Peer Effects and Gender Differences in High School Graduation in Oregon

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Abstract

In 2013, Oregon had the lowest high school graduation rate of any state at 68.7%, with a significant gender gap in rates between boys and girls.[1] This study explores the influence of peer effects on graduation probability and the individual characteristics that influence the gender gap in graduation outcomes for 9th graders entering high school. First, we look at the gender gap in graduation through various categories, such as a student's race, ethnicity and whether a student is economically disadvantaged. The study then assesses the significance of gender interactions with individual characteristics and the peer effect of the tenth grade graduation rate on the ninth grade graduation probability. We find that the peer effect has a small yet significant effect on a student's probability of graduating, and gender gaps partially arose from interactions with Hispanic and 8th grade math scores.

[1] Oregon Department of Education (2015).

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Executive Summary

The 2013 Oregon on time high school graduation rate was 68.7%, putting Oregon in last place out of any state in terms of high school graduation. Girls in the class of 2011 graduated at 7.5% higher than their male peers. In our study, we examine the gender gap in graduation rates in Oregon public schools and the possible factors that influence a student's probability of graduating on time.

The gender gap is an interesting case to study because most variables such as race, economically disadvantaged, and school, are evenly distributed over both genders. Research shows that boys have lagged cognitive development, and struggle more in the classroom environment. Graduation rates do not include special education diplomas, GEDs, or diplomas that were earned in more than four years. This study examines what variables affect a boy's probability of graduating more than a girl's probability of graduating by assessing the 4-year graduation rate by school year, and examining school-wide effects and their influence on a student's likelihood of graduating.

Our hypothesis is that because males have a lagged brain development, which makes them more sensitive to stressors, the peer effect would influence a boy's probability of graduating at higher rates than their female classmates. The proxy for the peer effect for assessing the ninth graders is the graduation rate of the 10^{th} grade class.

To run our regressions we use a logistic regression model (logit) because the dependent variable is bound between 0 and 1 and this is needed because our dependent variable is a probability. We also use robust standard errors clustered by school.

The peer effect has a small but significant effect on the probability of a student graduating on time. We find that gender gaps partially arise from interactions with Hispanic and 8th-grade math scores. Female Hispanics have a better chance of graduating than their male Hispanic peers. Also, the results show that males have a higher marginal return on 8th grade math test scores than females, apparently because a higher proportion of males have very low scores and low scores pose a greater impediment to graduation for males.

There are several implications of this study. Many of the obstacles to graduation, such as low achievement and economic disadvantage are typically already in place prior to high school. Even so, we find that a focus on Hispanic males and males who test in the lowest quartile for math may be especially effective in narrowing the gender gap and improving the overall graduation rate in Oregon.

Introduction

The state of Oregon has the lowest high school graduation rate in the country, with the Oregon Department of Education (ODE) reporting only 68.7% of students graduating on time in the 2012-2013 school year. The graduation rates of Oregon public high schools also have a significant gender gap favoring girls. We find this important because studies have proven that high school graduation is important in determining the future income and career opportunities for an individual.

As well as having the lowest graduation rate there is also a significant gender gap in Oregon. Although gender is determined at near random distributions, and both groups tend to share common family and school environments with equal distributions, males are much less likely to graduate than females. According to the ODE, if a female and a male have the same standardized test scores in 8th grade, the female is still more likely to graduate. We believe the gender gap may stem from differences in the effects of the environments on male and female students. In addition, evidence suggests that the brain develops differently between the genders, and boys mature at a later age than girls do. However, this neurological explanation may not be the only factor, or may be working in tandem with other components. In this study, we will be analyzing the effect of the peer influence on graduation probability, and how the effects differ between male and female students, to see if it can significantly explain the gender gap in graduation rates.

For the purpose of this study, the graduation rate refers to the on-time, 4-year cohort graduation rate. The ODE defines on-time graduation as a student graduating high school in four years. The

4-year cohort rate accounts for students who enter 9th grade in the same year, and graduate together four years later. Events such as death, foreign exchange programs, home schooling, enrolling in juvenile detention, alternative schooling, receiving a GED or an adult high school diploma are not counted in the graduation rate. While new calculations to the graduation rate by the ODE will include special education diplomas, this study does not include special education diplomas to match previous calculations by the ODE.

