N=859)	0.427 ***	0.694	0.069 **	0.019	0.106 ***	0.167
	(0.092)	(1.818)	(0.025)	(0.212)	(0.031)	(0.244)
Racial Difference (white-black)	-0.034	0.618	-0.009	0.213	0.025	0.227
C. Math Ability[d]						
High Math Ability (N= 5,166)	0.346 ***	1.590 **	0.025 ***	0.211 **	0.127 ***	0.441 ***
	(0.037)	(0.751)	(0.005)	(0.081)	(0.015)	(0.095)
Low Math Ability (N=4,499)	0.457 ***	0.973	0.113 ***	0.216 **	0.066 ***	0.207
	(0.043)	(1.167)	0.015	(0.123)	(0.010)	(0.171)
Math Abiilty Difference (high-low)	-0.111	0.616	-0.088	-0.005	0.061	0.234

Notes:

a. Robust standard errors are reported in parenthesis. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, cognitive ability (math scores), popularity, athletic ability and locus of control.

b. Reported coefficients on Any Post-Secondary and College Graduate are marginal effects.

c. Instruments include twin, oldest child, twin*oldest child and school leadership opportunities.

d. Students in the low ability group are those students below the 50 percentile. Students included in the high ability group include those students at or above the 50 percentile math score.

Table II.7. Alternative Instrumental Variables Specifications

	(a)		(b)		(c)		(d)	
Education								
High School Leadership	0.835	*	1.024	*	1.160		0.895	
	(0.502)		(0.551)		(0.786)		(0.762)	
F-statistic	8.07		13.72		13.77		14.11	
F-stastic p-value	0.0000		0.0000		0.0000		*0.000*	
Sargan p-value	0.8362		0.8098		n/a		n/a	
Any Post-Secondary Education								
High School Leadership	0.213	***	0.219	***	0.216	***	0.198	***
	(0.044)		(0.067)		(0.040)		(0.063)	
Rho	-0.396		-0.417		-0.480		-0.426	
	(0.184)		(0.175)		(0.137)		(0.170)	
College Graduate								
High School Leadership	0.357	***	0.365	***	0.375	***	0.373	***
	(0.115)		(0.079)		(0.073)		(0.075)	
Rho	-0.568		-0.583		-0.603		-0.599	
	(0.089)		(0.084)		(0.078)		(0.080)	
Instruments:								
School Leadership Opportunities	X		X		X			
Twin	X							
Eldest Child	X							
Twin*Eldest Child	X		X				X	
N=9,665 individuals								

Note:

a. Robust standard errors are reported in parenthesis. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, and cognitive ability (math scores).

b. Reported coefficients on Any Post-Secondary and College Graduate are marginal effects from probit models.

Table II.8. Instrumental Variables Exclusion Restrictions

	Model 1 (a)	Model 2 (b)
Outcome: Years of Education		
Twin	-0.050	-0.048
	(0.082)	(0.083)
	[z=0.61]	[z=-.057]
Oldest Child	-0.014	-0.051
	(0.030)	(0.031)
	[z=-0.46]	[z=-.051]
Twin*Oldest Child	0.012	0.018
	(0.173)	(0.175)
	[z=0.07]	[z=-.10]
School Leadership Opportunities	0.059	0.070
	(0.138)	(0.125)
	[z=0.43]	[z=0.56]
Popular, Athletic, Locus of Control	No	Yes
N= 9,665		

Notes:

a. Both model specifications include controls for demographics, family background, region, school quality, and cognitive ability (math scores). Specification two also includes controls for popularity, athletic ability and locus of control. N= 9,665 students. Robust standard errors are reported in parenthesis.

b. Coefficients represent estimates of the given variable on total years of education from separate regressions where leadership is instrumented with the other three instruments.

Table II.9. OLS Estimates with and without School Fixed Effects

	Model 1 (a)	Model 2 (b)	Model 1 (c)	Model 2 (d)
Education				
Marginal Effect	0.443 ***	0.397 ***	0.431 ***	0.383 ***
Standard Error	(0.028)	(0.028)	(0.030)	(0.030)
R-squared	0.4106	0.4192	0.3155	0.3273
Any Post-Secondary Education				
Marginal Effect	0.072 ***	0.063 ***	0.066 ***	0.057 ***
Standard Error	(0.007)	(0.007)	(0.008)	(0.008)
R-squared	0.3403	0.2166	0.1624	0.1709
College Graduate				
Marginal Effect	0.111 ***	0.100 ***	0.114 ***	0.103 ***
Standard Error	(0.009)	(0.009)	(0.009)	(0.009)
R-squared	0.3544	0.3602	0.2464	0.254
Popular, Athletic, Locus of Control	No	Yes	No	Yes
School Fixed Effects	No	No	Yes	Yes
N=9,665 individuals				
Number of schools= 1,119				

Note:

a. Robust standard errors are reported in parenthesis. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, cognitive ability (math scores), popularity, athletic ability and locus of control.

Table II.10. Sensitivity of Leadership Estimates to the Definition of Leadership

	OLS & Probit		Instrumental Variables[c]	
	(a)	(b)	(c)	(d)
A. Education				
High School Leadership	0.397 ***	0.384 ***	0.835 *	0.918 *
	(0.028)	(0.029)	(0.502)	-0.559
High School Math Score	0.605 ***	0.525 ***	0.559 ***	0.480 ***
	(0.027)	(0.027)	(0.045)	(0.054)
R-squared	*0.419*	0.395	n/a	n/a
F-statistic (p-value)	n/a	n/a	*0.0000*	*0.0000*
Sargan Statistic (p-value)	n/a	n/a	*0.836*	0.8905
B. Any Post-Secondary Education[b]				
High School Leadership	0.064 ***	0.053 ***	0.213 ***	0.224 ***
	(0.007)	(0.006)	(0.044)	(0.065)
High School Math Score	0.080 ***	0.059 ***	n/a	n/a
	(0.006)	(0.005)		
R-squared	0.267	0.2482	n/a	n/a
Rho	n/a	n/a	-0.396	-0.605
			(0.184)	(0.106)
College Graduate[b]				
High School Leadership	0.124 ***	0.145	0.357 ***	0.309 ***
	(0.011)	(0.013)	(0.115)	(0.138)
High School Math Score	0.219 ***	0.213	n/a	n/a
	(0.011)	(0.012)		
R-squared	0.328	0.3147	n/a	n/a
Rho	n/a	n/a	-0.568	-0.424
			(0.089)	(0.149)
Measure of Leadership	10th or 12th	12th	10th or 12th	12th
Number of Observations	9,665	9,099	9,665	9,099

Notes:

a. Robust standard errors are reported in parenthesis. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, cognitive ability (math scores), popularity, athletic ability and locus of control.

b. Reported coefficients in columns (a) and (b) on Any Post-Secondary and College Graduate are marginal effects from probit models.

c. Instruments include twin, oldest child, twin*oldest child and school leadership opportunities. IV specification also includes conrtol for school average math percentile.

Table II.11. Athletic Versus Non-Athletic Leadership[a,b,c]

	Education		Any Post-Secondary		College Graduation	
	OLS	IV	OLS	IV	OLS	IV
	(a)	(b)	(c)	(d)	(e)	(f)
Captain	0.377 ***	4.178	0.066 ***	0.070	0.128 ***	0.133
	(0.038)	(2.695)	(0.007)	(0.093)	(0.016)	(0.087)
Officer	0.316 ***	1.502 **	0.044 ***	0.209 ***	0.119 ***	0.214 **
	(0.031)	(0.727)	(0.007)	(0.040)	(0.013)	(0.099)

Notes:

a. Robust standard errors are reported in parenthesis. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, cognitive ability (math scores), popularity, athletic ability and locus of control.

b. Reported coefficients in columns (c) through (f) are marginal effects from probit models.

c. Instruments include twin, oldest child, twin*oldest child and school leadership opportunities.

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CHAPTER III: HIGH SCHOOL LEADERSHIP AND EDUCATIONAL ATTAINMENT REVISITED- EVIDENCE FROM THE HIGH SCHOOL AND BEYOND

1. Introduction

In chapter II, I find that high school leadership has a large, positive impact on subsequent educational attainment. This result is consistent with Lozano (2008), who, using a different subset of students and a different methodology, also finds that high school leadership has a positive impact on subsequent educational attainment. To my knowledge, to date these are the only two studies that have addressed this important education policy question, and both rely on data from the National Education Longitudinal Study of 1988 (NELS). In this chapter, I address this limitation of the existing research by using a different dataset, the sophomore cohort of the High School and Beyond (HS&B), to provide further evidence on the impact of high school leadership on subsequent educational attainment. The students of the sophomore cohort of the HS&B survey represent a cohort of students who were born exactly ten years before the students of the NELS. Apart from the interest in checking the robustness of the results to the alternative dataset, use of the HS&B, therefore, also provides an interesting cross-cohort comparison of estimated leadership/educational attainment effects.

In this chapter, I follow the same empirical approach described in chapter II. As a baseline, I begin by controlling for selection on observable characteristics parametrically using ordinary least squares and probit estimation procedures. Then, I relax the linearity assumption and estimate the impact non-parametrically using a propensity score matching (PSM) approach. Finally, instrumental variables (IV) estimation methods, which rely on variation in school leadership opportunities, birth order and twin indicators for identification, are used to directly address the endogeneity of high school leadership that arises when there is selection on characteristics that are not observed (by the econometrician).

In contrast to the NELS, which only asks questions about leadership in school related activities, the HS&B includes questions about both school sponsored and non-school sponsored extracurricular activities. This unique attribute of the HS&B allows me to test whether the estimated impact of high school leadership activities is sensitive to the availability of alternative leadership opportunities provided outside of school (e.g. church, community, Boy Scouts, etc.). This robustness check is particularly important for the implications of the results found in chapter II with respect to education policy. If, for example, students can compensate for the lack of available school sponsored leadership opportunities by undertaking a leadership role in a church or community activity, then the cutbacks or fees for extracurricular activities may be less of a concern. However, if, despite controls for the availability of outside opportunities, school sponsored activities remain an important determinant of educational attainment or are found to have a larger impact, then this may not be a valid argument for the cutbacks.

Another appealing attribute of the HS&B is that the survey asks questions about alternative activities that may be considered to be high school leadership experiences. These additional activities include speaking in front of a large group of people, chairing a meeting, and leading a group problem-solving session. In order to assess the extent to which these alternative leadership activities affect subsequent educational attainment, I also estimate models using dummy indicators for these activities.

Interestingly, despite the data coming from surveys of two different cohorts of students ten years apart, the results found using the HS&B data are remarkably similar to the NELS results reported in chapter II of this dissertation. Every estimation procedure and model specification examined suggests that high school leadership has a large, positive impact on subsequent educational attainment. The smallest estimate coming from the HS&B, for instance, suggests that students who held high school leadership positions complete roughly 0.480 more years of education than their non-leader peers. This estimate is slightly larger than the corresponding (smallest) estimate found in the NELS dataset (0.346) and is actually bigger than Altonji's (1995) largest point estimates of the effect of an additional year of science, foreign language and math class on total years of education (0.270, 0.416, 0.424, respectively). High school leadership is also predicted to increase the probability of post-secondary attendance by at least 8.5 percent and to increase the probability of obtaining a bachelor's degree by a minimum of 9.8 percent. Compared to the smallest estimates found with the NELS data, the estimates are also somewhat higher.

The instrumental variables estimation results also mirror those found with the NELS data. With each educational outcome and model specification, the IV estimates of the impact of high school leadership are larger in magnitude than their corresponding ordinary least squares and propensity score estimates. IV estimates of the impact of high school leadership on total years of education, for instance, suggest the impact of high school leadership is roughly 0.9 (versus 0.480) years of additional education. This IV estimate is nearly identical to that reported in chapter II with the NELS data. IV estimates also suggest that, with respect to post-secondary attendance and obtaining a bachelor's degree, the causal impact of high school leadership is larger than the OLS and PSM estimates suggest.

Evidence provided from the robustness checks reinforces the main results of the paper. First, the estimates on school sponsored leadership change little when dummy indicators for non-school sponsored leadership activities are included in the models. This result suggests that the effects reported in chapter II are likely not being confounded by the omission of controls for alternative (non-school related) leadership opportunities. The evidence arising from this analysis also suggests that, compared with leadership experience in non-school sponsored activities, leadership in school-sponsored activities is more beneficial. While the coefficients on both leadership indicators are positive, with each educational outcome, the school-sponsored coefficient is larger, and in most cases much larger, than the corresponding coefficient on non-school sponsored leadership.

Finally, evidence from the analyses that use other measures of leadership suggests that students also benefit from activities such as public speaking and leading group problem-solving sessions. With each alternative leadership measure and educational outcome, the OLS and PSM estimates indicate that these measures of leadership also have a large, positive impact on subsequent educational attainment. Similar to the previous results, the IV estimates are larger than the corresponding OLS and PSM estimates. However, in each case, the instruments are very weak first stage predictors of the leadership measures and the resulting coefficients are implausibly high. Nevertheless, descriptive evidence from OLS and PSM estimation further substantiates the main results of this chapter and chapter II - high school leadership is an important determinant of future educational success.

Taken as a whole, the evidence arising from this chapter suggests that the results reported in chapter II are not an artifact of the NELS dataset. Moreover, the results suggest that, compared with the students of the NELS, high school leadership was at least as, if not more, important in the determination of educational attainment for students of the earlier cohort. The results reported in this chapter reinforce the conclusions arising from previous work on this topic and provide more reason to believe that leadership opportunities are, in fact, an important determinant of a student's educational success. Finally, with respect to education policy, the results provide further reason to argue that decisions regarding the availability of activities should not be taken lightly.

2. Data

The data used in the empirical analysis come from the sophomore cohort of the HS&B. The HS&B includes 14,825 individuals who were in tenth grade in 1980. The students were re-interviewed in 1982, 1984, 1986 and 1992. As previously mentioned, the students of the HS&B were high school seniors in 1982. Compared with the students of the NELS, who were seniors in 1992, they represent a cohort exactly one decade older. Importantly, both datasets come from surveys designed by the National Center for Education Statistics and were created to be as similar as possible. These attributes of the datasets allow for meaningful cross-cohort comparisons of two groups of students 10 years apart. Similar to the NELS, in the HS&B students, their parents, their teachers and their school counselors were interviewed. The dataset also contains a rich collection of both individual and school level characteristics.

Importantly, like the NELS, the HS&B survey also asks a number of questions covering a wide range of extracurricular activities. Similar to the NELS, the responses include an indicator of whether the individual was a participant, a non-participant or if he was an officer or a captain in the particular activity. In contrast to the NELS, in which both tenth and twelfth grade leadership is observed, the HS&B only includes leadership indicators for the senior year of high school. Another aspect of the HS&B that differs from the NELS is that, in addition to school sponsored activities; the HS&B asks questions about leadership experience in non-school sponsored activities, such as community service organizations and churches. This unique attribute of the HS&B dataset allows me to construct dummy indicators for both school and non-school sponsored high school leadership experience. In doing so, I am able to test the robustness of the school-sponsored leadership experience to the potential for non-school sponsored leadership opportunities. A list of the activities used to construct these leadership indicators in the HS&B is provided in Appendix B, Table B1.

In order to create meaningful comparisons across the three estimation approaches, a common analysis dataset is created. This reduces the original sample of 14,825 students to 7,198 students.[43] Importantly, however, compared to the subset of students who are dropped from the analysis and to the full dataset, the observed mean leader/non-leader differences in educational outcomes in the analysis dataset do not largely differ (see Appendix B, Table B3). The differences in the eliminated subset of students are, in fact, larger than those observed in the analysis sample. This fact suggests that the sample selection, if anything, will lead to estimates that are smaller than what would be observed in a larger, more representative sample.

[43] Sample construction is detailed in Appendix B, Table B2.

Descriptive statistics of leadership dummy indicators are presented in Table III.1. In the main analysis, high school leadership is defined as it was in chapter II. A student is considered a leader if he was a captain or officer in a school-sponsored extracurricular activity.[44] Similar to the NELS dataset, there are a surprisingly large number of high school leaders in the sample. Of the 7,198 students in the sample, 3,086, or 42.9 percent, are leaders in a school sponsored activity. A much smaller proportion of students are leaders in non-school sponsored activities (16.7 %). Taken together, over 48 percent of the students are a leader in either a school sponsored or non-school sponsored activity. Clearly, the high proportion of student leaders is somewhat troublesome. As discussed in chapter II, however, this result is not unique to the HS&B or the NELS. Kuhn and Weinberger (2005), in fact, also find a high proportion of student leaders in both the Project Talent data (57.4 percent) and National Longitudinal Study of 1972 (32.3 percent). As I suggest in chapter II, this result may be due to student over-reporting leadership experience. Alternatively, it may be a result of the large number of activities (and the number of potential leadership positions within a given activity) used to construct the leadership variables.[45]

As mentioned earlier, another appealing aspect of the HS&B dataset is the availability of alternative measures of high school leadership experience. In addition to the president/officer measure of leadership, the HS&B asks students questions about the frequency of the following activities: (1) spoke before a group of 50 or more; (2) headed a group problem-solving session; and (3) chaired a meeting. With the HS&B data, I am therefore also able to estimate the impact of these alternative measures of high school

[44] See Appendix B, Table B1 for the specific activities considered "school sponsored."

[45] See Appendix B, Table B1 for full list of activities.

leadership on subsequent educational attainment. For each measure, I create a dummy indicator set equal to one if the student reports that he engaged in the activity at least once. While these other measures do not as directly reflect school extracurricular opportunities, the measures are useful in testing the impact of alternative leadership activities. Sample means of these leadership indicators indicate that 43.6 percent of sampled students have spoken in front of a group of 50 or more, 25 percent have chaired a meeting, and 32.4 percent of the students have headed a group problem-solving session.