This paper aims to analyze the cause of the low graduation rate and assess what influences the gender gap. The ODE collects data on students as they move through the school system, including attendance rates and test scores. We first analyze graduation rates, by assessing which variables contribute the most to the difference in achievement between boys and girls. We then focus on school wide factors and its effect on individual data, to answer the question: How do the school environment and student peers influence individual students?

Literature Review

In this study we test the effect of environmental factors on a student's probability of graduating and how this affects the genders differently. Previous research on similar areas of study is expansive and covers a wide range of subtopics. While cognitive ability may be held constant, research shows that boys tend to earn lower grades, have more disciplinary occurrences, and claim lower satisfaction in school (Jacob, 2002). All of these findings indicate that a gender gap exists in many of the variables measured in school districts nationwide, and also suggest the gap may be growing. An article published by *USA Today* says that in 2010, the college student body was made up of 57% women and 43% men.

A paper by Kleinfeld (1998), that looks at gender gaps in education, states that "males are more apt than females to believe that the school climate is hostile to them, that teachers do not expect as much from them and give them less encouragement to do their best." In addition he finds that females receive higher grade point averages all the way from grade school to college, and obtain higher-class ranks than their male peers. Women also get more honors in all subjects besides science and sports, and are making gains in the gap that exist in science honors. Women achieved higher scores in writing, language, study skills, and reading, while men only had a significant advantage in geopolitical skills. Men do achieve higher in math and science, but the gaps are small.

A study from the ODE looks at gender differences in the classroom environment, and finds that being economically disadvantaged has a greater effect on graduation outcome earlier in a

student's schooling, and still has a significant effect when a student is in high school. Another notable finding of this study is that, in the 8th grade, non-economically disadvantaged males graduate at higher rates than economically disadvantaged females, but by high school females of both economic groups were graduating at higher rates than their male peers.

A different approach to looking at the gender gap is to look at how the gap varies by race. Coley (2001) found that females score higher than males in reading and writing across all racial groups. However, for white and Hispanic students, males score higher in the sciences. In addition, there is a gender gap in graduation rates favoring females over males for white and Hispanic students, but not for African-Americans. This study demonstrates that there is some variation in the gender gap for certain races, but not uniform differences.

Given the results of prior studies, we want to look at what influences this gap. One of the possible factors affecting the gender gap that we look at is the peer effect a student faces. Hanushek and Rivkin (2008) look at how teacher experience and racial peer makeup affected achievement. In Texas, they saw initially that schools with a higher percentage of black students did not have an effect on achievement, but over time the achievement gap grew in schools with a higher percentage of black students. In their model, Hanushek and Rivkin use fixed effects to capture time invariant characteristics of students, like school by grade, school by year, and grade by year. For high performing white students, going to a school with a high black student body, did not indicate a significant effect on achievement, yet for black students there is a significant a negative effect of attending a school with a high proportion of black students. They also found a

strong negative correlation between achievement and the amount of teachers with very little or no experience.

Hoxby (2000) looks at peer effects within ethnic groups, and finds that peer effects are more prominent within the same ethnic groups. She also finds that the effects do not always show through the achievement of peers. For example, in classrooms that have more female students both genders achieve at higher rates, even though the average female performance in math is about the same as the male average.

Theory & Hypothesis

The gender gap in high school graduation paints a picture that males are disadvantaged in school in ways that affect their graduation probability. Although gender is randomly and evenly distributed, different factors seem to affect the sexes with different levels of magnitude. One of the causes that may be a factor of why males are disadvantaged in school is the way that outside factors, like peer effects, affect each gender at different magnitudes.

One explanation has to do with brain development. A study from Newcastle University shows a significant difference in brain connections between maturing males and females (Lim, 2013). Researchers expected there would be a sort of rewiring of the brain connections during puberty, where the brain discards useless structural connections so it can work more efficiently. This process of neural development occurs at a later age in males than in females, suggesting that females are more equipped to handle stressors and process information more efficiently.

This delayed brain development in males may provide an explanation for the gender gap in high school graduation. The lagged brain development of boys could provide reasoning for why they are more sensitive to their environment, including influences from their peers. This delayed development may also cause a male student to be more sensitive to things, such as being economically disadvantaged. Thus, the average class graduation rate at a school could act as a measure of the peer effect on individual graduation, and may show differences in its effect between genders. Our hypothesis is that the peer effect of the graduation rate plays a necessary positive role on individual graduation probability. In addition, males are more likely to be

affected than females. This hypothesis is based on the idea that slower development causes males to have harder time coping with certain environmental factors.

Additionally, there is substantial evidence that boys underperform compared to girls in the classroom. We investigate how peers affect a student's probability of graduation by assessing the role of various gender interactions with student characteristics such as test scores and discipline rates. We expect significant gender interactions with these variables, as this would help explain the differences behind the gender gap. Since the dependent variable in this study is a probability, a significantly positive gender interaction suggests that males are more sensitive to the effects of that variable. We expect there will be a gender gap in graduation rates, and a portion of the cause behind that gap, may be attributed to peer effects, as measured by school-wide data, for boys and girls at different levels of magnitude.

Data

Data for this analysis is provided by the Oregon Department of Education (ODE) and includes student-level information in panel data form on a variety of variables. Data is available from the school year beginning in 2003 until the school year beginning in 2013 for students attending public schools in Oregon. The variables provided and assessed are listed in Table 2 of the appendix. The original file includes 5.5 million observations. However, this analysis looks only at 9th graders with graduation outcomes, limiting the number of observations to around 200,000, which still provides many degrees of freedom

The primary dependent variable we analyze is the graduation outcome. The data includes 13 different graduation outcomes varying from an adult diploma to transferring out of the state. For the purpose of this analysis, we assess graduation outcomes in terms of 4-year high school graduation, also known as on-time graduation, or graduating with a 4-year cohort. This rate is calculated from regular high school diplomas, and regular high school diplomas earned but not yet awarded for the purpose of allowing a student to attend community college classes under the state budget. The data also includes observations for students who have not yet been in school long enough to graduate, and their observations for all outcome variables are left blank. Since this study predicts graduation probability, these observations are not included in the regression.

Methodology

The process of deciding which variables to use in the analysis and how to organize the observations is complex. Several variables in the data had missing or inconsistent observations and are omitted. Four potential variables for the regression include homeless, freshman year on track, pregnant, and discipline days. Yet, all of these variables have to be omitted for various reasons. The variable representing if a student is homeless is only collected on a large scale starting in the 2012 school year. The variable recording if a student met freshman on-track requirements is only collected starting in the 2011 school year. The pregnancy variable is only recorded if the student participates in a program for student parents. Lastly, the variable for discipline days records a zero if the student is expelled, so when a student is expelled it is not recorded as a disciplinary event.

Next, we attempt to assess the influence of peer effects on individual high school graduation probability, but are limited by the data that the ODE can legally collect on students in public schools. Such data as family income, number of friends, and natural propensity for schooling are not available. In the space of true peer-effect data, we use school-level proxy variables to determine how the environment of a school may influence or not influence individual students. The proxy that we use for school environment is grade-wide graduation rate. We use this because a school with a high graduation rate may foster a culture that encourages other students to graduate at a higher rate. We then use this as a proxy for peer effects because many of the actions of a student's peers are captured in whether the peers graduate or not.

A problem with quantifying an average peer effect with the data provided is that a student's own value is captured with his or her peers. This forces us to consider other ways to measure peer effects. One approach is to view a 9th grader's peers as the group of students who were in 9th grade during the previous school year, when they were in 8th grade. Yet, this approach is not very useful as proxy for peer effects, because at most Oregon public schools, the 8th and 9th graders are not on the same campus and therefore would not be interacting with one another. Another approach measures a 9th grader's peers as the 10th graders in that same year.[2] Since the students in this 10th grade this year are at the same campus as this year's 9th graders, they actually interact with the current 9th graders. We feel this is a necessary aspect of a peer effect, and for this reason, we measure the average graduation rate using this year's 10th graders.

Next, we look at individual student effects. We split these controls into two groups: demographic controls and achievement controls. Demographic controls focus on variables outside of a student's control, and include such things as ethnicity, and gender. We also control for if a student is ever classified as economically disadvantaged, which is used as a proxy for family income, and if a student is ever in the English as a Second Language (ESL) program. Lastly, we control for if a student is ever classified as a special education student.

The achievement controls are variables that a student can have direct control over, including test scores, attendance and discipline. For test scores, we include the student's standardized reading and math test scores in 8th grade. The reason we did not use their high school test scores is because in Oregon high schools, standardized tests can be taken in any year until the student

[2] At first glance this year's 10th graders and last year's 9th graders should be the exact same, but this year's 10th graders includes any new students in 10th grade, and drop any students not at the school anymore.

passes the exam. Since we are analyzing graduation probability for 9th graders, we can only use test scores that have been completed by all students prior to 9th grade. For attendance, we look at a student's average attendance in all the years they are in the sample before 9th grade. Lastly, for discipline, we control for if a student ever had an out of school suspension (OSS), in school suspension (ISS), or was expelled.