Table III.2 presents outcome and control summary statistics by leadership status. As in chapter II, three different measures are used to assess the impact of high school leadership on subsequent educational attainment: (1) years of education, (2) probability of attending any post-secondary institution, and (3) probability of holding a college degree. Each of these outcome variables is measured in the year 1992, approximately ten years after high school. Similar the NELS results, a simple comparison of education outcome sample means supports the main hypotheses of the essay. Compared with non-leaders, for example, leaders have, on average, obtained roughly 0.7 more years of education. In addition, 84% of leaders have acquired some post-secondary education by 1992, while only 72% of non-leaders have attended. Finally, while nearly 50% of high school leaders are college graduates, just 34% of non-leaders have graduated. Each of these differences in means is statistically significant at the one percent level.

In order to maintain comparability with the NELS analyses, controls for demographics, family background, and school quality are coded to be as similar as possible.[46] In contrast to the NELS, in which these measures are available in both eighth grade and in high school, control variables in the NELS are limited to high school values.

[46] Variable definitions are provided in Appendix B, Table B4.

Similar to the trends seen in the NELS sample, evidence provided by the descriptive statistics in the HS&B suggests that there is also substantial heterogeneity in many individual, family, and school characteristics across the two groups.

Similar to the NELS leaders, compared with their non-leader counterparts, sampled high school leaders in the HS&B come from families with greater family incomes. In addition, leaders are more likely to come from schools that have smaller enrollments[47] and a smaller proportion of Hispanic students. Interestingly, different from the NELS leader sample, the HS&B leader sample also has a higher proportion of Black students than the corresponding non-leader sample (13.57 versus 11.34 percent). Also in contrast to the NELS sample, in which a smaller proportion of the leaders attended public schools and a higher proportion of leaders attended both Catholic and private non-Catholic schools, a greater percentage of leaders in the HS&B attend public and non-Catholic schools. However, the difference is quite small and, with respect to public schools, is not statistically different from zero.

On average, the high school leaders also have a statistically significant higher math test score percentile than the non-leaders, suggesting that leadership is positively correlated with cognitive ability. Like the NELS, in addition to more traditional controls, the HS&B includes self-reported measures of athletic ability, popularity, and locus of control.[48] Differences in these characteristics also mirror those found in the NELS data.

[47] In the HS&B, total school enrollment is used instead of 12th grade enrollment as was used in the NELS analysis. This is done to maximum sample size in the HS&B.

[48] As defined in chapter II, the term "locus of control" refers to a student's belief about the causes of the good or bad outcomes in his life. A student with a high locus of control is said to be *internal*. An internal student believes that he controls himself and his life, while an *external* student believes that his "environment, some higher power, or other people" control his decisions and his life. [http://en.wikipedia.org/wiki/Locus_of_control]

High school leaders are more likely to report that others see them as athletic and popular and also have a higher locus of control, or are more internal, than their non-leader peers.

3. Empirical Approach

As discussed above, I follow the empirical approach described in detail in section three of chapter II. I begin by controlling for selection on observed characteristics. First, I estimate the following linear equation by OLS (probit for discrete outcomes):

$$Y_i = \beta_1 X_i + \beta_2 L_i + \varepsilon_i \ , \tag{1}$$

where Y_i is the educational outcome, X_i is a vector of observed covariates, L_i is a leadership dummy indicator, and ε_i is the error term.

Then, I relax the linearity assumption and estimate the impact of high school leadership on educational attainment by PSM, where a probit model is used to predict the propensity to undertake a leadership position ("the propensity score"). After leaders are matched to the non-leader with the most similar propensity score, the impact of high school leadership is recovered by taking the average of the matched leader/non-leader differences across the N matched pairs:

$$ATT = \frac{1}{N_T} \sum_{i \in T} [Y_i - Y_{j(i)}], \tag{2}$$

where N_T represents the number of student leaders, Y_i is the educational outcome for a student leader, and $Y_{i(j)}$ is the educational outcome of the matched non-leader j for student i.

Finally, I use an IV estimation procedure to control for selection on characteristics that are unobserved. In the case of years of education, I estimate a simple two-stage least squares model, where L_i in equation (1) above is replaced by its predicted value, $\hat{L}_i$.

Predicted high school leadership, $\hat{L}_i$, is recovered from estimation of the following selection equation:

$$L_i^* = \alpha_1 X_i + \alpha_2 Z_i + u_i \quad [L_i = 1 \mid L_i^* > 0], \tag{3}$$

where L_i^* is a latent indicator variable, X_i is defined as in equation (1), Z_i is a vector of instruments, and u_i the error term. In the case of the discrete outcomes, I estimate a bivariate probit model. Marginal effects are recovered using a bootstrapping procedure with 500 replications.

The instruments included in the vector Z_i in equation (3) that are used to identify high school leadership are the same instruments used in chapter II: (1) school leadership opportunities[49], (2) twin, (3) oldest child, and (4) twin*oldest child.[50] Table III.3 summarizes the variables used as instruments. Similar to the NELS dataset, simple descriptive statistics (panel A), suggest that the leader sample has a higher number of school leadership opportunities than its non-leader counterpart. Whereas, on average, 44.5 percent of the leaders' classmates are also leaders, only about 39 percent of the non-leaders' classmates are leaders. In contrast the trends seen in the NELS sample, however, the mean differences with respect to the other instruments (twin, oldest child and the interaction term) are much smaller and are not statistically different from zero. In fact, in the HS&B, there are a higher proportion of eldest children in the non-leader sample than the leader sample. However, panel B shows that compared with students who are neither a twin nor an oldest child, of which 42 percent are leaders, a higher proportion of students

[49] As in chapter II, school leadership opportunities are constructed by taking the number of leaders, excluding the student himself, divided by all of the individuals in a student's school.

[50] For a detailed discussion of the rationale for (and potential problems with) the use of these instruments, please see section 3 of chapter II.

who are either just a twin or are both a twin and an oldest child are leaders (45.5 and 47.6, respectively). While the trends are not as strong as they are for students of the NELS, there is, therefore, still reason to believe that these variables are associated with leadership.

4. Results

Table III.4 presents results from each estimation approach. All model specifications include controls for standard demographic characteristics, family background characteristics, school characteristics, regional differences, and math scores. Each model is estimated with and without controls for self-reported popularity, athletic ability and locus of control. In addition to reporting the estimates on high school leadership, Table III.4 also reports coefficients on the math test score percentile. This is done to provide a reference of relative magnitude of the leadership effects.

Results from OLS and probit models are reported in columns (a) and (b). Similar to the results found in the NELS sample, in each case, the estimates are precisely estimated and suggest that high school leadership has a large, positive impact on subsequent educational attainment. With respect to years of education, for example, the OLS point estimate suggests that students who are leaders in high school complete about a half more year of education than their non-leader peers. This estimate is greater than the corresponding OLS estimate in the NELS sample of around 0.40 years. While a half year of education may not seem like a large effect, compared to the impact of math test score, this estimate is actually quite large. It is, in fact, equivalent to a 23 percentile point increase in standardized test math score.[51] The OLS estimate is also greater than

[51] This is calculated by taking the coefficient on leadership divided by the coefficient in math test score (which represents the impact of a 10 percentile point increase) multiplied by ten.

Altonji's (1995) <u>largest</u> point estimates of a full year of science, foreign language or math class on total years of education (0.270, 0.416, 0.424, respectively). Similarly, large, marginal effects are found for both the probability of college attendance (roughly 9 percent) and the probability of college graduation (12 to 14 percent). Compared to the NELS probit marginal effects, the HS&B leadership estimate for college attendance is somewhat higher, while the estimate for college graduation is about the same.[52]

Estimates from PSM estimation are reported in columns (c) and (d). Also similar to the results reported in chapter II for the NELS sample, the PSM estimates do not differ greatly from the OLS and probit estimates. In models that do not control for popularity, athletic ability and locus of control, the PSM coefficients are slightly lower in magnitude than their OLS and probit counterparts. However, when these additional controls are included in the model, the PSM estimates for years of education and college attendance are actually slightly greater than the OLS and probit estimates (0.48 versus 0.46 years and 9 versus 8.7 %). The similarity of the PSM and OLS/probit results suggests that the OLS results are not highly sensitive to the linearity assumption.

Instrumental variables estimates of the impact of high school leadership on the three measures of educational attainment are reported in columns (e) and (f). As in the NELS analysis, the instruments pass both the first-stage F-test[53] and the Sargan-Hansen

[52] The corresponding marginal effects on college attendance in the NELS sample are 7% and 6.4%. The corresponding marginal effects on college graduation in the NELS sample are 14.1% and 12.5%. See Table II.3.

[53] The null hypothesis here is that the instruments can be omitted from the first stage equation. The p-value on this test is zero, providing evidence that the instruments are strong predictors of high school leadership and are therefore sufficiently powerful.

test of over-identifying restrictions.[54] Interestingly, the IV estimates are all larger than their corresponding OLS and probit estimates. This result mirrors the result found in the NELS sample. With respect to years of education, for example, whereas the OLS and probit estimates suggest high school leaders complete about a half more year of education, the IV estimate in almost a full year (0.90). This IV estimate on years of education is, in fact, nearly identical the IV estimate in the NELS sample. The IV estimates coming from the bivariate probit model of the impact of high school leadership on the probability of college graduation are also larger than their corresponding probit marginal effects. While the marginal effect from the univariate probit model indicates high school leadership are 12 to 14% more likely to earn a bachelor's degree, the bivariate probit estimates suggest the premium is almost double, or 23 to 24%. The IV estimates in the post-secondary attendance bivariate probit models are also larger than their probit and PSM counterparts; however, the difference is smaller (11 to 13% versus 8.5 to 10%).

As discussed in chapter II, the most straightforward explanation for the comparatively large IV estimates is that, rather than being upward biased, the OLS and PSM estimates are actually biased downward. As mentioned earlier, this result could be due to the fact that the source of selection bias is not the traditional ability bias, but rather is an unobserved characteristic, such as being a bookworm, that makes a student less likely to be a leader but more likely to attain further education. In this case, the instrumental variables estimation procedure is appropriately correcting for the negative bias. Results from the bivariate probit models here mirror those found in chapter II and

[54] The joint null hypothesis here is that all but one of the instruments are uncorrelated with the error term and are therefore properly excluded from the outcome equation. The Sargan p-values are 0.6224 and 0.746. Consequently, the null hypothesis cannot be rejected as conventional confidence levels.

suggest that this explanation is, in fact, likely. In both model specifications for both discrete outcomes, the correlation coefficient rho is negative. This indicates that high school leadership is endogenous and that the direction of the endogeneity bias is downward. Following Card (2001), the alternative explanation is that the IV method, is measuring a treatment effect for the students who are induced into a leadership position due to a change in the instrument who have a much greater marginal return to their leadership experience than the students who chose to be leaders.

Regardless of the interpretation of the results, similar to the NELS results, every estimation method and model specification examined suggests the impact of high school leadership is large, positive, and significant in both an economic and statistical sense. The smallest estimates found are non-trivial and the evidence implies the impact may be much larger for some students. These findings lend credence to the results of chapter II by illustrating that they are not merely an artifact of the NELS dataset. Moreover, the results from the HS&B suggest that, compared with students of the NELS, high school leadership was a just as, if not more, important determinant of future educational success for students from the earlier cohort.

5. Robustness Checks

In this section, I exploit two unique aspects of the HS&B to perform robustness checks. First, I test whether the relationships estimated above are sensitive to the omission of non-school sponsored leadership activities. Then, I estimate the impact of alternative measures of leadership on subsequent educational attainment.

School sponsored versus non-school sponsored activities

The results reported above are consistent with the results reported in chapter II and Lozano's (2008) results. Evidence coming from both the NELS and the HS&B indicates that high school leadership is an important determinant of future educational success. This result suggests that school systems should think carefully before cutting extracurricular activities. The analyses thus far, however, have ignored the potential impact of the availability of alternative leadership opportunities for students. Churches and community organizations, such as Boy Scouts, for example, also provide students with leadership opportunities. If these alternative leadership opportunities provide students with the same benefit as school sponsored activities, then the policy implications for school cutbacks may not be as clear. In this section, I test the sensitivity of the estimates to the availability of non-school sponsored leadership activities. In particular, in addition to the leadership indicator that has been included in the analyses above, I include a dummy indicator for non-school sponsored leadership. Equation (1) is therefore re-specified as follows:

$$Y_i = \beta_1 X_i + \beta_2 L_i + \beta_3 NSL_i + \varepsilon_i \,, \tag{1'}$$

where Y_i, X_i, L_i and ε_i are defined as in equation (1) and NSL_i is a dummy indicator for leadership experience in a non-school sponsored activity. In PSM estimation, non-school sponsored leadership is included in the group of matching variables, X_i. The IV selection equation is also amended to include an additional instrument: non-school leadership opportunities.[55]

[55] This measure is constructed the same way as the school leadership opportunity variable. It is set equal to the number of leaders in non-school sponsored activities within a school divided by the total number sampled students in that school (excluding, of course, the individual's choice).

Results from estimations that include this additional variable are reported in Table III.5. Table III.5 shows that the inclusion of the dummy indicator for non-school sponsored activities has very little effect on the magnitude of the school sponsored coefficients. The IV estimate of high school leadership on years of education in model 2, for example, only falls from 0.857 to 0.849. Similarly, the coefficient in the college graduation model falls from 0.238 to 0.231, a change of only 0.007. This result indicates that school leadership effects are not sensitive to the availability of leadership in activities outside of school.

Additionally, in each model specification and for every educational outcome, the estimated coefficients on school sponsored leadership activities are much larger than the corresponding coefficient on non-school sponsored activities. In terms of total years of education, for example, while not statistically different from zero, the estimated coefficient on non-school sponsored activities is only 0.182. This estimate is more than four times smaller than the coefficient on leadership in a school sponsored activity. Similar results are found in both the post-secondary attendance and college graduation models. With respect to college graduation, for example, the estimated marginal effect of non-school sponsored leadership is roughly four percent, or over five times smaller than the corresponding impact of school sponsored leadership (22.5%). This result suggests that non-school sponsored activities are not a perfect substitute for school sponsored activities.

Alternative measures of leadership experience

As mentioned previously, the HS&B also asks students about the frequency of the following activities: (1) speaking in front of a group of 50 or more, (2) chairing a meeting, and (3) heading a group problem-solving session. In this section, I test the impact of these other leadership activities on educational attainment. Results from these analyses are reported in Table III.6.

With each leadership measure and educational outcome, the OLS and PSM estimates indicate that these alternative measures of leadership also have a large, positive impact on subsequent educational attainment. The estimated impact of “spoke before a group of 50 or more”, for example, is 0.332 years more education. Similar results are found with “chaired a meeting” and “headed a group problem solving session” (0.357 and 0.206). Large effects are also found with respect to both any post-secondary attendance and college graduation. Speaking in front of a group of 50 or more, for instance, is predicted to increase the probability of college attendance by 5.3 to 7.3 percent and to increase the probability of college graduation by 3.6 to 7.2 percent.

Similar to the main results of the paper, the IV estimates are larger than the corresponding OLS and PSM estimates. However, in each case, the instruments are very weak first stage predictors of the leadership measures and, admittedly, the resulting coefficients are implausibly high. Nevertheless, the descriptive evidence from OLS and PSM estimation further substantiates the main results of this chapter and chapter II - high school leadership is an important determinant of future educational success.

6. Conclusion

To date, both studies that examine the impact of high school leadership on subsequent educational attainment have relied upon data from the NELS. In this chapter, I address this limitation of the existing literature by providing further evidence on the impact of high school leadership on subsequent educational attainment using data from the sophomore cohort of the High School and Beyond (HS&B). Similar to the results reported in chapter II, every estimation procedure and model specification examined suggests that high school leadership has a large, positive impact on subsequent educational attainment for students of the HS&B. Taken as a whole, the evidence arising from this chapter suggests that the results reported in chapter II are not merely an artifact of the NELS dataset and indicate that high school leadership was an at least, if not more, important determinant of educational attainment for students of the earlier cohort. The results reported in this chapter reinforce the conclusions arising from previous work on this topic and provide more reason to believe that leadership opportunities are, in fact, an important determinant of a student's educational success. With respect to education policy, the results provide further reason believe that decisions regarding cutbacks of school extracurricular activities that provide students with leadership opportunities should be given careful consideration.