Finally, we consider the unique nature of each year and school in the data. To do this, we use fixed effects for each year and school. These fixed effects control for the unobserved differences between each school and each year. We estimate our model using logit, with clustered standard errors on school. We use a logit model to bind our independent variable between 0 and 1. This is necessary because the dependent variable is a probability, which means it would not make sense to interpret it at a value less than 0 or greater than 1. We cluster our standard errors on school in order to control for the fact that some of the outcomes do not influence students individually and may affect students at the same school in a uniform fashion. We especially thought this is important for the standard errors of the peer effect.

Empirical Specifications

The base model for the specification focuses on predicting 9th grade on-time graduation. First, we focus purely on the gender difference between girls and boys and how that predicts graduation. Then, we add on various variables to see how the coefficients change with different components. We believe that graduation probability is a function of several parts, as shown below:

9th Grade On-Time Graduation Probability = f (Peer Effects, Unique Student Characteristics, Unique School Characteristics, Unique Year Characteristics)

Peer effects are represented through the measurement of 10th grade graduation rates. Student characteristics include demographic controls that a student cannot control, and achievement controls that a student can control and that contribute to academic success. Lastly, School and year characteristics are controlled through fixed effects.

The first regression looks at the unconditional gender difference of high school graduation and does not include fixed effects. This lets us assess what the raw effect of being male is without controlling for other factors:

$$Logit\ (9th\ Grade\ On\text{-}Time\ Graduation\ Probability_{\ i}) = \beta_0 + \beta_1 Male_i + u_i \quad (1)$$

The second regression adds demographic variables, school fixed effects and year fixed effects, to assess how the characteristics that a student cannot control affect his or her chances of graduating:

$$Logit\ (9th\ Grade\ On\text{-}Time\ Graduation\ Probability_{\ i}) = \beta_0 + \beta_1 Male_i + \beta_2\ Demographics_i + i.School\ Fixed\ Effects + i.Year\ Fixed\ Effects + u_{i\ .}\quad (2)$$

The third regression adds gender interactions into the regression, to see how these variables affect the genders differently. The results of this show whether either of the genders are receiving significantly different effects from these variables:

$$Logit(9th\ Grade\ On\text{-}Time\ Graduation\ Probability_{\ i}) = \beta_0 + \beta_1 Male_i + \beta_2\ Demographics_i + \beta_3\ Gender\ Interactions_i + i.School\ Fixed\ Effects + i.Year\ Fixed\ Effects + u_{i\ .}\quad (3)$$

The fourth regression adds 8th grade test scores into the regression to see how controlling for a student's test scores affects their probability of graduating and how it affects the other variables:

$$Logit(9th\ Grade\ On\text{-}Time\ Graduation\ Probability_{\ i}) = \beta_0 + \beta_1 Male_i + \beta_2\ Demographics_i + \beta_3\ Gender\ Interactions_i + \beta_4\ 8th\ Grade\ Test\ Scores_i + i.School\ Fixed\ Effects + i.Year\ Fixed\ Effects + u_{i.}\quad (4)$$

The fifth regression adds the other achievement controls, average attendance and discipline, and takes out gender interactions, in order to see how these additional variables affect probability of graduating:

$$Logit(9th\ Grade\ On\text{-}Time\ Graduation\ Probability_{\ i}) = \beta_0 + \beta_1 Male_i + \beta_2\ Demographics_i + \beta_3\ Gender\ Interactions_i + \beta_4\ Achievement_i + i.School\ Fixed\ Effects + i.Year\ Fixed\ Effects + u_{i.}\quad (5)$$

Finally, the sixth regression adds gender interactions for all variables. The final regression has all the variables so we can see what the effects are when controlling for everything that we select:

$$Logit(9th\ Grade\ On\text{-}Time\ Graduation\ Probability_{\ i}) = \beta_0 + \beta_1 Male_i + \beta_2\ Demographics_i + \beta_3\ Gender\ Interactions_i + \beta_4\ Achievement_{\ i} + i.School\ Fixed\ Effects + i.Year\ Fixed\ Effects + u_i \quad (6)$$

Results & Analysis

The initial regression that we are running is the effect of being male on a student's probability of graduating from high school. This regression is run without controls or fixed effects to see the pure gender gap. The pure marginal effect of being male from equation (1) is -0.0725, or 7.25%. This result shows that without controls, males are 7.25% less likely to graduate than their female peers. The average gap in graduation rates between girls and boys over the six years between 2008-2013 is 7.49%, with a particularly large increase in the gap in the last recorded school year. Since the regression shows a similar number to what the data tells, this suggests the regression is working properly and the data is well assembled.