Table III.1. Descriptive Statistics for Leadership Indicators in the HS&B

	Mean	Std. Dev
Primary Measure of High School Leadership (comparable to NELS):		
Leader in school-sponsored activity[a]	0.429	0.495
Other Measures of High School Leadership:		
Leader in any activity[a]	0.483	0.500
Leader in non-school sponsored activity[a]	0.167	0.373
Spoke in front of group of 50 or more	0.436	0.496
Chaired a meeting	0.250	0.433
Headed a group problem-solving session	0.324	0.468

Notes:

a. A list of activities used to construct leadership variables is presented in Table B1.

b. N= 7,198

Table III.2. Descriptive Statistics by Leadership Status[a]: HS&B

	Full Sample		Leader		Non-Leader		Difference[b]		
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev.	Mean	Std. Error	
Outcomes:									
Years of Education	14.463	1.744	14.851	1.716	14.172	1.709	0.679	(0.041)	***
College Graduate	0.405	0.491	0.497	0.500	0.336	0.472	0.161	(0.012)	***
Any Post-Secondary Education	0.775	0.418	0.844	0.362	0.723	0.448	0.122	(0.010)	***
Controls:									
Male	0.458	0.498	0.484	0.500	0.438	0.496	0.046	(0.012)	***
Black	0.114	0.318	0.139	0.346	0.096	0.294	0.044	(0.008)	***
Hispanic	0.194	0.396	0.181	0.385	0.204	0.403	-0.022	(0.009)	***
Age	27.464	0.605	27.457	0.576	27.469	0.625	-0.012	(0.014)	
Socioeconomic status	0.779	8.641	0.667	7.283	0.863	9.534	-0.196	(0.206)	
Family Income	4.047	2.606	4.223	2.602	3.915	2.601	0.308	(0.062)	***
High school enrollment	1199.6	775.6	1111.7	763.2	1265.6	778.3	-153.9	(18.383)	***
Public high school	0.723	0.447	0.729	0.445	0.719	0.449	0.010	(0.011)	
Catholic high school	0.223	0.416	0.212	0.409	0.231	0.422	-0.019	(0.010)	*
% free lunch in high school									
% Black in high school	12.929	22.125	13.567	23.072	12.451	21.376	1.116	(0.527)	**
% Hispanic in High School	11.105	21.496	10.789	21.115	11.342	21.777	-0.553	(0.512)	
Northeast	0.252	0.434	0.223	0.416	0.273	0.446	-0.050	(0.010)	***
Midwest	0.293	0.455	0.289	0.453	0.296	0.457	-0.007	(0.011)	
West	0.191	0.393	0.195	0.396	0.188	0.391	0.007	(0.009)	
South	0.264	0.441	0.293	0.455	0.242	0.428	0.051	(0.010)	***
Math Score	0.552	0.257	0.589	0.248	0.524	0.260	0.065	(0.006)	***
Athletic	0.163	0.370	0.275	0.446	0.080	0.271	0.195	(0.009)	***
Locus of Control	0.105	0.608	0.178	0.604	0.050	0.606	0.128	(0.014)	***
Popular	0.161	0.368	0.251	0.434	0.094	0.292	0.157	(0.009)	***
	N= 7,198		N= 3,086		N= 4,112				

Notse:

a. Leadership is defined as leader in school sponsored activity to maintain comparability with NELS analyses.

b. Difference is calculated as mean(leaders) - mean(non-leaders). *,**, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table III.3. Descriptive Statistics for Instruments in the HS&B

	Leader	Non-Leader	Difference
A. Means by Leadership Status			
% HS peers in leadership positions	0.445	0.388	0.058 **
Twin	0.024	0.021	0.003
Oldest Child	0.169	0.178	-0.008
Twin * Oldest Child	0.002	0.001	0.001
B. Proportion Leader			
Neither twin nor oldest child	0.420		
Twin only	0.455		
Oldest child only	0.408		
Twin & Oldest child	0.476		

Notes:

a. Difference is calculated as mean(leaders) - mean(non-leaders). *,**, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

b. N= 3,086 leaders and 4,112 non-leaders.

Table III.4. The Impact of High School Leadership on Subsequent Educational Attainment in the HS&B[a]

	OLS & Probit		Propensity Score Matching		Instrumental Variables[c]	
	(a)	(b)	(c)	(d)	(e)	(f)
A. Education						
High School Leadership	0.525 ***	0.464 ***	0.492 ***	0.480 ***	0.906 **	0.857 **
	(0.037)	(0.039)	(0.056)	(0.062)	(0.296)	(0.311)
High School Math Score	0.228 ***	0.207 ***			0.216 ***	0.197 ***
	(0.008)	(0.008)			(0.011)	(0.011)
R-squared	0.230	0.244				
F-statistic					0.000	0.000
Sargan Statistic (p-value)					0.6224	0.746
B. Any Post-Secondary Education[b]						
High School Leadership	0.099 ***	0.087 ***	0.085 ***	0.090 ***	0.135 *	0.107
	(0.010)	(0.010)	(0.014)	(0.015)	(0.067)	(0.070)
High School Math Score	0.037 ***	0.033 ***				
	(0.002)	(0.002)				
R-squared	0.128	0.138				
Rho					-0.088	-0.048
Standard Error					(0.175)	(0.176)
C. College Graduate[b]						
High School Leadership	0.139 ***	0.120 ***	0.112 ***	0.098 ***	0.232 **	0.238 **
	(0.012)	(0.013)	(0.016)	(0.017)	(0.097)	(0.087)
High School Math Score	0.071 ***	0.065 ***				
	(0.003)	(0.003)				
R-squared	0.160					
Rho					-0.209	-0.255
Standard Error					(0.164)	(0.165)
Popular, Athletic, Locus of Control	No	Yes	No	Yes	No	Yes
N= 7,198 individuals						

Notes:

a. Robust standard errors in parethesis. *,**,*** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, and cognitive ability (math score).

b. Reported coefficients in columns (a), (b), (e) and (f) on Any Post-Secondary and College Graduate are marginal effects from probit models.

c. Instruments include twin, oldest child, twin*oldest child and school leadership opportunities.

Table III.5. School Sponsored Versus Non-School Sponsored Leadership Activities

	OLS & Probit		Propensity Score Matching		Instrumental Variables[c]	
	(a)	(b)	(c)	(d)	(e)	(f)
A. Years of Education						
School Sponsored Leadership Activities	0.484 ***	0.424 ***	0.478 ***	0.270 ***	0.881 **	0.849 **
	(0.038)	(0.039)	(0.060)	(0.066)	(0.301)	(0.315)
Non-School Sponsored Leadership Activities	0.254 ***	0.237 ***	n/a	n/a	0.182	0.055
	(0.049)	(0.049)			(0.342)	(0.342)
B. Any Post-Secondary Education[b]						
High School Leadership	0.089 ***	0.077 ***	0.081 ***	0.044 ***	0.125 *	0.094
	(0.010)	(0.010)	(0.015)	(0.016)	(0.074)	(0.075)
Non-School Sponsored Leadership Activities	0.060 ***	0.058 ***	n/a	n/a	0.058 **	0.057 **
	(0.012)	(0.012)			(0.010)	(0.010)
C. College Graduate[b]						
High School Leadership	0.131 ***	0.112 ***	0.114 ***	0.067 ***	0.225 **	0.231 **
	(0.013)	(0.013)	(0.017)	(0.019)	(0.085)	(0.092)
Non-School Sponsored Leadership Activities	0.053 ***	0.049 ***	n/a	n/a	0.043 **	0.039 **
	(0.017)	(0.017)			(0.012)	(0.015)
Popular, Athletic, Locus of Control	No	Yes	No	Yes	No	Yes
N= 7,198 individuals						

Notes:

a. Robust standard errors in parethesis. *,**,*** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, and cognitive ability (math score).

b. Reported coefficients in columns (a), (b), (e) and (f) on Any Post-Secondary and College Graduate are marginal effects from probit (or bivariate probit) models.

c. Instruments include twin, oldest child, twin*oldest child, school sponsored leadership opportunities, and non-school sponsored leadership activities.

Table III.6. Alternative Measures of High School Leadership[a]

	OLS & Probit		Propensity Score Matching		Instrumental Variables[c,d]	
	(a)	(b)	(c)	(d)	(e)	(f)
A. Years of Education						
Spoke before a group of 50 or more	0.332 ***	0.282 ***	0.269 ***	0.255 ***	2.824 *	2.017
	(0.037)	(0.037)	(0.056)	(0.059)	(1.556)	(1.437)
Chaired a meeting	0.357 ***	0.298 ***	0.389 ***	0.351 ***	3.701 **	3.334 **
	(0.042)	(0.042)	(0.065)	(0.068)	(1.683)	(1.683)
Headed a group problem-solving session	0.206 ***	0.157 ***	0.201 ***	0.212 ***	7.044	8.256
	(0.039)	(0.039)	(0.060)	(0.060)	(5.118)	(7.365)
B. Any Post-Secondary Education[b]						
Spoke before a group of 50 or more	0.073 ***	0.064 ***	0.051 ***	0.053 ***	0.863 **	0.794 *
	(0.010)	(0.010)	(0.013)	(0.014)	(0.434)	(0.429)
Chaired a meeting	0.072 ***	0.061 ***	0.079 ***	0.063 ***	0.693	0.658
	(0.010)	(0.011)	(0.015)	(0.016)	(0.381)	(0.392)
Headed a group problem-solving session	0.045 ***	0.036 ***	0.046 ***	0.037 ***	0.823	0.914
	(0.010)	(0.010)	(0.014)	(0.014)	(0.833)	(1.089)
C. College Graduate[b]						
Spoke before a group of 50 or more	0.072 ***	0.058 ***	0.056 **	0.036 **	0.339	0.117
	(0.012)	(0.013)	(0.016)	(0.017)	(0.355)	(0.350)
Chaired a meeting	0.088 ***	0.072 ***	0.077 ***	0.084 ***	0.797	0.709
	(0.014)	(0.015)	(0.019)	(0.019)	(0.424)	(0.433)
Headed a group problem-solving session	0.050 ***	0.036 **	0.042 **	0.053 **	1.685	2.058
	(0.013)	(0.014)	(0.017)	(0.017)	(1.329)	(1.937)
Popular, Athletic, Locus of Control	No	Yes	No	Yes	No	Yes
N= 7,198 individuals						

Notes:

a. Robust standard errors in parethesis. *,**,*** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographics, family background, region, school quality, and cognitive ability (math score).

b. Reported coefficients in columns (a), (b), (e) and (f) on Any Post-Secondary and College Graduate are marginal effects from probit models.

c. Instruments include twin, oldest child, twin*oldest child and school leadership opportunities.

d. First-stage results indicate that the instruments are very weak predictors of these variables. Coefficients should therefore be intrepreted with caution.

7. References

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CHAPTER IV: HIGH SCHOOL LEADERSHIP AND POST-SCHOOLING EARNINGS

1. Introduction

As discussed in the introduction, while the evidence coming from Kuhn and Weinberger[56] (2005) indicates that leadership skill is an important determinant of post-schooling earnings, the analysis is limited to ordinary least squares estimation, which assumes linearity and does not control for selection on unobserved characteristics. It is therefore difficult to determine the extent to which the estimated impact of high school leadership on earnings is, in fact, causal. In addition, the analysis in the KW paper is limited to white men. This restriction allows KW to assess the leadership effects on a sample that is homogenous with respect to race and gender. Today, however, the number of females in college outnumbers that of males by nearly three to two[57] and women represent a substantially larger portion of the traditionally male-dominated occupations than they did in the past.[58] Women are also taking on leadership positions in increased numbers. According to the Center for Women's Business Research, for example, 10.1 million firms are owned by women[59] and the growth rate of women-owned firms was

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[56] In the interest of brevity, for the remainder of this chapter, I refer to Kuhn and Weinberger (2005) as KW.

[57] Jacob, 2002

[58] Longley, Robert. "Many U.S. Jobs have Become Less Male-Dominated: BLS Statistics show changing face of American workplace." About.com, April 2005.

[59] http://www.nfwbo.org/facts/index.php

almost double that of all firms from 1997 to 2004 (17 percent versus 9 percent).[60] In light of the recent emergence of females into prominent leadership positions, including women in the analyses should provide a more representative sample. The inclusion of females also allows for interesting cross gender comparisons of high school leadership effects.

In this chapter, I address these gaps in this small, but growing, body of research concerning the importance of leadership skill in the labor market by revisiting earlier results and by providing updated evidence on the return to leadership skill for both white men and white women. The essay builds on KW, which, using data from the Project Talent, the National Longitudinal Study of 1972, and the sophomore cohort of the High School and Beyond (HS&B), finds that white men who were leaders in high school earn significantly more than their non-leader peers as adults.

I begin the empirical analysis by replicating KW's regression results for white men of the sophomore cohort of the HS&B as precisely as possible. I then extend their analysis in several ways. First, I replicate their regression analysis for a sample that includes both white men and women from the HS&B. This exercise allows me to examine the extent to which the leadership premiums reported by KW for white male students differ from those estimated on a larger, more representative sample that includes women. Then, using data from the National Education Longitudinal Study of 1988 (NELS), I test the persistence of the KW leadership effects for students from a later cohort.

Importantly, while the replication and extension of the KW analysis provides an interesting cross-cohort comparison and tests the sensitively of their results to the gender restriction, the ordinary least squares method does not appropriately control for the non-

[60] http://www.womensleadershipexchange.com/index.php?pagename=fastfacts

random selection of students into leadership positions. To address this limitation, I also estimate the earnings returns to high school leadership experience using the empirical approaches described in chapter II. In addition to using OLS estimation, I relax the linearity assumption and estimate the impact non-parametrically using a propensity score matching (PSM) approach. Then, I use instrumental variables (IV) estimation methods, which rely on variation in school leadership opportunities, birth order and twin indicators for identification, to directly address the endogeneity of high school leadership that arises when there is selection on characteristics that are not observed (by the econometrician). In doing so, I am able to assess the extent to which observed leadership earnings premiums found by KW (and found in the replication analyses) may be interpreted as the causal effects of high school leadership. Finally, I estimate the models separately by gender. This analysis provides some insight into leadership/earnings gender differentials and allows me to assess how these gender differences have changed across the two cohorts of students.

While my replication of KW is not perfect, I am successful in replicating their major findings for white men in the sophomore cohort of the HS&B. The results indicate that high school leadership has a large, positive impact on the earnings of white men from the HS&B. When women are included in the HS&B sample, the estimated effects are somewhat smaller, indicating a relatively weaker relationship between high school leadership and earnings for white women of the HS&B. Similarly, compared with KW's sample of white men of the HS&B, the estimated effects arising from the NELS dataset are smaller in magnitude. This result implies that the earnings impact of high school leadership has dampened across the two cohorts. Nevertheless, estimates from each alternative sample and model specification used in the replication analysis indicate that students who were high school leaders do, in fact, earn more than their non-leader peers.

For the most part, the results coming from the empirical methods described in chapter II of this dissertation echo the KW regression results. For both datasets, the OLS and PSM estimates indicate that high school leadership has a large, positive impact on post-schooling earnings. OLS estimates, for example, indicate that leaders in the HS&B sample are earn 13.3 percent more than their non-leader peers, while leaders from the NELS are predicted to earn 10.6 percent more than non-leaders. Also consistent with the results reported in chapters II and III of this dissertation, the IV point estimate on high school leadership in the NELS dataset is much larger than the corresponding OLS and PSM estimates. The IV estimate in the NELS model is, in fact, more than three times the size the OLS and PSM estimates and suggests leaders in high school earn 32.2 percent more than their non-leader peers. This result indicates that the OLS and PSM estimates are biased downward. In contrast, the IV estimate on high school leadership in the HS&B sample is large and negative. The IV estimate suggests that HS&B leaders actually earn 26.2 percent *less* than their non-leader peers. This puzzling result persists with alternative specifications and the inclusion of school controls.

Finally, the results imply that high school leadership differentially impacts men and women. Moreover, the gender differences appear to have changed across the two cohorts of students. While men of the HS&B benefit from their leadership experience to a larger extent than their female counterparts; women of the NELS earn higher leadership premiums than their male peers.

2. Data

In this essay, I use two datasets from the National Center for Education Statistics (NCES). In the first part of the analysis, I replicate and extend KW's analysis using the sophomore cohort of the HS&B. Then, I estimate the models using data from the NELS. The HS&B data includes individuals who were sophomores in 1980. The students were re-interviewed in 1982, 1984, 1986 and 1992. The NELS includes individuals who were in eighth grade in 1988. The participants were re-interviewed in 1990, 1992, 1994 and 2000. The sophomores from the HS&B represent the graduating class of 1982, while the NELS students represent the class of 1992. The two groups of students therefore represent cohorts of students who are exactly ten years apart in age. This attribute of the datasets allows for meaningful cross-cohort comparisons.

In each survey, the students, their parents, their teachers and their school counselors were interviewed. The datasets each contain a rich collection of both individual and school level characteristics. For the purposes of this research, these studies are particularly well-suited as each asks a number of questions covering a wide range of extracurricular activities. Moreover, the responses include an indicator of whether the individual was a participant, a non-participant or if he was an officer or a captain in the particular activity. This allows me to construct dummy indicators of high school leadership experience as demonstrated by holding a position as a team captain or a club officer. These measures are available when the students were in their senior year in the HS&B. The NELS also contains indicators of tenth grade extracurricular involvement. However, to maintain consistency with KW, leadership activities are restricted to leadership in the twelfth grade only. A list of the activities used to construct the leadership indicators is provided in Appendix C, Table C1.

To construct the analysis samples, I follow the KW sample selection criteria as closely as possible. This is done in order to provide meaningful comparisons and replications of KW. Because wages are not available in the HS&B, the primary outcome of interest is log annual earnings. In the HS&B, earnings are measured in 1991, approximately nine years after high school graduation. NELS earnings come from the 2000 survey and represent earnings of students eight years after high school. Following KW, in addition to the race restriction, each sample is restricted to high school graduates who are working at the survey date who have earnings that are not in the extreme tails of the distribution. This restriction eliminates individuals earning less than $2,500 and more than $100,000 in 1991 dollars. The resulting estimates should therefore be interpreted as the impact of leadership skill on earnings, *conditional on employment*. The samples are further reduced due to missing key variables. A detailed breakdown of the sample selection criteria is available in Appendix C, Table C2.

Descriptive statistics for each dataset are presented in Table IV.1. Summary statistics are reported for each full sample and are also broken out by gender. The HS&B sample includes 2,460 men and 2,443 women. Compared with KW's sample of white men from the HS&B (Column 1), the replicated sample has 77 more observations. It is important to note, however, that while not perfect; the replicated sample means for white men in the HS&B (column 2) do not largely differ from KW (column 1). The NELS sample includes 2,400 men and 2,324 women.

Annual earnings are reported in the first row of Table IV.1. Consistent with data from the U.S. Department of Labor, in both datasets, average male earnings exceed those of their female counterparts. In the HS&B sample, average female earnings are approximately 79% of males. Ten years later, the earnings gap is largely unchanged, as the average woman in the NELS sample earns about 78% that of her male counterpart in the NELS dataset. These gender earnings gaps are comparable with the national gender wage gaps found in the Current Population Survey (CPS). In 2000, for instance, CPS median earnings for full-time women workers were 76 percent of their male counterparts. The observed time trend is also consistent with CPS evidence, which illustrates the gender wage gap has remained relatively stable since the 1990s.[61]

Turning to the leadership measures, similar to the trends seen in chapters II and III, there are a large number of leaders in both samples. In the HS&B sample, 47.5 percent of the students are leaders in either a team or club, and 46.1 percent of the NELS sampled students are leaders. In the HS&B sample, the proportion of white men and women who are high school leaders is nearly identical (47.6 and 47.4, respectively). The type of leadership activities in which each gender participates, however, does differ. Whereas 12.7 percent of men fall into the "team captain only" category, just 6.4 percent of women are only a team captain. Similarly, fewer women are both a team captain and president.[62] In contrast, a larger portion of women are in the "president only" group (22.4 % of men versus 29.2 % of women). Parallel differences are seen with participation in

[61] In 2007, women's median wages equaled 80 percent of their male counterparts. The comparable earnings gap in 1997 was 76 percent. For details, see www.bls.gov/cps.

[62] To maintain consistency with KW, I refer to leadership in a club as "president" when, in fact, the student could have held a position as a vice-president, secretary, treasurer, etc.

the respective activities. In terms of the breakdown by activity, comparable gender trends are seen in the NELS sample. Compared with their male counterparts, for instance, a smaller percentage of women are both team captain and president or only a captain, while a larger portion of females are presidents only. Interestingly, however, compared with the HS&B sample, the NELS sample has a higher proportion of female leaders (48.6 versus 47.4%) and a lower proportion of male leaders (43.9 versus 47.6%).

The proportion of students earning a college degree remained largely unchanged between the HS&B and NELS cohorts (41.2 versus 42.6 percent). The average number of students pursuing some college, however, did increase from the HS&B to the NELS (32.3 to 43.5 percent). Consistent with the national statistics, compared with men, women in both samples are more likely to have earned a college degree eight to nine years after high school.[63] Math test score percentiles reflect the within gender/cohort percentile. The scores are therefore not comparable across gender or cohort. The fact that each mean math score percentile is close to 50, however, suggests that I have not disproportionately selected a group of students with high math ability.

Before turning to the analysis, it is instructive to examine the differences in log annual earnings by leadership status. Table IV.2 reports sample means of log annual earnings for each measurement of high school leadership and dataset by gender. The evidence from the simple summary statistics supports the main hypotheses of the paper. With each dataset, for each gender, and for every measurement of high school leadership, mean log annual earnings for high school leaders are higher than the corresponding mean earnings of non-leaders. In the full HS&B, for instance, mean log annual earnings of

[63] According to USA Today, in the fall of 2005, women made up 57 percent of all college students. http://www.usatoday.com/news/education/2005-10-19-male-college-cover_x.htm.

non-leaders are 9.904 while the mean log annual earnings of students who were either a team captain or club president are 10.007. Similarly, mean log annual earnings of non-leaders in the NELS are 10.222, lower than the corresponding mean earnings for leaders in the NELS (10.343).

3. Replication and Extensions of Kuhn and Weinberger (2005) Regression Analyses

In this section, I re-visit the relationship between high school leadership and earnings as reported in KW. I follow the basic methodology used in KW, which is to regress log annual earnings on measures of high school leadership, controlling for cognitive ability (math scores), family background characteristics (parents' education) and high school fixed effects. In particular, I estimate the following linear model:

$$LnY_{is} = \beta_1 LB_{is} + \beta_2 LT_{is} + \beta_3 LC_{is} + \beta_4 PB_{is} + \beta_5 PT_{is} + \beta_6 PC_{is} + \beta_7 X_{is} + \phi_s + \varepsilon_{is}, \quad (1)$$

where LnY_{is} is log annual income for student i in school s; LB_{is}, LT_{is} and LC_{is} are dummy variables for leadership as a captain and president, a captain only, and a president only, respectively. Participation dummy variables for participation in both a sport and club, sport only and club only are given by PB_{is}, PT_{is}, and PC_{is}. X_{is} is a vector of individual and family background characteristics, ϕ_s is a school specific error term that is constant within a school, and ε_{is} is an individual specific error term.

I begin by estimating (1) for white men of the sophomore cohort of the HS&B. This replication of columns 9 through 12 from KW Table 3 is done to ensure that the extensions are truly comparable. Then, I estimate (1) for the larger, more representative, sample that includes both white men and women of the HS&B. In doing so, I test the sensitivity of the estimates reported by KW for white men to the inclusion of women from the HS&B. Finally, I estimate (1) on a similar sample drawn from the NELS. This cross-cohort comparison allows me to assess whether leadership premiums found by KW for the HS&B persist for the later cohort of students.

KW argue that using high school leadership to proxy for leadership skill allows one to avoid certain types of endogeneity. For example, an individual who receives a promotion or earns high wages for some unrelated reason may begin to develop leadership skill or, as a result, may believe that he is a leader and be inclined to self-report himself as such. Concurrent self-reported measures of leadership skill might therefore be confounded by these possible relationships. Use of high school leadership experience as a proxy for leadership skill avoids this reverse causality problem.[64] In this paper, however, I am interested in recovering the causal impact of high school leadership. While the use of high school leadership as a proxy for leadership skill avoids the potential problems caused by reverse causality mentioned above, selection into a high school leadership position is not random. The inclusion of math scores, parents' and own education and all differences in high school quality (via school fixed effects) in the regressions should help mitigate these concerns. However, the resulting coefficients arising from the OLS estimation in this section should be interpreted carefully. Specifically, the estimates should be interpreted as the difference in later-life earnings among white students of the same gender, with the same cognitive ability, family background, and stock of human capital (in some specifications), who attended the same high school in the twelfth grade. The issue of causality is revisited in section four.

Results

Replication results for white men of the sophomore cohort of the HS&B are presented in Table IV.4. In columns (1), (3), (5), (7), I report KW's Table 3 results for

[64] Fortin (2008) also uses high school measures of non-cognitive skills to avoid these complications.

the HS&B sample. The results of my replication are reported in columns (2), (4), (6) and (8). While not perfect, I am successful in reproducing KW's major findings. In all four model specifications, the estimated coefficient on each measure of leadership (captain and president, captain only, and president only), has a statistically significant, positive impact on earnings of white men approximately nine years after graduating from high school. The replicated coefficient in the base model (only with high school fixed effects and no other controls) indicates that white men who were both captain and president of an activity in the twelfth grade earn 23% more than men who were neither captain nor officer of an activity. This estimate differs only slightly from KW's estimate of 23.6%. The estimated earnings premium for men who were captains, but not officers is 13.3%, while the earnings premium for men who were an officer but not a captain is 16.1%. These estimates are also quite similar to KW's (11.4 and 17.4%, respectively). Also similar to the KW results, the estimates change little when math test scores are included in the regression. Likewise, when controls for parents' education are included in the model, the coefficients remain largely unchanged. In fact, while the coefficients drop slightly with the inclusion of math score, the estimates from model three are nearly identical to the base coefficients once controls for parents' education are added to the regression. Finally, while education is likely to be endogenous with respect to earnings, KW also include indicators for college attendance and college degree in the model. The inclusion of the education controls is done to assess the extent to which the observed earnings premiums are a reflection of leader/non-leader educational differences. Consistent with KW's findings, the education controls do little to the leadership coefficients. The coefficient on "both captain and president" indicator, for instance, falls by just 6.5 percent (from 0.23 to 0.215). This result suggests that very little of leadership/earnings effect for white men is driven by differences in educational attainment.

Table IV.4 reports comparable coefficients from the estimation of equation (1) for samples that include both white men and women from the HS&B (columns 1-4) and the NELS (columns 5-8). First, looking at the HS&B sample, the estimated impact of high school leadership on log earnings remains large, positive, and statistically significant for the larger sample. However, the addition of females to the HS&B male sample has the effect of dampening the coefficients on each measure of high school leadership. In models that control for math test scores and parents' education, for instance, the point estimate on "both captain and president" drops from 0.230 to 0.175. Similar trends are seen for the other measures of leadership and in the alternative model specifications. This result suggests that women of the HS&B benefit from their high school leadership experience to a lesser extent than their male counterparts. This gender difference is examined in more detail in section five.

Next, turning to the NELS results, while similar to the HS&B results, the estimates indicate that high school leadership has a positive impact on earnings, compared with the HS&B coefficients, the estimated coefficients are smaller in magnitude. Looking at the results from the model specification that includes math scores and parents' education (columns 3 and 7), for example, the point estimate on "both captain and president" in the HS&B suggests that students who were team captains and officers of a club earn more 17.5 percent more than their non-leader peers. The corresponding estimate for the NELS sample is less than half this size (8.6 percent).

Similarly, the NELS estimates of the impact of high school leadership on earnings for both "captain only" and "president only" leadership indicators are also smaller than their HS&B counterparts. This result suggests that, while high school leaders from the NELS still earn more than their non-leader peers, the impact of high school leadership experience on earnings has fallen over time.

In sum, the replication analysis indicates that, compared with a sample that includes both men and women of the HS&B and a sample from the NELS dataset, the effects reported by KW for white men of the HS&B represent an upper bound on the impact of high school leadership on future earnings. Nevertheless, estimates from each alternative sample and model specification used in the replication analysis indicate that students who were high school leaders do, in fact, earn more than their non-leader peers. The smallest estimates (coming from the NELS model that controls for own education) suggests that students who were leaders earn roughly 4 to 7 percent more than their non-leader peers. These most conservative estimates are still not trivial. In terms of magnitude, they are, for instance, in the same ballpark as many empirical estimates of the return to an additional year of education.[65]

4. The Causal Impact of High School Leadership on Post-Schooling Earnings

While the evidence provided above further substantiates KW's conclusion that leadership skill is positively related to earnings, the OLS method assumes linearity and does not control for selection on unobserved characteristics. It is therefore difficult to determine whether the estimates arising from the descriptive analyses above are actually

[65] Card (2001), summarizes estimates from 11 studies on return to schooling. The majority of these estimates range from about 0.05 to 0.15. See Table II, pages 1146-1147.

reflective of the causal impact of high school leadership or are merely a result of observed correlation between high school leadership and future earnings.

As discussed in chapter II, *a priori*, the direction of the selection bias is ambiguous. Following arguments drawn from the education literature, where the traditional unobserved variable is "ability" that causes the so-called "ability bias," one would think that a factor such as unobserved student ability or motivation would be positively correlated with both leadership and future earnings, leading to upward biased OLS estimates. However, high school leadership involves tasks such as managing other students and speaking in front of other people. Such experiences are likely to be more costly for students who are less social or are bookworms. These students may therefore not undertake leadership positions, but may still earn more in the future if they instead contribute to their human capital at home, in the library, or at their computer. In this case, the estimated impact of leadership on earnings with OLS will be understated.

To address the limitations of the existing research, in this section, I estimate the impact of high school leadership on earnings using the empirical approaches described in detail in chapter II of this dissertation. First, in addition to OLS, I control for observed characteristics non-parametrically using propensity score matching (PSM). The assumption here is that the variables included in a vector of observed variables are sufficient to eliminate any relationship between selection into leadership and unobserved characteristics or shocks impacting earnings. Then, I use instrumental variables estimation to control for selection on unobserved characteristics under the assumption that there is a set of variables that are related to leadership but are uncorrelated with the unobserved characteristics or shocks.

In order to use these approaches, I must first consolidate the three leadership dummy variables from equation (1) into a single dummy variable that is set equal to one if a student was either a team captain or a club officer in any activity.[66] In addition, in order to identify the impact of leadership with IV, it is necessary to drop the participation indicators from the analysis. To maintain consistency with KW, with each estimation approach, I control for gender, math scores and parents' education. Since own education is endogenous with respect to both leadership and earnings, controls for some college and a college degree are omitted. The resulting estimates therefore represent the average impact of high school leadership in any activity (team or club), unconditional on participation, and unconditional on subsequent educational attainment. Additionally, since school leadership opportunities are a school-level variable, high school fixed effects cannot be included in the IV estimation procedure. I therefore estimate the OLS models with and without high school fixed effects.

Empirical Approach

To create a baseline for comparison, I first impose the above restrictions on equation (1) and estimate the following linear equation by OLS:

$$\ln Y_i = \beta_1 L_i + \beta_2 X_i + \varepsilon_i \ , \tag{2}$$

where $\ln Y_i$ is log annual earnings, X_i is a vector of observed covariates, L_i is the leadership dummy indicator, and ε_i is the error term. I estimate (2) both with and without high school fixed effects.

Then, I relax the linearity assumption and estimate the impact of high school leadership on log earnings by PSM, where a probit model is used to predict the

[66] This change implicitly imposes the restriction that $\beta_1 = \beta_2 = \beta_3$ in equation (1).

propensity to undertake a leadership position ("the propensity score"). After leaders are matched to the non-leader with the most similar propensity score, the impact of high school leadership is recovered by taking the average of the matched leader/non-leader differences across the N matched pairs:

$$ATT = \frac{1}{N_T} \sum_{i \in T} [Y_i - Y_{j(i)}], \tag{3}$$

where N_T represents the number of student leaders, Y_i is the educational outcome for a student leader, and $Y_{i(j)}$ is the educational outcome of the matched non-leader j for student i.

Finally, I use an IV estimation procedure to control for selection on characteristics that are unobserved (by the econometrician). I estimate a simple two-stage least squares model, where L_i in equation (1) above is replaced by its predicted value, $\hat{L}_i$. Predicted high school leadership, $\hat{L}_i$, is recovered from estimation of the following selection equation:

$$L_i^* = \alpha_1 X_i + \alpha_2 Z_i + u_i \quad [L_i = 1 \mid L_i^* > 0], \tag{4}$$

where L_i^* is a latent indicator variable, X_i is defined as in equation (1), Z_i is a vector of instruments, and u_i the error term. The instruments included in the vector Z_i in equation (3) that are used to identify high school leadership are the same instruments used in chapters II and III: (1) school leadership opportunities[67], (2) twin, (3) oldest child, and (4) twin*oldest child.[68]

Results

Results from each estimation approach and dataset are reported in Table IV.5. HS&B results are reported in Panel A, while NELS results are reported in Panel B. First, looking at the OLS and PSM results (columns 1-3), the estimates for both datasets are consistent with the results reported in section 4—high school leaders earn more than their non-leader counterparts. In the model without fixed effects, for instance, the OLS estimates for both the HS&B and NELS samples indicate that high school leaders earn 9.6 percent more than their non-leader peers. When high school fixed effects are included in the regression, the point estimates on high school leadership increase in each dataset. Leaders in the HS&B sample are predicted to earn 13.3 percent more than their non-leader peers, while leaders from the NELS are predicted to earn 10.6 percent more than non-leaders. These results suggest that, with each dataset, failure to control for differences in high school characteristics leads to estimates that are biased downwards. For both samples, the evidence coming from the PSM approach also suggests that high school leadership has a positive impact on future earnings; however, the PSM estimates on high school leadership are somewhat lower than their corresponding OLS estimates. Similarly, consistent with the results reported in chapters II and III of this dissertation, the IV point estimate on high school leadership in the NELS dataset is much larger than the corresponding OLS and PSM estimates. The IV estimate in the NELS model is, in fact,

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[67] As in chapters II and III, school leadership opportunities are constructed by taking the number of leaders, excluding the student himself, divided by all of the individuals in a student's school.

[68] For a detailed discussion of the rationale for (and potential problems with) the use of these instruments, please see section 3 of chapter II.

more than three times the size the OLS and PSM estimates and suggests leaders in high school earn 32.2 percent more than their non-leader peers. This result corroborates the results reported in chapters II and III and indicates that the OLS and PSM estimates are biased downward.

In contrast to the NELS IV result, the IV estimate on high school leadership in the HS&B sample is large and negative. The IV estimate suggests that HS&B leaders actually earn 26.2 percent *less* than their non-leader peers. One potential explanation for this perplexing result is that the driving source of unobserved heterogeneity in the HS&B is not the bookworm attribute discussed previously, but is instead a characteristic like unobserved student motivation or ability that is biasing the OLS and PSM estimates upward. Recall, however, that these estimates reflect the impact of high school leadership on earnings, *unconditional on educational attainment*. In light of the large IV estimates reported in chapter II for the educational attainment outcomes; therefore, this explanation seems unlikely. The more probable explanation is that the instruments simply do not work as well with respect to earnings for this HS&B sample.

To investigate the validity of the instruments, the first stage IV results are reported Table IV.6. In both samples, the first stage F-statistic on the null hypothesis that the instruments can be excluded from the first stage equation is zero, indicating the instruments are sufficiently powerful predictors of high school leadership. In addition, I report the p-values on the Sargan-Hansen test of over-identifying restrictions. The joint null hypothesis for this test is that all but one of the instruments are uncorrelated with the error term and are therefore properly excluded from the outcome equation. The p-values are 0.2539 and 0.8793 for the HS&B and NELS, respectively. In both cases, the null hypothesis cannot be rejected at conventional confidence levels. Taken together, the evidence indicates that instruments are, in fact, valid.