The next part of the analysis splits the regressions into two types: those with only demographic controls, and those with achievement controls added in. All results are conveyed in marginal effects format from a logit regression.

Variable Analysis of Results without Achievement Controls

The first part of the analysis does not control for achievement characteristics (test scores, attendance rates, and disciplinary occurrences) as seen in equation (2). All coefficients in this regression have negative influences on graduation probability, except for the peer effect. Several coefficients are not significant, like if a student is in an ESL program. This suggests students in and out of ESL graduate no differently between the groups. The coefficient for if a student is another race other than black, white, or Hispanic is insignificant, as well. This may be because minority populations are so small in the state, and there is little ethnic influence within the

groups to cause students of other races to graduate at rates different from white students, but consistently within the ethnic group. It is important to keep in mind that this variable does combine some very high and some very low performing groups, like Native Americans and Asian students.

The exception to the all-negative coefficients is the peer effect. 10th grade graduation has a significantly positive effect on an individual student's outcomes, but is very small. A one percent increase in 10th grade graduation only increases the graduation probability for a 9th grader by 0.1%. Since graduation rates are typically clustered fairly closely, there is not much variation, which may explain why the effect is so small. This also suggests the effect will rarely be very large, because graduation rates can only increase so much. The gender interaction with the peer effect is not significant, indicating that their peers do not affect boys and girls differently in this regard.

Variables that have negative effects on graduation probability are special education, being male, qualifying as economically disadvantaged, identifying as black, and attending a non-regular high school. If a student is in special education, his or her chances of graduating decrease by nearly 17%. This relatively large estimate occurs because special education diplomas are not included in the measurement of graduation rates, and because the regression does not account for individual achievement. Attending a non-regular school also has a large coefficient, making a student 24.40% less likely to graduate on time with a regular high school diploma.[3] This is likely because students who attend non-regular schools are achieving at low rates, and frequently attend programs that may not follow the same requirements as a regular high school. These students

[3] For a list and explanation of school types in Oregon, refer to Table 3 in the appendix

may be attending schools were alternative certificates, GEDs, or other degree types are awarded upon completion.

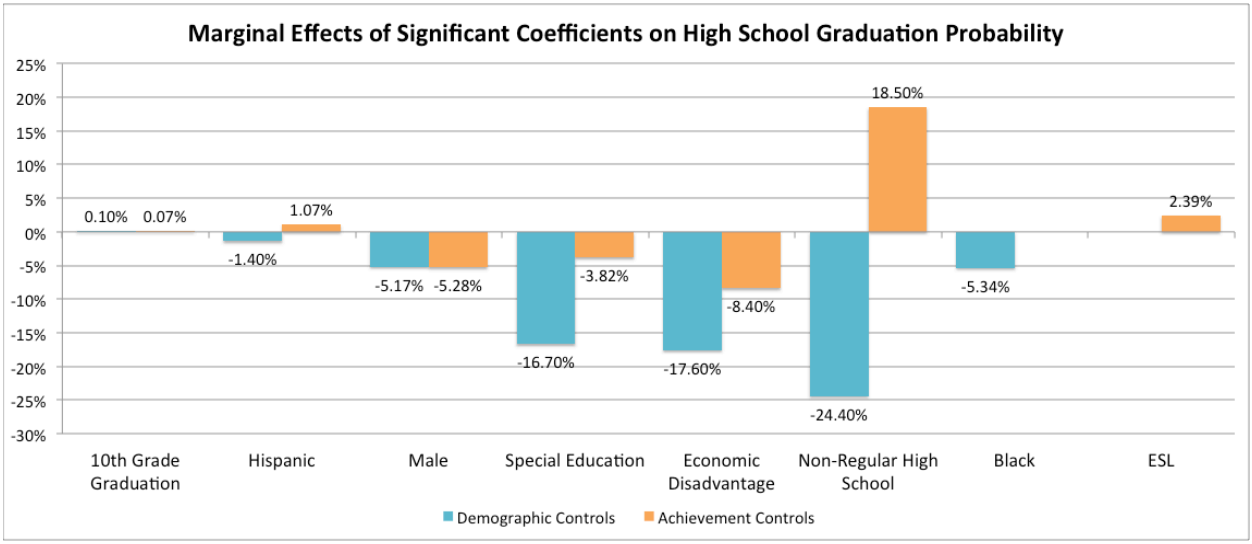
The third largely negative coefficient in this regression is economic disadvantage. An economically disadvantaged student is 17.6% less likely to graduate than his or her non-disadvantaged peer. This suggests that economic disadvantage plays a large role in determining if a student graduates, a finding supported by prior studies, particularly those of the ODE. In addition, the coefficient for being a male suggests that boys are more than 5% less likely to graduate than girls when they are in 9th grade. This follows the existence of the gender gap in graduation rates, were 73.3% of girls graduated in 2014, but only 64.7% of boys did.