Given the statistical validity of the instruments, the large negative coefficient in the HS&B sample remains somewhat puzzling. As discussed in chapter II, the school leadership opportunity variable will be valid, provided it is not correlated with unobserved school or student characteristics. Therefore, while the instruments pass the standard statistical tests, there may still be problems with them if these conditions are not met. In particular, if school opportunities are negatively correlated with unobserved school characteristics, the resulting IV estimates will be downward biased. Since the school leadership opportunity variable is a school-level variable, I am unable to control for high school fixed effects. I can, however, control for school characteristics similar to those used in chapters II and III. Table IV.7 reports alternative IV estimates from the HS&B. For comparison purposes, column (1) reports the estimate from Table IV.5. Column (2) presents the IV estimate from a model that includes the following school-level controls: public, Catholic, percent black, percent Hispanic, enrollment, and regional dummies. The IV estimate of -23.9 percent from this, more inclusive, model is less negative than the estimate reported in Table IV.5 (-26.2 percent). This result may suggest that the omitted school variables are leading to estimates that are biased downwards. However, the estimate remains large and negative. Columns (3) and (4) report estimates from specifications in which the only instrument is school leadership opportunities. Once again, this alternative specification has little impact on the IV estimate. Overall, the IV estimate on the HS&B remains somewhat of a puzzle and I leave this issue for future research.

5. Gender Differences

In this section, I explore gender differences in the return to high school leadership. I begin by estimating the KW analyses separately for men and women for each dataset. This provides a descriptive analysis that allows for comparisons of gender differences for each type of leadership activity. Then, using the empirical approaches of chapters II and III, I estimate the causal effects of high school leadership experience separately for men and women in both datasets.

Replication of KW separately by gender

Estimates for white men and women of the sophomore cohort of the HS&B are presented in Table IV.8. Looking at the base model, similar to the results for white men, the coefficients on each of the three leadership indicators for white women are positive. Compared with those of males, however, the female earnings premiums on high school leadership are somewhat lower. While this difference is quite small for those students who are "captain and president" (23 versus 22.4 for men and women, respectively), the difference is much larger for those students who are a "team captain only." Whereas the estimates suggest that males who were a "team captain only" in high school earn roughly 13.3 percent more than their non-leader peers, the corresponding estimate for women is only 8.5 percent and is not statistically different from zero. Similarly, female students who fall into the "president only" category appear to benefit to a lesser extent from their leadership skill than their male counterparts (12.8 versus 16.1 percent, respectively).

In contrast to those of males, once additional controls are included in the regression, the coefficients on the leadership indicators for females systematically decrease. In the final specification with education controls, in fact, the only leadership coefficient that remains statistically different from zero is that on the captain and president dummy. This result indicates that women who were both captain and president in high school earn roughly 14.6 percent more than their non-leader counterparts. In contrast to the base model, in which the male/female coefficients on “captain and president” are quite similar, the 14.6 percent estimate for women is more than 30 percent lower than the corresponding estimate for men (21.5 percent). Moreover, while the coefficients on both the “captain only” and “president only” indicators are positive, they are roughly half the magnitude of the corresponding male coefficients. Overall, while the evidence from the HS&B suggests that leadership skill is positively related to female earnings, compared to that of their male counterparts, the relationship between leadership skill and earnings in the HS&B appears to be weaker.

Next, I estimate equation (1) separately for white men and women of the NELS. As mentioned previously, the students of the NELS sample represent a cohort of students who were born exactly ten years before the students in the HS&B. This cross-cohort comparison allows me to evaluate the extent to which the gender pattern seen with the HS&B cohort has changed over time.

Results from the NELS sample are presented in Table IV.9. First, compared to the estimated impact of leadership in the HS&B sample, in each model specification, the estimated leadership earnings premiums for white men in the NELS sample are substantially lower. The point estimate on the “captain and president” dummy variable in the base model, for instance, is only 0.080. This estimate is more than 65 percent lower than the corresponding estimate of the impact of being “captain and president” on earnings in the HS&B (0.23). Similar trends are seen in the "captain only" and "president only" categories.

Turning to women, the results show that all three leadership indicators are statistically significant and positively correlated with earnings eight years later. The evidence from the base model indicates that women who were both team captain and club president in high school earn 21.2 percent more than their non-leader counterparts. This estimate is roughly one percent lower than that for the women of the HS&B (22.4). In contrast to the results for men, the estimated impacts of being only a team captain or a club president in the NELS sample are *larger* than the corresponding HS&B estimates. Whereas, in the base model, the earnings premium associated with serving as a team captain (but not president) is 12.8 percent for the HS&B, it is nearly 25 percent higher in the NELS. This cross-cohort trend persists across each model specification.

Interestingly, in the NELS sample, the gender patterns are remarkably different than those found in the HS&B sample. First consider the base model results. Whereas the estimated leadership premiums for men in the HS&B are larger than those of their female counterparts, in the NELS sample, the estimated leadership premium for women is over twice that of their male counterparts for each leadership dummy variable. This pattern persists across the model specifications. In the final specification, in fact, each of the female leadership indicators is larger in magnitude than that of their male counterparts. For instance, the results indicate that women who were both captain and president earn 9.5 percent more than their non-leader peers. The corresponding estimate for men is just 4.3 percent and is not statistically different from zero. A similar pattern is seen for the other two leadership indicators.

Overall, the descriptive evidence provided in this section leads to the following conclusions with respect to gender and cohort comparisons. First, in every case, leadership skill appears to be an important determinant of earnings for both men and women. Second, while the relative importance of leadership skill with respect to earnings appears to have fallen over time for men, for women who are either a captain or president, the benefit seems to have increased. Finally, while men appear to have benefited to a larger extent than their female counterparts in the HS&B, this gender trend reverses sign for the students of the NELS who were born ten years later.

Causal effects by gender

To assess whether the results can be interpreted as causal effects, I estimate the impact of any high school leadership on earnings separately by gender using OLS, PSM and IV. Results from each estimation approach and dataset are reported in Table IV.10. Results from the HS&B are reported in Panel A, while the NELS results are given in Panel B.

First, looking at the HS&B results, the gender trends mirror those found in the descriptive evidence above. With each econometric method, the point estimate on high school leadership for men is larger than the corresponding estimate for women. In the OLS models with fixed effects, for instance, the estimates imply that the return to high school leadership for men is almost twice the impact for women (17.9 versus 10.9 percent). Similarly, while the PSM estimate suggests men who were high school leaders earn 13 percent more than their non-leader peers; the corresponding estimate for women of the HS&B is actually negative and is not statistically different from zero. The IV results also suggest that the large, negative effects reported in the overall sample are being driven by the females of the HS&B. While, for both genders, the IV estimates are negative (and not statistically different from zero), the estimate for females is much more negative than the estimate for men (-43.9 versus -7.1).

Turning to the results from the NELS sample, the gender pattern reverses sign. With every econometric method, the estimates indicate that women of the NELS benefit from high school leadership to a larger extent than their male peers. The OLS model with fixed effects, for example, implies that women leaders earn almost 16 percent more than their non-leader peers. The corresponding estimate for men is about 9 percent. Similarly, both the PSM and IV estimates suggest that women of the NELS benefit more than their male counterparts. While the IV estimates are much larger than the corresponding OLS and PSM estimates and are not statistically different from zero, the gender difference is 5 percent, which is quite similar to the differences found with the alternative estimation methods.

Overall, the evidence from Table IV.10 is consistent with the results reported in Tables IV.8 and IV.9 -- while men appear to have benefited to a larger extent than their female counterparts in the HS&B, in the cohort of students born ten years later, women benefit more from their leadership experience.

6. Conclusion

In this chapter, I provide further evidence on the impact of high school leadership on post-schooling earnings. While smaller in magnitude, estimates from replication of the KW regression analysis with an alternative HS&B sample and the NELS sample, indicate that students who were high school leaders do, in fact, earn more than their non-leader peers. With one puzzling exception, the results coming from the empirical methods described in chapter II of this dissertation echo the KW regression results. Finally, while, compared with their female counterparts, men of the HS&B appear to benefit from their leadership experience to a larger extent; women of the NELS earn higher leadership premiums than their male peers. These results provide further evidence that high school leadership is an important determinant of a student's future labor market success. Moreover, the gender differentials suggest that one way to narrow wage gaps is to get more women involved in high school leadership positions.

While this essay provides only the second piece of economic evidence on the impact of high school leadership on later-life earnings and therefore represents a useful contribution to the literature, the study has a few shortfalls that should be noted. First, the estimates reported in this paper represent the effects of high school leadership on earnings eight to nine years after high school when the average age of student is roughly 26. Clearly, this point in the age-earnings profile is not the ideal point to test the impacts. For instance, many individuals are pursuing graduate degrees at this stage in their lives or have not yet settled on their permanent career path. Reported earnings may therefore not equal potential earnings.[69] Future research is needed to estimate the impact of high school leadership on earnings later in the lifecycle. Second, due to data limitations, the analysis in this essay has focused on log annual earnings rather than log wages. Restricting the analysis to full-time workers should help mitigate concerns arising from part-time or part-year earnings; however, this limitation should be addressed in the future. Finally, in this essay, I have estimated the impact of earnings conditional on employment. To the extent that high school leadership also increases the probability of employment, the unconditional impact of high school leadership on future earnings may be even larger

[69] This may also be one source of the puzzling IV result reported with HS&B sample.

than the estimates reported in this paper. Despite these limitations, the evidence presented in this essay suggests that high school leadership is an important determinant of post-schooling earnings and future research on this topic certainly seems warranted.

Table IV.1. Sample Means by Gender and Dataset

	HS&B				NELS		
	K&W Males[a]	Total	Males	Females	Total	Males	Females
Earnings							
Annual Earnings	$ 26,100	$ 23,310	$ 25,928	$ 20,393	$ 32,464	$ 36,164	$ 28,092
Leadership[b]							
Captain and President	0.121	0.122	0.126	0.118	0.095	0.104	0.085
Captain only	0.133	0.097	0.127	0.064	0.101	0.145	0.049
President only	0.222	0.256	0.224	0.292	0.264	0.190	0.352
Total Leadership	0.476	0.475	0.476	0.474	0.461	0.439	0.486
Membership[b]							
Team and Club	0.490	0.487	0.488	0.486	0.400	0.451	0.340
Team only	0.111	0.315	0.114	0.044	0.099	0.150	0.039
Club only	0.267	0.081	0.261	0.376	0.359	0.242	0.498
Total Participation	0.868	0.883	0.862	0.906	0.858	0.843	0.877
Math Score (percentile/100)	0.538	0.529	0.519	0.535	0.527	0.523	0.528
Educational Attainment							
High School	0.290	0.316	0.308	0.219	0.139	0.171	0.101
Some College	0.320	0.323	0.315	0.331	0.435	0.458	0.407
College degree or higher	0.390	0.412	0.377	0.450	0.426	0.370	0.492
Parents' Education							
High School[c]	0.601	0.602	0.596	0.608	0.466	0.496	0.490
College Degree[d]	0.326	0.316	0.318	0.315	0.447	0.475	0.471
Number of Schools	699	811	713	717	985	850	843
Sample Size	2,383	4,903	2,460	2,443	4,764	2,440	2,324

Notes:

a. Sample means from the sophomore cohort of the High School and Beyond sample in Kuhn and Weinberger (2005)
The column corresponds to column four of Table 1 in Kuhn and Weinberger (2005).

b. Leadership/membership in senior year of high school.

c. At least one parent is a high school graduate, but neither has a college degree.

d. At least one parent has a college degree.

Table IV.2. Mean Log Annual Earnings by Leadership Status and Gender

	HS&B			NELS		
	Total	Males	Females	Total	Males	Females
Earnings						
Annual Earnings (Overall)	$ 23,310	$ 25,928	$ 20,393	$ 32,464	$ 36,164	$ 28,092
Log Annual Earnings	9.955	10.077	9.833	10.279	10.401	10.151
Log Earnings by Leadership						
Neither Captain nor President	9.904	10.006	9.802	10.222	10.366	10.057
Captain only	10.086	10.173	9.921	10.394	10.428	10.292
President only	9.948	10.102	9.825	10.293	10.441	10.212
Captain and President	10.064	10.207	9.922	10.376	10.451	10.276
Captain or President	10.007	10.149	9.864	10.343	10.443	10.247
Number of Schools	811	713	717	985	850	843
Sample Size	4,903	2,460	2,443	4,764	2,440	2,324

Table IV.3. Replication of KW Table 3 HS&B OLS Regression Results: Impact of High School Leadership on Log Annual Earnings of White Males

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	KW	Replication	KW	Replication	KW	Replication	KW	Replication
Leadership								
Captain and President	0.236 **	0.230 **	0.224 **	0.221 **	0.231 **	0.230 **	0.221 **	0.215 **
	(0.055)	(0.054)	(0.055)	(0.054)	(0.056)	(0.054)	(0.056)	(0.054)
Captain only	0.114 *	0.133 *	0.106 *	0.126 *	0.111 *	0.130 **	0.109 *	0.122 *
	(0.048)	(0.047)	(0.048)	(0.047)	(0.048)	(0.047)	(0.048)	(0.047)
President only	0.174 **	0.161 **	0.163 **	0.154 **	0.167 **	0.157 **	0.165 **	0.149 **
	(0.038)	(0.037)	(0.038)	(0.037)	(0.038)	(0.037)	(0.039)	(0.037)
Membership								
Team and Club	0.050	0.062	0.014	0.037	0.017	0.040	0.017	0.031
	(0.051)	(0.050)	(0.051)	(0.049)	(0.051)	(0.049)	(0.051)	(0.050)
Team only	0.085	0.072	0.064	0.060	0.065	0.062	0.071	0.063
	(0.064)	(0.062)	(0.064)	(0.051)	(0.064)	(0.062)	(0.065)	(0.062)
Club only	-0.056	-0.047	-0.073	-0.058	-0.073	-0.057	-0.071	-0.054
	(0.053)	(0.052)	(0.052)	(0.051)	(0.053)	(0.051)	(0.053)	(0.052)
Math Score (percentile/100)			0.235 **	0.201 **	0.250 **	0.217 **	0.208 **	0.149 *
			(0.054)	(0.056)	(0.055)	(0.057)	(0.061)	(0.061)
Parents' Education					-0.071	-0.056	-0.060	-0.061
High School					(0.066)	(0.054)	(0.069)	(0.054)
					-0.102	-0.100	-0.101	-0.123 *
College Degree					(0.070)	(0.058)	(0.074)	(0.058)
Educational Attainment								
Some College							-0.033	-0.006
							(0.041)	(0.040)
College degree or higher							0.052	0.121 *
							(0.046)	(0.043)
Number of Schools	699	713	699	713	699	713	699	713
Sample Size	2,383	2,460	2,383	2,460	2,383	2,460	2,383	2,460
Adjusted R-squared	0.1890	0.1834	0.2010	0.1911	0.2010	0.1923	0.2030	0.2008

Notes:

a. All specifications include school fixed effects. Standard errors in parenthesis. ** and * denote statistical significance at the 1% and 5% level, respectively.

b. This sample includes men who were in grade 12 in 1982 who completed high school with annual earnings between $2,500 and $100,000 in 1991.

Table IV.4. OLS Estimates of the Impact of High School Leadership on Log Annual Earnings: Full Samples (both genders)[a,b]

	HS&B[c]				NELS[d]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Leadership								
Captain and President	0.197 **	0.179 **	0.175 **	0.155 **	0.127 **	0.090 *	0.086 *	0.057 *
	(0.036)	(0.035)	(0.036)	(0.036)	(0.029)	(0.028)	(0.029)	(0.028)
Captain only	0.098 *	0.084 *	0.083 *	0.074 *	0.074 *	0.058 *	0.055	0.039
	(0.035)	(0.034)	(0.034)	(0.034)	(0.030)	(0.030)	(0.030)	(0.031)
President only	0.129 **	0.110 **	0.108 **	0.091 **	0.120 **	0.093 **	0.092 **	0.074 **
	(0.025)	(0.025)	(0.025)	(0.025)	(0.020)	(0.020)	(0.020)	(0.020)
Membership								
Team and Club	0.077 *	0.039	0.038	0.022	0.117 **	0.095 **	0.092 **	0.060 *
	(0.038)	(0.037)	(0.037)	(0.038)	(0.029)	(0.029)	(0.028)	(0.029)
Team only	0.057	0.036	0.034	0.022	0.078 *	0.062	0.058	0.036
	(0.048)	(0.048)	(0.048)	(0.048)	(0.033)	(0.033)	(0.033)	(0.034)
Club only	-0.022	-0.042	-0.043	-0.044	0.033	0.009	0.008	-0.008
	(0.039)	(0.038)	(0.038)	(0.039)	(0.027)	(0.027)	(0.027)	(0.027)
Math Score (percentile/100)		0.309 **	0.301 **	0.201 **		0.278 **	0.269 **	0.157 **
		(0.041)	(0.042)	(0.044)		(0.031)	(0.031)	(0.032)
Parents' Education								
High School			0.032	0.020			0.055	0.049
			(0.040)	(0.040)			(0.045)	(0.045)
College Degree			0.050	0.006			0.069	0.039
			(0.045)	(0.045)			(0.046)	(0.046)
Educational Attainment								
Some College				0.020				0.004
				(0.027)				(0.025)
College degree or higher				0.182 **				0.188 **
				(0.030)				(0.031)
Number of Schools	811	811	811	811	985	985	985	985
Sample Size	4,903	4,903	4,903	4,903	4764	4764	4764	4764
Adjusted R-squared	0.3188	0.3334	0.3335	0.346	0.3805	0.3981	0.3991	0.4174

Notes:

a. All specifications include school fixed effects and male dummy indicator.

b. Standard errors are clustered at schoo level and given in parenthesis. ** and * denote statistical significance at the 1% and 5% level, respectively.

c. This sample includes white men and women who were in grade 12 in 1982 who completed high school with annual earnings between $2,500 and $100,000 in 1991.

d. This sample includes white men and women who were in grade 12 in 1992 who completed high school with annual earnings in 2000 between $2,500 and $100,000 (1991 dollars).

Table IV.5. OLS, PSM and IV Estimates of the Impact of High School Leadership on Log Annual Earnings[a,b]

	OLS w/o FE	OLS w/ FE	PSM	IV
A. HS&B[c]				
High School Leadership	0.096 ***	0.133 ***	0.069 **	-0.262 *
	(0.019)	(0.020)	(0.022)	(0.137)
Adjusted R-squared	*0.0996*	*0.3293*		
F-Statistic (p-value)				*0.0000*
Sargan Statistic (p-value)				*0.2539*
B. NELS[d]				
High School Leadership	0.096 ***	0.106 ***	0.080 **	0.322 *
	(0.016)	(0.016)	(0.030)	(0.185)
Adjusted R-squared	*0.0719*	*0.3951*		
F-Statistic (p-value)				*0.0000*
Sargan Statistic (p-value)				*0.8066*

Notes:

a. All specifications include controls for male, math score and parents' education.

b. Standard errors are clustered at school level and given in parenthesis. ***,** and * denote statistical significance at the 1%, 5% , and 10% level, respectively.

c. This sample includes men and women who were in grade 12 in 1982 who completed high school with annual earnings between $2,500 and $100,000 in 1991. Sample includes 4,903 students in 811 schools.
IV sample includes 4,141 students in 769 schools.

d. This sample includes men and women who were in grade 12 in 1992 who completed high school with annual earnings in 2000 between $2,500 and $100,000 (1991 dollars). Sample includes 4,764 students in 985 schools.
IV sample includes 4,621 students in 949 schools.

Table IV.6. First Stage IV Results[a]

	HS&B[b]	NELS[c]
School Leadership Opportunities	0.389 **	0.289 **
	(0.046)	(0.056)
Twin	0.102	0.020
	(0.093)	(0.046)
Oldest Child	0.047	-0.002
	(0.025)	(0.018)
Twin*Oldest Child	-0.182	0.181 *
	(0.235)	(0.088)
Number of Schools	769	949
Sample Size	4,141	4,621
F-Statistic	18.90	8.35
F-Statistic p-value	0.0000	0.0000
Sargan Statistic (p-value)	0.2539	0.8793

Notes:

a. All specifications include controls for male, math score and parents' education. Standard errors in parenthesis. ** and * denote statistical significance at the 1% and 5% level, respectively.

b. This sample includes men and women who were in grade 12 in 1982 who completed high school with annual earnings between $2,500 and $100,000 in 1991.

c. This sample includes men and women who were in grade 12 in 1992 who completed high school with annual earnings in 2000 between $2,500 and $100,000 (1991 dollars).

Table IV.7. Alternative IV Estimates of the Impact of High School Leadership on Log Annual Earnings in the HS&B[a,b,c]

	(1)	(2)	(3)	(4)
High School Leadership	-0.262 *	-0.239	-0.286 *	-0.286
	(0.137)	(0.227)	(0.142)	(0.246)
F-Statistic	18.90	6.600	71.53	23.67
F-Statistic (p-value)	0.0000	0.0000	0.0000	0.0000
Sargan Statistic (p-value)	0.2539	0.2136	n/a	n/a
School Controls[d]	No	Yes	No	Yes
Instruments:				
School Leadership opportunities	X	X	X	X
Twin	X	X		
Oldest Child	X	X		
Twin*Oldest Child	X	X		

Notes:

a. All specifications include controls for male, math score and parents' education.

b. Standard errors are clustered at school level and given in parenthesis. ***,** and * denote statistical significance at the 1%, 5% , and 10% level, respectively.

c. This sample includes men and women who were in grade 12 in 1982 who completed high school with annual earnings between $2,500 and $100,000 in 1991.

d. School controls include public, catholic, percent black, percent hispanic, enrollment and region.

Table IV.8. OLS Estimates of the Impact of High School Leadership on Log Annual Earnings by Gender: HS&B

	(1)		(2)		(3)		(4)	
	Males	Females	Males	Females	Males	Females	Males	Females
Leadership								
Captain and President	0.230 **	0.224 **	0.221 **	0.196 **	0.230 **	0.176 *	0.215 **	0.146 *
	(0.054)	(0.059)	(0.054)	(0.058)	(0.054)	(0.058)	(0.054)	(0.057)
Captain only	0.133 *	0.085	0.126 *	0.069	0.130 **	0.064	0.122 *	0.067
	(0.047)	(0.059)	(0.047)	(0.057)	(0.047)	(0.057)	(0.047)	(0.056)
President only	0.161 **	0.128 *	0.154 **	0.102 *	0.157 **	0.093 *	0.149 **	0.064
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.036)
Membership								
Team and Club	0.062	0.000	0.037	-0.032	0.040	-0.047	0.031	-0.089
	(0.050)	(0.064)	(0.049)	(0.064)	(0.049)	(0.064)	(0.050)	(0.063)
Team only	0.072	0.052	0.060	0.031	0.062	0.014	0.063	-0.039
	(0.062)	(0.085)	(0.051)	(0.085)	(0.062)	(0.064)	(0.062)	(0.085)
Club only	-0.047	-0.074	-0.058	-0.093	-0.057	-0.104	-0.054	-0.123
	(0.052)	(0.064)	(0.051)	(0.064)	(0.051)	(0.065)	(0.052)	(0.064)
Math Score (percentile/100)			0.201 **	0.303 **	0.217 **	0.262 **	0.149 *	0.115
			(0.056)	(0.066)	(0.057)	(0.066)	(0.061)	(0.069)
Parents' Education								
High School					-0.056	0.086	-0.061	0.065
					(0.054)	(0.064)	(0.054)	(0.062)
College Degree					-0.100	0.180	-0.123 *	0.106
					(0.058)	(0.067)	(0.058)	(0.066)
Educational Attainment								
Some College							-0.006	0.066
							(0.040)	(0.044)
College degree or higher							0.121 *	0.280 **
							(0.043)	(0.049)
Number of Schools	713	717	713	717	713	717	713	717
Sample Size	2,460	2,443	2,460	2,443	2,460	2,443	2,460	2,443
Adjusted R-squared	0.1834	0.2051	0.1911	0.2200	0.1923	0.2250	0.2008	0.2509

Notes:

a. All specifications include school fixed effects. ** and * denote statistical significance at the 1% and 5% level, respectively.

b. This sample includes men and women who were in grade 12 in 1982 who completed high school with annual earnings between $2,500 and $100,000 in 1992.

Table IV.9. OLS Estimates of the Impact of High School Leadership on Log Annual Earnings by Gender: NELS

	(1)		(2)		(3)		(4)	
	Males	Females	Males	Females	Males	Females	Males	Females
Leadership								
Captain and President	0.080 *	0.212 **	0.058	0.151 **	0.057	0.145 **	0.043	0.094 *
	(0.040)	(0.047)	(0.039)	(0.045)	(0.039)	(0.045)	(0.040)	(0.046)
Captain only	0.076	0.162 *	0.068	0.137 *	0.067	0.134 *	0.062	0.110
	(0.041)	(0.060)	(0.040)	(0.056)	(0.041)	(0.056)	(0.041)	(0.057)
President only	0.088 *	0.170 **	0.078 *	0.126 **	0.079 *	0.126 **	0.076 *	0.084 *
	(0.033)	(0.028)	(0.033)	(0.027)	(0.033)	(0.027)	(0.032)	(0.027)
Membership								
Team and Club	0.084 *	0.172 **	0.069	0.132 *	0.068	0.132 *	0.050	0.077
	(0.035)	(0.050)	(0.036)	(0.047)	(0.036)	(0.047)	(0.036)	(0.049)
Team only	0.075	0.172	0.061	0.079	0.060	0.079	0.048	-0.009
	(0.044)	(0.070)	(0.044)	(0.066)	(0.044)	(0.066)	(0.044)	(0.062)
Club only	0.023	0.060	0.004	0.019	0.004	0.019	-0.002	-0.009
	(0.038)	(0.046)	(0.039)	(0.043)	(0.039)	(0.050)	(0.038)	(0.045)
Math Score (percentile/100)			0.186 **	0.413 **	0.182 **	0.394 **	0.124 *	0.234 **
			(0.044)	(0.050)	(0.044)	(0.050)	(0.048)	(0.056)
Parents' Education								
High School					0.024	0.050	0.029	0.028
					(0.084)	(0.057)	(0.085)	(0.055)
College Degree					0.026	0.090	0.017	0.040
					(0.085)	(0.057)	(0.086)	(0.057)
Educational Attainment								
Some College							-0.034	0.107 *
							(0.033)	(0.050)
College degree or higher							0.091 *	0.319 **
							(0.041)	(0.060)
Number of Schools	816	796	816	796	816	796	816	796
Sample Size	2,440	2,324	2,440	2,324	2,440	2,324	2,440	2,324
Adjusted R-squared	0.4309	0.4872	0.4380	0.5187	0.4378	0.5205	0.4449	0.5468

Notes:

a. All specifications include school fixed effects. Clustered (school-level) standard errors are in parenthesis. ** and * denote statistical significance at the 1% and 5% level, respectively.

b. This sample includes white men and women who were in grade 12 in 1992 who completed high school with annual earnings between $2,500 and $100,000 in 1999 (1991 dollars).

Table IV.10. OLS, PSM and IV Estimates of the Impact of High School Leadership on Log Annual Earnings by Gender[a]

	OLS w/o FE	OLS w/ FE	PSM	IV[f,g]
A. HS&B				
Men[b]	0.140 **	0.179 **	0.134 **	-0.071
	(0.024)	(0.029)	(0.029)	(0.173)
Women[c]	0.042	0.109 **	-0.017 **	-0.439 *
	(0.028)	(0.032)	(0.032)	(0.205)
B. NELS				
Men[d]	0.071 *	0.089 **	0.067 *	0.257
	(0.024)	(0.026)	(0.024)	(0.247)
Women[e]	0.118 **	0.157 **	0.111 **	0.303
	(0.022)	(0.023)	(0.028)	(0.245)

Notes:

a. ** and * denote statistical significance at the 1% and 5% level, respectively. All specifications include controls for math score and parents' education.

b. This sample includes white men who were in grade 12 in 1982 who completed high school with annual earnings between $2,500 and $100,000 in 1992. N= 2,460. Number of schools= 713.

c. This sample includes white women who were in grade 12 in 1982 who completed high school with annual earnings between $2,500 and $100,000 in 1992. N= 2,443. Number of schools= 717.

d. This sample includes white men who were in grade 12 in 1992 who completed high school with annual earnings between $2,500 and $100,000 in 1992 dollars. N= 2,440. Number of schools= 816.

e. This sample includes white women who were in grade 12 in 1992 who completed high school with annual earnings between $2,500 and $100,000 in 1992 dollars. N= 2,443. Number of schools= 717.

f. HS&B instruments include twin, oldest child, twin*oldest child, average leadership opportunites per school. For men, N= 2,028 and number of schools = 656. F-statistic p-value= 0.000 and Sargan pvalue= 0.5538. For women, N= 2,113 and number of schools= 678. F-statistic p-value= 0.000. Sargan p-value= 0.3931.

g. NELS instruments include twin, oldest child, twin*oldest child, average leadership opportunites per school. For men, N= 2,380 and number of schools = 799. F-statistic p-value= 0.006 and Sargan pvalue= 0.8865. For women, N= 2,241 and number of schools= 775. F-statistic p-value= 0.0053. Sargan p-value= 0.6390.

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APPENDIX A: CHAPTER II DATA DETAIL

Table A1. Activities Used to Construct Chapter II Leadership Variable[a]

A. 10th grade Leadership

Sports:
Baseball/Softball
Basketball
Football
Soccer
Swim Team
Other team sport
Other individual sport
Cheerleading
Pom-pom, drill team

Potential Responses:	
1	School does not have
2	Did not participate
3	Intramural sports
4	JV
5	Varsity
6	**Captain/Co-captain**

Other Activities:
School play or musical
Student government
NHS or other academic honor society
School yearbook, newspaper, or literary magazine
Service clubs (AFS, Key Club)
Academic club
Hobby club
FTA, FHA, or FFA or other vocation education or professional club

Potential Responses:	
1	Does not offer
2	Does not participate
3	Participated
4	**Participated Officer**

B. 12 Grade Leadership

Interscholastic sports:
Team sport at school
Individual sport at school
Cheer/Pompom

Potential Responses	
1	School does not have
2	Did not participate
3	Intramural sports
4	JV
5	Varsity
6	**Captain/Co-captain**

Other activities:
Band, orchestra, chorus or other music group
Drama, school play, or musical
Student government
NHS, other academic society
School yearbook, newspaper, or literary magazine
Service clubs
Academic clubs
Hobby clubs
FTA, FHA, FFA or other vocational education or professional club
Intramural team sport
Intramural individual sport

Potential Responses	
1	Does not offer
2	Does not participate
3	Participated
4	**Participated Officer**

Elected officer of school class

Potential Responses	
1	**Yes**
2	No

Notes:
a. An individual is considered to be a high school leader if he gave a bolded response to a question regarding his participation in any of the above listed activities.

Table A2. Construction of Chapter II Analysis Dataset

	Number of Observations[a]	Number of Observations Lost[b]	Percent of Sample Retained
Total Sample	12,144		100.00%
Variables			
Leadership	11,665	479	96.06%
Years of Education	11,552	113	95.13%
College Graduate	11,552	0	95.13%
Any Post-Secondary Education	11,552	0	95.13%
Male	11,552	0	95.13%
Black	11,552	0	95.13%
Hispanic	11,552	0	95.13%
Age	11,449	103	94.28%
High School math score	11,036	413	90.88%
8th grade math score	11,036	0	90.88%
High School socioeconomic status	10,936	100	90.05%
8th grade socioeconomic status	10,936	0	90.05%
High school family income	10,576	360	87.09%
8th grade family income	10,576	0	87.09%
High school enrollment	10,540	36	86.79%
Public high school	10,378	162	85.46%
Catholic high school	10,362	16	85.33%
% free lunch in high school	10,261	101	84.49%
% Black in high school	10,207	54	84.05%
% Hispanic in High School	10,204	3	84.03%
Northeast	10,204	0	84.03%
Midwest	10,204	0	84.03%
West	10,204	0	84.03%
High school: popular	10,066	138	82.89%
8th grade: popular	10,066	0	82.89%
High school: athletic	10,059	7	82.83%
8th grade: athletic	10,059	0	82.83%
High school: locus of control	10,006	53	82.39%
8th grade: locus of control	10,006	0	82.39%
Twin	10,006	0	82.39%
Eldest child	10,006	0	82.39%
% Peer leaders	9,665	341	79.59%

Notes:

a. Denotes the number of students left in sample after dropping students with missing values for any previous variable.

b. Denotes the number of students dropped due to missing value of variable.

Table A3. Outcome Summary Statistics by Leadership Status: Full Sample Versus Analysis Dataset (Chapter II)

	Years of Education	College Graduate	Any Post-Secondary
Full Dataset (N= 11,552)[a]			
Leader	14.899	0.495	0.901
Non-Leader	13.903	0.249	0.749
Difference	0.996 ***	0.246 ***	0.151 ***
Analysis Dataset (N=9,665)			
Leader	14.968	0.514	0.911
Non-Leader	13.994	0.262	0.763
Difference	0.974 ***	0.253 ***	0.148 ***
Difference-in-Difference	0.022	-0.006	0.004

Table A4. Chapter II Variable Definitions

Variable	Definition
Outcomes:	
Years of Education	Total years of education
Any Post-Secondary Education	Equal to 1 if r attended any post-secondary institution
College Graduate	Equal to 1 if r graduated from college
Controls:	
Male	Equal to 1 if r is male
Black	Equal to 1 if r is black
Hispanic	Equal to 1 if r is Hispanic
Age (years)	Age in years
8th grade socioeconomic status	Indice for r's family socioeconomic status in 8th grade
High school socioeconomic status[a]	Indice for r's family socioeconomic status in high school
8th grade family income	Indice for r's family income in 8th grade
High school family income	Indice for r's family income in high school
High school enrollment	Equal to r's high school class enrollment size
Public high school	Equal to 1 if r's high school is public.
Catholic high school	Equal to 1 if r's high school is Catholic
Private (non-Catholic) high school	Equal to 1 if r's high school is private non-Catholic
% free lunch in high school	Percentage of students in r's high school who receive free lunch
% Black in high school	Percentage of students in r's high school who are black
% Hispanic in high school	Percentage of students in r's high school who are Hispanic
High school math score[b]	R's standardized math test score percentile
8th grade math score	R's 8th grade standardized test score percentile
8th grade: athletic	Equal to 1 if r reports himself as "very athletic" in 8th grade
High school: athletic	Equal to 1 if r reports himself as "very athletic" in high school
8th grade: popular	Equal to 1 if r reports himself as "very popular" in 8th grade
High school: popular	Equal to 1 if r reports himself as "very popular" in high school
8th grade: locus of control	Indice for r's locus of control in 8th grade
High school: locus of control	Indice for r's locus of control in high school
Northeast	Equal to 1 if r lives in northeast
Midwest	Equal to 1 if r lives midwest
West	Equal to 1 if r lives in the west
South	Equal to 1 if r lives in the south
Instruments:	
School Leadership Opportunities	Equal to the proportion of r's classmates (other sampled students) who are leaders.
Twin	Equal to 1 if r is a twin
Oldest Child	Equal to 1 if r is oldest child
Twin*Oldest Child	Equal to 1 if r is twin and oldest child

Notes:

a. All high school variables taken from 12th grade survey. If missing, variable is replaced with 10th grade variable.

b. Math scores percentiles are from exams administered by the survey. Percentiles are divided by ten so that the deviation is approximately equal to one.

c. Locus of control is a composite measure created by the NELS. The indice reflects whether a student is more internal , meaning he believes his actions impact his outcomes. A student with an low locus of control is said to be external, meaning he believes someone or something else controls his outcomes.