The effects of ethnicity on graduation probability are negative for the two largest minority groups in the state, in comparison to white students. Black students are also more than 5% less likely to graduate than their white peers. This follows the lower than average graduation rate for black students, at 58.21%. Finally, the marginal effect coefficient for Hispanic students is negative, as Hispanics are 1.40% less likely to graduate than their white peers.

Figure 1 below depicts the differences in significant variables between demographic-only regressions and those with achievement controls included.

Variable Analysis of Results with Achievement Controls

Figure 1



When achievement controls for test scores, using the regression from equation (5), attendance rates, and disciplinary occurrences are included, some of the coefficients change significantly. For example, special education has much less of an effect on graduation probability, though it is still significantly negative with a marginal effect of -3.82%, and the coefficient for economic disadvantage also becomes less negative, with a statistically significant marginal effect of -8.40%. Furthermore, special education students graduate at higher rates than previously recorded. Economic disadvantage is an obstacle for student's probability of graduating, but once academic controls are included, this becomes less of an obstacle. In other words, a student prone to academic success will see economic disadvantage as a significant obstacle, but not as great of one as it would be without accounting for each individual's academic actions.

The marginal effect of being male does not change much when achievement controls are included in the regression. Boys are 5.28% less likely to graduate than females, a small change from 5.17%. This suggests that gender differences are not affected by individual achievement.

Participating in an ESL program has a significant positive marginal effect on graduation probability when achievement is controlled for. This could be because ESL is a program for bilingual students, and knowledge of a second language can be considered an additional skill that can help with academic success. In addition, being black no longer has a significant impact on graduation probability, indicating that black students do not have a significantly different graduation probability than their white peers when controlling for achievement.

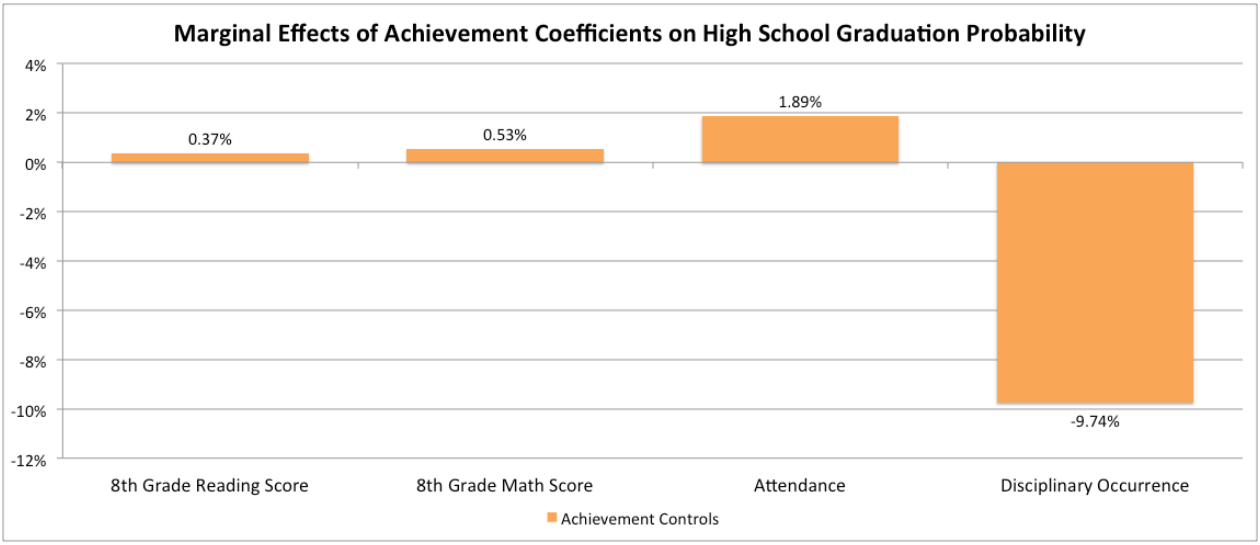
Interestingly, once we do control for achievement, the coefficient for Hispanic is positive, increasing graduation probability by 1.07% over white students. This change specifically occurs when test scores are included as controls. This suggests that when all else is held equal, if a Hispanic and a white student earn the same score on their standardized tests, the Hispanic student is more likely to graduate. However, Hispanic students have an average graduation rate of 64.9%, while white students at a rate of 74.1%. The positive coefficient may be explained by the fact that average test scores are lower for Hispanics than for white students, and Hispanic students are more sensitive to an increase in test scores in terms of graduation probability. Other possible explanations include family structure and cultural differences between ethnic groups.