APPENDIX B. CHAPTER III DATA DETAIL

Table B1. Activities Used to Construct Chapter III Leadership Variables[a]

A. School Sponsored Activities:

Sports:
Varsity Sport
Other Sport
Cheer/Pom-pom

Potential Response	
1	Haven't participated
2	Participated actively
3	Participated leader

Other Activities:
Band, orchestra, chorus or other music group
Drama, school play, or musical
Student Government
NHS or other academic society
School yearbook, newspaper or literary magazine
Service club
Academic club
Hobby Club
Vocational Education Club, Junior Achievement

B. Non-School Sponsored Activities[b]:
Youth community organizations
Church activities
Service clubs and community service activities
Sororities, fraternities

Potential Response	
1	Haven't participated
2	Participated actively
3	Participated leader

Notes:
a. In main analyses, an individual is considered a high school leader if he participated as a leader in a school sponsored activity.
b. Non-school sponsored activities are used in sensitivity analyses.

Table B2. Construction of Chapter III Analysis Dataset

	Number of Observations[a]	Number of Observations Lost[b]	Percent of Sample Retained
Total Sample	14,825		100.00%
Variables			
Leadership	11,341	3,484	76.50%
Years of Education	10,384	957	70.04%
College Graduate	10,384	0	70.04%
Any Post-Secondary Education	10,384	0	70.04%
Male	10,384	0	70.04%
Black	10,384	0	70.04%
Hispanic	10,384	0	70.04%
Age	9,261	1,123	62.47%
Math Score	9,261	0	62.47%
Socioeconomic Status	9,261	0	62.47%
Family Income	9,261	0	62.47%
High School Enrollment	8,663	598	58.44%
Public High School	8,663	0	58.44%
Catholic High School	8,663	0	58.44%
% Black in High School	8,368	295	56.45%
%Hispanic in High School	8,327	41	56.17%
Northeast	8,327	0	56.17%
Midwest	8,327	0	56.17%
West	8,327	0	56.17%
Popular	8,294	33	55.95%
Athletic	8,292	2	55.93%
Locus of Control	8,189	103	55.24%
Twin	8,189	0	55.24%
Eldest Child	7,200	989	48.57%
% Peer Leaders	7,198	2	48.55%

Notes:

a. Denotes the number of students left in the sample after dropping students with missing values for any previous variable.

b. Denotes the number of students dropped due to missing value of variable.

Table B3. Outcome Summary Statistics by Leadership Status: Full Sample Versus Analysis Dataset (Chapter III)

	Years of Education	Any Post-Secondary	College Graduate
Full Dataset (N= 10,384)[a]			
Leader	14.780	0.832	0.479
Non-Leader	14.087	0.707	0.312
Difference	0.694 **	0.125 **	0.167 **
Analysis Dataset (N= 7,198)			
Leader	14.851	0.844	0.497
Non-Leader	14.172	0.723	0.336
Difference	0.679 **	0.122 **	0.161 **
Difference-in-Difference	0.015	0.003	0.006
Dropped Observations (N= 3,186)			
Leader	14.605	0.800	0.435
Non-Leader	13.905	0.673	0.261
Difference	0.699 **	0.127 **	0.174 **

Note:
a. "Full dataset" includes all students for whom leadership and education are observed.

Table B4. Chapter III Variable Definitions

Variable	Definition
Outcomes:	
Years of Education	Total years of education
Any Post-Secondary Education	Equal to 1 if r attended any post-secondary institution
College Graduate	Equal to 1 if r graduated from college
Controls:	
Male	Equal to 1 if r is male
Black	Equal to 1 if r is black
Hispanic	Equal to 1 if r is Hispanic
Age (years)	Age in years
Socioeconomic status[a]	Indice for r's family socioeconomic status in high school
Family income	Indice for r's family income in high school
High school enrollment	Equal to r's high school enrollment size
Public high school	Equal to 1 if r's high school is public.
Catholic high school	Equal to 1 if r's high school is Catholic
Private (non-Catholic) high school	Equal to 1 if r's high school is private non-Catholic
% Black in high school	Percentage of students in r's high school who are black
% Hispanic in high school	Percentage of students in r's high school who are Hispanic
Math score[b]	R's standardized math test score percentile
Athletic	Equal to 1 if r reports himself as "very athletic" in high school
Popular	Equal to 1 if r reports himself as "very popular" in high school
Locus of control	Indice for r's locus of control in high school
Northeast	Equal to 1 if r lives in northeast
Midwest	Equal to 1 if r lives midwest
West	Equal to 1 if r lives in the west
South	Equal to 1 if r lives in the south
Instruments:	
School Leadership Opportunities	Equal to the proportion of r's classmates (other sampled students) who are leaders.
Twin	Equal to 1 if r is a twin
Oldest Child	Equal to 1 if r is oldest child
Twin*Oldest Child	Equal to 1 if r is twin and oldest child

Notes:

a. All high school variables taken from 12th grade survey. If missing, variable is replaced with 10th grade variable.

b. Math scores percentiles are calculated from exam scores taken on math exam administered by the survey. Percentiles are divided by ten so that the deviation is approximately equal to one.

c. Locus of control is a composite measure created by the HS&B. The indice reflects whether a student is more internal , meaning he believes his actions impact his outcomes. A student with an low locus of control is said to be external, meaning he believes someone or something else controls his outcomes.

APPENDIX C. CHAPTER IV DATA DETAIL

Table C1. Activities Used to Construct Chapter IV Leadership Variables[a]

A. HS&B

Sports:
Varsity Sport
Other Sport
Cheer/Pom-pom

Potential Response	
1	Haven't participated
2	Participated actively
3	**Participated leader**

Other Activities:
Band, orchestra, chorus or other music group
Drama, school play, or musical
Student Government
NHS or other academic society
School yearbook, newspaper or literary magazine
Service club
Academic club
Hobby Club
Vocational Education Club, Junior Achievement
Youth community organizations
Church activities
Service clubs and community service activities
Sororities, fraternities

B. NELS

Interscholastic sports:
Team sport at school
Individual sport at school
Cheer/Pompom

Potential Responses	
1	School does not have
2	Did not participate
3	Intramural sports
4	JV
5	Varsity
6	**Captain/Co-captain**

Other activities:
Band, orchestra, chorus or other music group
Drama, school play, or musical
Student government
NHS, other academic society
School yearbook, newspaper, or literary magazine
Service clubs
Academic clubs
Hobby clubs
FTA, FHA, FFA or other vocational education or professional club
Intramural team sport
Intramural individual sport

Potential Responses	
1	Does not offer
2	Does not participate
3	Participated
4	**Participated Officer**

Notes:
a. An individual is considered to be a high school leader if he gave a bolded response to a question regarding his participation in any of the above listed activities.

Table C2. Construction of Chapter IV Analysis Datasets

Selection Criteria	Number of Observations[a]	Number of Observations Lost[b]	Percent of Sample Retained
A. HS&B			
Total Sample	14,825		100.00%
Criteria:			
White	9,137	5,688	61.63%
Not High School Dropout	8,693	444	58.64%
Working and $2,500 < Earnings < $100,000	6,401	2,292	43.18%
Leader Observed	5,408	993	36.48%
Math Score Observed	5,183	225	34.96%
School ID Observed	5,183	0	34.96%
Weighted Observations	4,903	280	33.07%
B. NELS			
Total Sample	12,144		100.00%
Criteria:			
White	8,264	3,880	68.05%
Not High School Dropout	7,905	359	65.09%
Working and $2,500 < Earnings < $100,000[c]	5,837	2,068	48.06%
Leader Observed	5,458	379	44.94%
Math Score Observed	5,148	310	42.39%
School ID Observed	4,953	195	40.79%
Weighted Observations	4,764	189	39.23%

Notes:

a. Denotes the number of students left in the sample after dropping students based on criteria in column one.

b. Denotes the number of students dropped due to criteria in column one.

c. 1991 dollars

APPENDIX D: PROPENSITY SCORE MATCHING DETAIL

Propensity score matching (PSM) is a non-parametric econometric approach used to recover the causal impact of a treatment based on selection on observable characteristics. Commonly used in the program evaluation literature, matching is arguably an improvement over ordinary least squares (OLS) estimation because it is not constrained by the assumption that the treatment effect is linearly related to the outcome and, unlike OLS, by matching each treated observation with an untreated counterpart, the researcher can explicitly test whether there is sufficient overlap between the two groups. Matching methods have been shown to perform well when researchers have a rich dataset and when outcomes of control and treated groups are measured in an identical fashion.[70]

Despite being widely applied across many disciplines, there is little consensus regarding the empirical implementation of PSM. Implementation issues, discussed at length in Caliendo & Kopeinig (2008), include the method and choice of variables included in the estimation of the propensity score, the choice of matching method, selection of the areas of common support, and estimation of the standard errors. Given the lack of consensus and the possibility that different choices may yield different results, it is important to evaluate the relative sensitivity of reported estimates to alternative implementation methods.

In this appendix, I discuss the propensity score matching method in greater detail. I begin by describing the primary parameter of interest and discussing the main assumptions underlying the credibility of the matching approach. Then, I discuss key implementation issues and re-visit PSM estimates of the impact of high school leadership

[70] See, for instance, Heckman, Ichimura and Todd (1997, 1998), Heckman et al. (1998), and Diaz and Handa (2006).

on subsequent educational attainment as reported in chapter II. I first test the sensitivity of the estimates to alternative propensity score model specifications and estimation methods. Then, I test the sensitivity of the PSM estimates to alternative matching approaches. Finally, I describe and implement the Rosenbaum Bounds Method, a method that tests the relative sensitivity of PSM estimates to the presence of unobserved heterogeneity.

Propensity score matching and identification of the treatment effect

The treatment effect that has received the most interest in the program evaluation literature and is most commonly estimated using PSM is the *average effect of treatment on the treated*, or the ATT. In this context, this parameter represents the average effect of high school leadership (the treatment) on the outcome of those students who undertook a leadership position in high school (the treated). Formally, the ATT is defined as follows:

$$ATT = E[y_{1i} - y_{0i} \mid L_i = 1] = E[y_{1i} \mid L_i = 1] - E[y_{0i} \mid L_i = 1]. \qquad \text{(D1)}$$

The problem that naturally arises in this context is that the counterfactual, $E[y_{0i} \mid L_i = 1]$, is not observed. Subsequently, the counterfactual, y_{0i}, must be constructed. The basic idea underlying the matching methodology can be described as follows. For each treated individual, find an untreated individual, or group of untreated individuals, who are observationally equivalent across a number of covariates, X_i. Then, the observed outcome of these individuals can be used as the counterfactual for the treated individual.

The credibility of using matching approaches to recover causal effects relies on two assumptions. The first assumption for identification of the ATT using a matching approach is the assumption of common support. The common support assumption says that for every set of characteristics, X_i, there exists both a treated and untreated student, or there is sufficient overlap between the leaders and non-leaders. Formally, the common support condition states $0 < \Pr[L_i = 1 | X_i] < 1$. It is important to note that this assumption explicitly rules out perfect predictability of leadership given X_i. Second, the researcher must maintain the assumption of conditional independence. The conditional independence assumption (CIA) states that conditional on the observed covariates, X_i, the outcome of the non-treated individual is independent of the treatment. Formally, the CIA states that $(y_{1i}, y_{0i}) \perp L_i \mid X_i$.

When there are a large number of observable characteristics, it becomes increasingly difficult to find an exact match for each treated individual. This problem, commonly known as the dimensionality problem, is addressed through the use of matching on the propensity score. The propensity score is defined as the probability of treatment conditional on observed characteristics, X_i. Formally, the propensity score is defined as $p(X_i) = pr(L_i = 1 | X_i)$. Rosenbaum and Rubin (1983) show that if CIA holds such that y_0 is independent of L_i given the covariates X_i, then it is also independent of the propensity score. That is, if $(y_1, y_0) \perp L_i \mid X_i$, then $(y_1, y_0) \perp L_i \mid p(X_i)$. Rather than using exact matching, matching can therefore be done on the propensity score without violation of CIA. Provided the variables included in the calculation of the leadership probability properly control for all differences between the leader and non-leader in a matched pair, the CIA holds and the resulting PSM estimate is an unbiased estimate of the causal effect.

Estimating the propensity score

The first step of implementing PSM is to estimate the propensity score. When estimating the propensity score, the researcher faces two issues: (1) choice of first-stage estimation method and (2) selection of variables to be included in the propensity score model.

The first issue is somewhat less critical. As Caliendo & Kopeinig (2008) argue, in the case of a simple binary treatment variable, any discrete choice model can be used to estimate the propensity score in the first stage. Since the purpose of the first stage is classification, the choice of model isn't likely to be a critical one. Logit and Probit models, for instance, are likely to yield similar predictions. In chapter II, the propensity score is estimated using a Probit model in the first stage. In this appendix, I test the sensitivity of the reported chapter II estimates to the choice of the first-stage model by re-estimate the effects using a Logit model in the first stage. Results from this exercise are reported in Table D.1. The original results (from chapter II, Table II.3, model 2) are reported in the first column. The corresponding Logit results are given in column 2. With each outcome, the estimates coming from the Logit model are somewhat lower than the estimates reported in chapter II. However, in each case, the impact of high school leadership on educational attainment remains quite large and is statistically significant at the one percent level.

The second step in the implementation of PSM involves the choice of conditioning variables. As discussed above, the key identifying assumption of PSM is that conditional on a set of variables, X , the treatment assignment can be considered ignorable. The variables included in the propensity score equation must therefore plausibly satisfy this condition. As discussed by Caliendo and Kopeinig (2005), the chosen variables should simultaneously affect both the assignment to treatment and the outcome of interest and should be selected based on economic theory or knowledge of the previous research. Research by Heckman and other economists in the evaluation literature has shown that the method performs relatively better when there are a rich set of controls included in the propensity score equation.[71] To illustrate the impact of increasing the number of control variables, I begin by matching students on basic demographic controls (gender, race and age). Then, one at a time, I add controls for family background, school quality, region, and math ability. Finally, I add the potentially endogenous controls (popularity, athletic ability and locus of control). Results of this exercise are reported in Table D.2. From the table, it is apparent that the choice of conditioning variables has a significant impact on the estimates. With each outcome, up until math ability is included, the estimates continually decrease after each additional set of controls is included. However, when controls for popularity, athletic ability, and locus of control are included in the conditioning set, the estimates actually increase.

With any valid matching procedure, the matched sample should be "balanced" in the sense that the differences in covariate means observed in the unmatched sample are no longer evident in the matched sample. Perfect matching on the propensity score therefore eliminates any bias arising from the differences in observed covariates. Figure 1 compares the covariate bias present before and after matching on all of the observed

[71] See, for instance, Heckman, Ichimura and Todd (1997, 1998), Heckman et al. (1998) and Diaz and Handa (2006).

characteristics.[72] It illustrates that matching on the propensity score in chapter II is successful in balancing the covariates. The matched sample, for example, reduces high school math score bias present in the raw data by nearly 50%. Similarly, covariate bias is significantly reduced across all other variables. This is illustrated by the fact that compared with the unmatched sample bias curve, the bias curves of the matched sample is relatively flat, fluctuating slightly around the zero axis.

To further investigate the impact of conditioning variables; Figure 2 illustrates the subsequent reduction in covariate bias after conditioning on the potentially endogenous variables: popularity, athletic ability and locus of control. The two lines reflect the covariate bias present before and after the additional controls are added to the first-stage Probit model. From the figure, it is apparent that for the majority of the variables, the covariate bias is reduced when students are matched on a wider range of characteristics. This is reflected by the fact that the trend line of the richer model fluctuates closer around the zero axis, while the trend lines of less rich model is more variable and is reflective of larger covariate bias among the leaders and non-leaders. The larger PSM estimates from the more inclusive model (Model 2) are therefore likely less biased and are preferred over the Model 1 estimates.

Matching Methods

[72] Percent bias is calculated as follows:

$$\%Bias = \frac{100(\overline{X}_T - \overline{X}_U)}{\sqrt{(s_T^2 + s_U^2)/2}}$$

where $\overline{X}_T$ and $\overline{X}_U$ indicate covariate means of leaders and non-leaders, respectively and s_T^2 and s_U^2 are their corresponding sample variances.