Another variable that is positive with achievement controls is if a student attends a non-regular high school. This is likely because achievement controls adjust for many of the differences between students at regular and non-regular high schools. Most of the non-regular schools are alternative or charter schools, and options like hospital programs or youth correctional facilities only make up a small portion of this category. The main reason behind such a switch is

complicated, and far above our understanding of the intricacies in different programs that include non-regular schooling.

The coefficient results of the actual achievement controls are seen in Figure 2. Increased test scores and attendance lead to increased probability of graduating. A one percent increase in an individual's attendance rate increases graduation probability by 1.89%, although attendance rates are largely clustered in the 90th percentile with an average attendance rate around 92%. Of the test scores, 8th grade math results have a larger impact on graduation probability, and since tests are out of several hundred points, a marginal effect of 0.53% can play a big role. Compared to a 0.37% marginal increase in graduation probability with reading scores, higher math scores seem to have higher returns for students. This is possible because mathematical ability is frequently viewed as a measure of academic prowess and intelligence, which are important evaluators in college admission processes, and basic job skills. On the other hand, a disciplinary occurrence has a large and negative impact on graduation probability, lowering a student's chances of graduating by 9.74%.

Figure 2



Analysis of Gender Interactions

The final step of the analysis is to include gender interactions for all variables in the analysis. No gender interactions are significant at the 95% level when only demographic controls are included, as seen in equation (3). When achievement controls are added, only the variables for Hispanic and 8th grade math scores are significant at the 95% level, as seen in Figure 3. This is interesting because it suggests that of the variables available, only two help explain the gender gap in graduation rates.

Equation (6) shows that the coefficient for the math score gender interaction is 0.55, meaning that for each additional point scored on the 8th grade math exam, graduation probability increases 0.55% for boys. An additional point scored on the 8th grade math exam for a female increases graduation probability by 0.49%. The difference may seem small, but tests are scored out of 300 points, so an increase of just a few points can quickly add up as an influence on