After propensity scores are calculated for each individual, an estimator of the treatment effect is constructed by matching the treated individuals to a non-treated individual or group of non-treated individuals based on their propensity score. There are a several ways in which PSM estimators may be constructed. In general, they are of the following form:

$$ATT = 1/N_T \sum_{i \in T} [y_i - \sum_{j \in C_i} w(i,j) y_j] \tag{D2}$$

where N_T represents the number of treated individuals, C_i is the set of control individuals for each treated individual i, and $w(i,j)$ is some weighting function that depends on the choice of matching estimator. Matching methods include nearest neighbor, kernel, caliper, radius, among others. I discuss some of these methods below.

Perhaps the simplest and most intuitive PSM technique is the nearest neighbor (NN) estimator. With NN, each observation is matched to the non-treated individual (or K individuals) with the most similar propensity score. Formally, the set of control individuals is defined as $K_i = j \mid Min_j \parallel p_i(X_i) - p_j(X_j) \parallel$. NN can either be 1-to-1 or 1-to-K. In the cases of 1-to-1 matching, equation (D2) becomes

$$ATT = 1/N_T \sum_{i \in T} [y_i - y_j]. \tag{D3}$$

One issue that arises in the case of 1-to-1 matching is whether to match with or without replacement. Matching without replacement means that each control observation is matched to one and only one treated individual. In contrast, if matching is done with replacement, each control may be assigned to more than one treated individual. The decision between the two methods represents a tradeoff between bias and variance.

Matching without replacement increases the number of controls used in the analysis and subsequently decreases variance; however, if the propensity score differences of these matched pairs are comparatively greater than the "with replacement" matches, the method increases bias. 1-to-K NN matching is always done with replacement and the ATT is given by

$$ATT = 1/N_T \sum_{i \in T} [y_i - 1/K \sum_{k \in C_i} y_k]. \quad \text{(D4)}$$

Closely related to NN, radius matching uses all of the matches within a given distance of the propensity score of the treated unit. The number of matches, K, varies by treated individual such that

$$ATT = 1/N_T \sum_{i \in T} [y_i - 1/K_i \sum_{k_i \in C_i} y_{k_i}]. \quad \text{(D5)}$$

The number of observations used in the control set, K_i, is based on the difference in propensity scores and is defined as follows:

$$K_i = \forall j \,|\, \| p_j(X_j) - p_i(X_i) < r \|, \quad \text{(D6)}$$

where r denotes the radius.

An alternative matching estimator is the kernel matching estimator. Kernel matching uses all control individuals within the area of common support. In contrast to NN or radius matching, in which each control unit is assigned an equal weight, with kernel matching each control observation is given a different weight defined by the specified kernel. Control individuals with the closest propensity score are given relatively large weights while little weight is attributed to those furthest away. Formally, the weight used in kernel matching is defined as follows:

$$w(i,j)=\frac{K(p(X_i)-p(X_j))}{\sum_{j=1}^{N_{C,i}}K(p(X_i)-p(X_j))}, \tag{D7}$$

where K is the kernel (for example, the Gaussian kernel). Other matching estimators include local linear regression, stratification and mahalanobis matching, among others.[73]

Table D.3 reports PSM education estimates for some of these alternative matching methods. The reported estimates from chapter II, Table II.3 are reported in column (1). Columns 2-6 give estimates from the 1-to-1 NN with replacement, Guassian kernel, 0.1 radius, 0.01 radius, and 0.001 matching methods, respectively. The results illustrate that the PSM estimates are not highly sensitive to the choice of matching method. In terms of years of education, for instance, all six estimates fall within a range of 0.353 to 0.408 years of education. Similarly, the estimates on any post-secondary education range from 0.052 to 0.061 and the estimates on college completion range from 0.088 to 0.109. In each case, the estimates reported in chapter II are neither the lower nor upper bound of these PSM ranges.

Rosenbaum Bounds

An important limitation of PSM is that the students are matched only on their observable characteristics. Therefore, while students are matched on some variables that are not traditionally available to the researcher, if there is still some characteristic, u, that affects selection into leadership and systematically differs within matched pairs (i.e. all leaders are more motivated than their matched non-leader) that is not adequately captured by the included observed variables, students in a matched pair will no longer have the same probability of being a leader. In this case, the odds ratio of leadership within a matched pair will no longer equal one, the CIA will be violated and, unless the variable

[73] See Cameron and Trivedi (2005) for more details.

u has a negligible impact on the outcome, the presence of unobserved heterogeneity will result in biased PSM estimates.

While it is impossible to address this issue explicitly with the PSM method, Rosenbaum (2002) suggests a bounding method that allows the researcher to assess the extent to which such an unobserved variable, u, would have to affect the odds ratio within a matched pair in order to undermine the estimated PSM effects. The method tests the sensitivity of the estimated effects to different levels of unobserved heterogeneity, Γ, where Γ is defined as the ratio of the odds of high school leadership within a matched pair. A Γ value of one, for instance, indicates no unobserved heterogeneity, while for a value of two, the odds of being a leader for students j and k are said to differ by a factor of two. To illustrate this approach more formally, I closely follow the discussion provided in Caliendo and Kopeinig (2005)[74]. To begin, assume that the leadership probability is given by following equation:

$$P(X_i) = P(LEAD_i = 1 \mid X_i) = F(\beta X_i + \gamma u_i)\,, \tag{D8}$$

where X_i is the vector of observed covariates and u_i is an unobserved variable. For simplicity, further suppose that the variable u_i takes on a value of zero or one. For instance, you could think of this unobserved factor as unobserved student motivation or determination. If we further assume that F follows a logistic distribution, then the odds that an individual in a matched pair of students (j,k) is a leader is given by the following equation:

$$\frac{P(X_i)}{(1-P(X_i))}\,\forall i \in j,k\ . \tag{D9}$$

[74] A complete discussion of this approach is found in Rosenbaum (2002). DiPrete and Gangl (2004) also provide a more detailed discussion.

The odds ratio for this matched pair of students, j and k, can then be written as follows:

$$\frac{\frac{P(X_j)}{(1-P(X_j)}}{\frac{P(X_k)}{1-P(X_k)}} = \frac{P(X_j)(1-P(X_k))}{P(X_k)(1-P(X_j))} = \frac{\exp(\beta X_k + \gamma u_k)}{\exp(\beta X_j + \gamma u_j)} = \exp(\gamma(u_k - u_j)). \qquad \text{(D10)}$$

Equation (D10) shows that, while matching students j and k on their observed covariates, X_i, eliminates the impact of the x-vector, the odds of treatment may still differ depending on the value of γ and on the difference in the value of the unobserved variable, u_i. If the unobserved factor does not have a significant impact on the leadership assignment (γ=0) or if the two individuals in the matched pair have the same value of u_i (they are both motivated/determined individuals), the odds ratio will be equal to one, which implies there is no unobserved heterogeneity. However, if both of these conditions do not hold, the odds of treatment assignment within a matched pair will differ, the CIA will fail, and the resulting estimate will be biased.

Rosenbaum shows that equation (D10) implies the following bounds on the ratio of the odds that either of the two students in the matched pair will be leaders:

$$\frac{1}{\Gamma} \leq \frac{P(X_k)(1-P(X_j))}{P(X_j)(1-P(X_k))} \leq \Gamma, \qquad \text{(D11)}$$

where $\Gamma = e^{\gamma}$. If Γ=1, there is no unobserved heterogeneity and the two individuals in the matched pair have the same probability of being a leader. For values of Γ that are not equal to one, however, the two individuals in the matched pair will differ in their odds of being a leader. If Γ=2, for instance, the odds of being a leader for students j and k are said to differ by a factor of 2. In this sense, Γ can be interpreted as the level of unobserved heterogeneity.

For different levels of Γ, Rosenbaum then shows that bounds can be computed for the significance level of the null hypothesis of no treatment effect. To apply this approach to empirical estimates, the researcher calculates p-critical values, which represent the upper bound on the significance level of the estimated treatment effect coefficient. If, at high values of Γ, the upper bound of the significance level is still statistically significant at conventional levels, this implies that it would take a large level of unobserved heterogeneity to undermine the PSM estimates. Alternatively, if the estimates are sensitive at low levels of Γ, there is reason to believe that the treatment effects are more likely to suffer from bias due to the presence of unobserved heterogeneity.

I test the sensitivity of the PSM estimates to unobserved heterogeneity using the Rosenbaum Bounds methods. Bounds are calculated for each of the reported effects from Model 2 in chapter II. Since high school math scores are observed, the estimated impact of this characteristic on the probability of high school leadership is known. I am therefore able to equate the impact of an unobserved trait at each gamma level to the estimated impact of cognitive ability (math scores) on the log odds of leadership in a matched pair.

Rosenbaum bounds and their corresponding math score equivalent effects are reported in Table D.4. The critical level at which the PSM results should be questioned is attained at a gamma value of 1.55 for years of education and college degree and at 1.7 for attending any post-secondary institution. The approach suggests that in order for a 95% confidence interval of the estimated impact of leadership on educational attainment to contain zero, an unobserved factor would have to affect the ratio of the log odds of leadership in a matched pair by a factor of between 1.55 and 1.7. To put the magnitude of these effects in perspective, a level of 1.55 is attained at a difference in math score mean of 2.37 or nearly 2.5 standard deviations, while a level of 1.7 is attained at mean difference of 2.87 or almost 2.9 standard deviations. Given these equivalent effects, the Rosenbaum Bounds estimates suggest that an unobserved characteristic would have to have quite a large impact on the leadership probability in order to suggest that leadership has no causal impact on educational attainment. This result supports all of the evidence presented in chapters II and III.

Table D.1. Sensitivity of PSM Estimates to Choice of First-Stage Model

	First-Stage Model	
	Probit	Logit
Education		
Coefficient on High School Leadership	0.391 ***	0.352 ***
	(0.460)	(0.053)
Any Post-Secondary Education		
Coefficient on High School Leadership	0.059 ***	0.056 ***
	(0.009)	(0.012)
College Graduate		
Coefficient on High School Leadership	0.104 ***	0.087 ***
	(0.015)	(0.015)

Notes:

a. Standard errors are reported in parenthesis. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographic, family, region, school, cognitive ability (math scores), popularity, athlet ability, and locus of control.

N= 9,665 students.

Table D.2. The Effect of Increasing the Number of Control Variables on Propensity Score Estimates[a]

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Education						
Coefficient on High School Leadership	0.949 ***	0.591 ***	0.582 ***	0.573 ***	0.346 ***	0.391 ***
Standard Error	(0.214)	(0.044)	(0.054)	(0.047)	(0.044)	(0.051)
Any Post-Secondary Education						
Coefficient on High School Leadership	0.145 ***	0.089 ***	0.088 ***	0.077 ***	0.050 ***	0.059 ***
Standard Error	(0.050)	(0.009)	(0.011)	(0.011)	(0.010)	(0.009)
College Graduate						
Coefficient on High School Leadership	0.215 ***	0.152 ***	0.152 ***	0.158 ***	0.095 ***	0.104 ***
Standard Error	(0.078)	(0.014)	(0.015)	(0.012)	(0.015)	(0.015)
Controls						
Basic	X	X	X	X	X	X
Family		X	X	X	X	X
School			X	X	X	X
Region				X	X	X
Math Ability					X	X
Popular, Athletic, Locus of Control						X

Notes:

a. Standard errors are bootstrapped with 50 replications and are reported in parenthesis. All estimates are statistically significant at the 1% as level as indicated by ***. N= 9,665 students.

Figure 1. Covariate Balance Induced by Propensity Score Matching

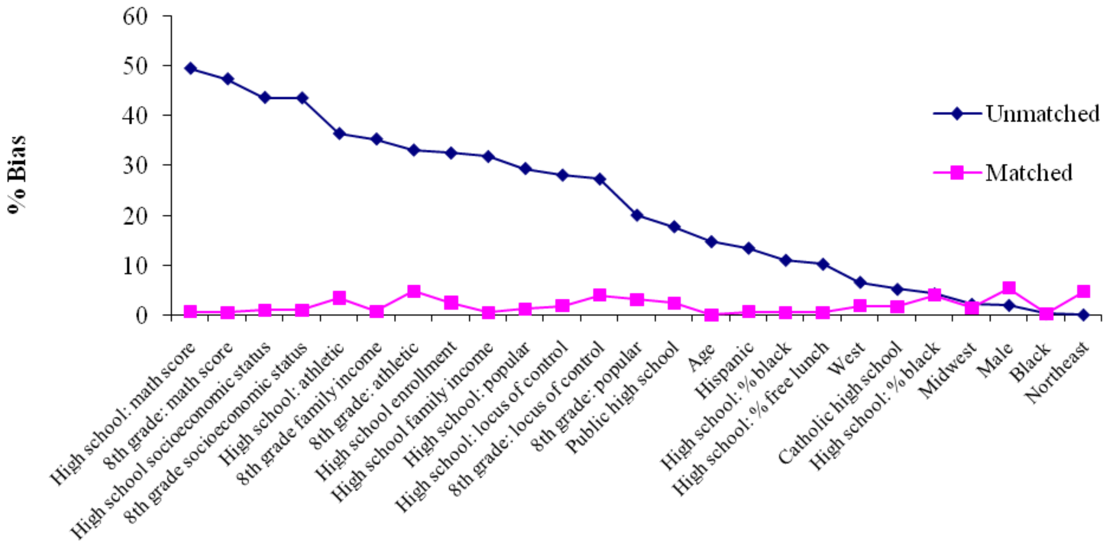

Figure 2. Impact of Increasing Number of Control Variables on Covariate Balance Induced by Propensity Score Matching

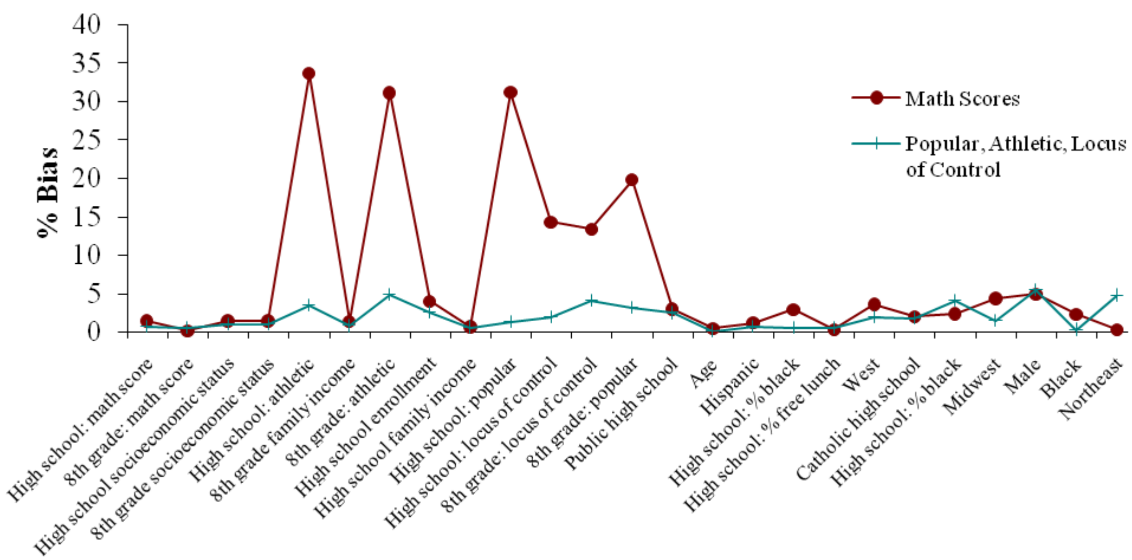

Table D.3 Sensitivity of PSM Estimates to Matching Approach

	1-to-1 NN w/ replacement	1-to-1 NN w/o replacement	Gaussian Kernel	Radius (r=.1)	Radius (r=.01)	Radius (r=.001)
Education						
Coefficient on High School Leadership	0.391 ***	0.373 ***	0.369 ***	0.408 ***	0.353 ***	0.372 ***
Standard Error	(0.051)	(0.034)	(0.040)	(0.038)	(0.041)	(0.041)
Any Post-Secondary Education						
Coefficient on High School Leadership	0.059 ***	0.061 ***	0.054 ***	0.058 ***	0.052 ***	0.056 ***
Standard Error	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
College Degree						
Coefficient on High School Leadership	0.104 ***	0.088 ***	0.097 ***	0.109 ***	0.093 ***	0.095 ***
Standard Error	(0.015)	(0.009)	(0.011)	(0.011)	(0.012)	(0.012)

Notes:

a. Robust standard errors are reported in parenthesis. Standard errors are bootstrapped with 50 replications. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively. All specifications include controls for demographic, family, region, school, cognitive ability (math scores), popularity, athleticness, and locus of control. N= 9,665 students.

Table D.4. Rosenbaum Bounds on 1-to1 NN PSM Education Estimates[a]

Γ	P-Critical			High School Math Score Equivalent[b]	
	Education	Any Pse	College Degree	Mean Difference	Number of Standard Deviations from Mean
1	<.001	<.001	<.001	0.007	0.007
1.1	<.001	<.001	<.001	0.52	0.522
1.2	<.001	<.001	<.001	0.99	0.994
1.3	<.001	<.001	<.001	1.42	1.426
1.4	<.001	<.001	<.001	1.82	1.828
1.5	0.026	0.002	0.029	2.2	2.210
1.55	**0.125**	0.008	**0.111**	2.37	2.381
1.6		0.023		2.55	2.561
1.65		0.057		2.7	2.712
1.7		**0.120**		2.87	2.883

Notes:

a. All estimates come from specifications that include controls for demographic, family, region, school, cognitive ability (math scores), popularity, athleticness and locus of control. N=9,665.

b. Math equivalent is evaluated at the empirical means of high school math score. Mean difference is the difference in average math score between leaders and non-leaders. Standard deviation of high school math score across all 9,665 students is 0.9955.

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