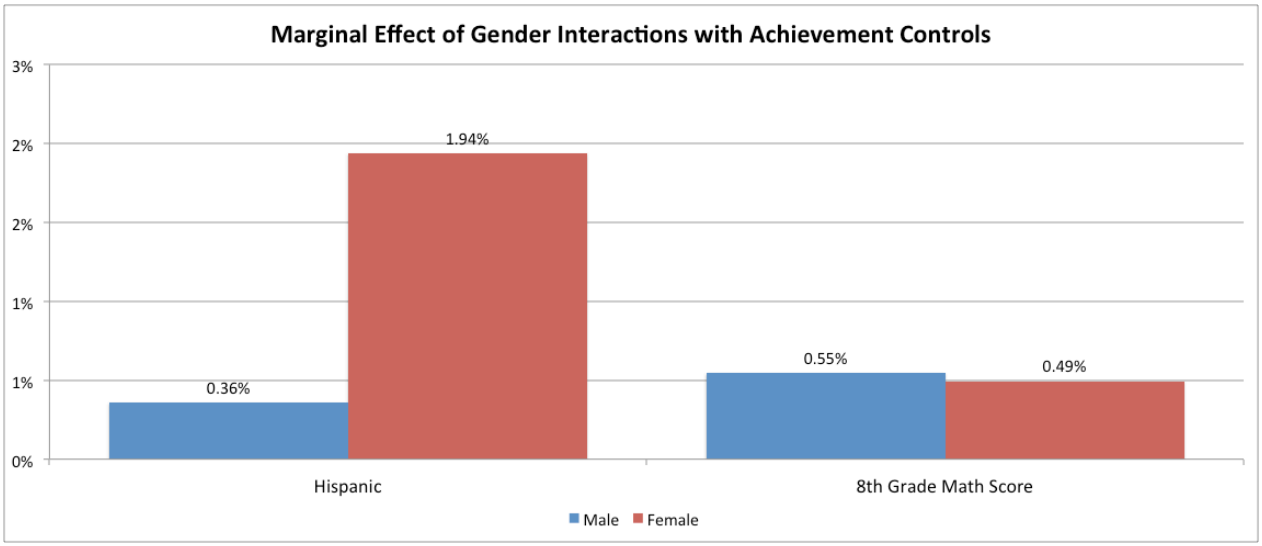
graduation probability. This result appears to show that math scores are more important for male graduation probability than for females, and the returns on math scores are higher for males.

There are many possible explanations for this. Perhaps a possible explanation is a greater variance exists in the male test scores than females despite having almost identical means. This indicates that there are more males doing both very poorly and very well in math. In addition, since math has historically been a male-dominated topic, boys may assess their personal academic ability by their success in math tests and classes. While a higher score on a test does more for boys than girls in encouraging graduation, it also does more to harm boys than girls if he or she scores a point lower on their exam.

Another way to assess this difference is to look at the chances of graduating based on math test quartiles. The bottom quartile has a large gap that narrows quite a bit by the top quartile. The gap goes from 11.8% in the lowest quartile to 2.9% in the top quartile. This shows that low achieving males are far less likely to graduate than their low-achieving female peers. The gap begins to shrink and by the third quartile the gap shrinks to less than the overall gender gap in graduation. There is a similar shrinking gap across reading test score quartiles but the gap is more consistent, and starts smaller and does not shrink as much as the math score. This is a possible explanation for the gender interaction with math test scores because doing poorly on math tests is very detrimental to a male's chances of graduating and the non-linearity of test scores makes it so many males fall into this lowest and highest quartiles.

Another significant gender interaction is with Hispanic. The results show that there is a significant positive effect for both genders, which is much larger for female Hispanics. For graduation probability, there is a 0.36% marginal increase for male Hispanics and a 1.94% marginal increase for female Hispanics. This means that female Hispanics are outperforming their male Hispanic peers. An explanation for this is hard to determine because factors that affect the genders are not significantly different than any other ethnicity, compared to white students. One explanation is that in some Hispanic families, males are pushed more toward activities like work than school, while females are pushed more toward education. This would likely cause female Hispanics to do better in school, have a higher probability of graduating, and possibly have higher returns to school than their male counterparts.

Figure 3


Marginal Effect of Gender Interactions with Achievement Controls
3%
2%
2%
1%
1%
0%
1.94%
0.36%
0.55%
0.49%
Hispanic
8th Grade Math Score
Male
Female

Conclusion

In conclusion, we find that gender gaps partially arose from interactions with Hispanic and 8th grade math scores. Furthermore, no other gender interactions were significant, and none are significant when we do not account for an individual's achievement through test scores, attendance rates, and disciplinary occurrences. Finally, the peer effect of student graduation rates does have a significantly positive, if small, impact on graduation probabilities for both boys and girls at an equal level.

The implications of the study include that in order to improve graduation rates the Oregon public school system must focus on improving graduation rates for the Hispanic population, especially males, and focus on helping males with low math scores. Economically disadvantaged individuals suffer most from low graduation rates regardless of gender; however economically disadvantaged males suffer more than economically disadvantaged females.

Further analysis, including assessing other peer effects besides graduation rate, such as discipline and attendance is an intriguing expansion on our current research. Also, analyzing peer effects within ethnic groups would be intriguing as previous literature points to the strong effect of peer influence within racial groups. It is also possible that peer effects are stronger during different years of schooling than in ninth grade. Testing for peer effects at younger ages could prove to have a greater effect on the graduation outcome of a student.

Appendix

Graph 1

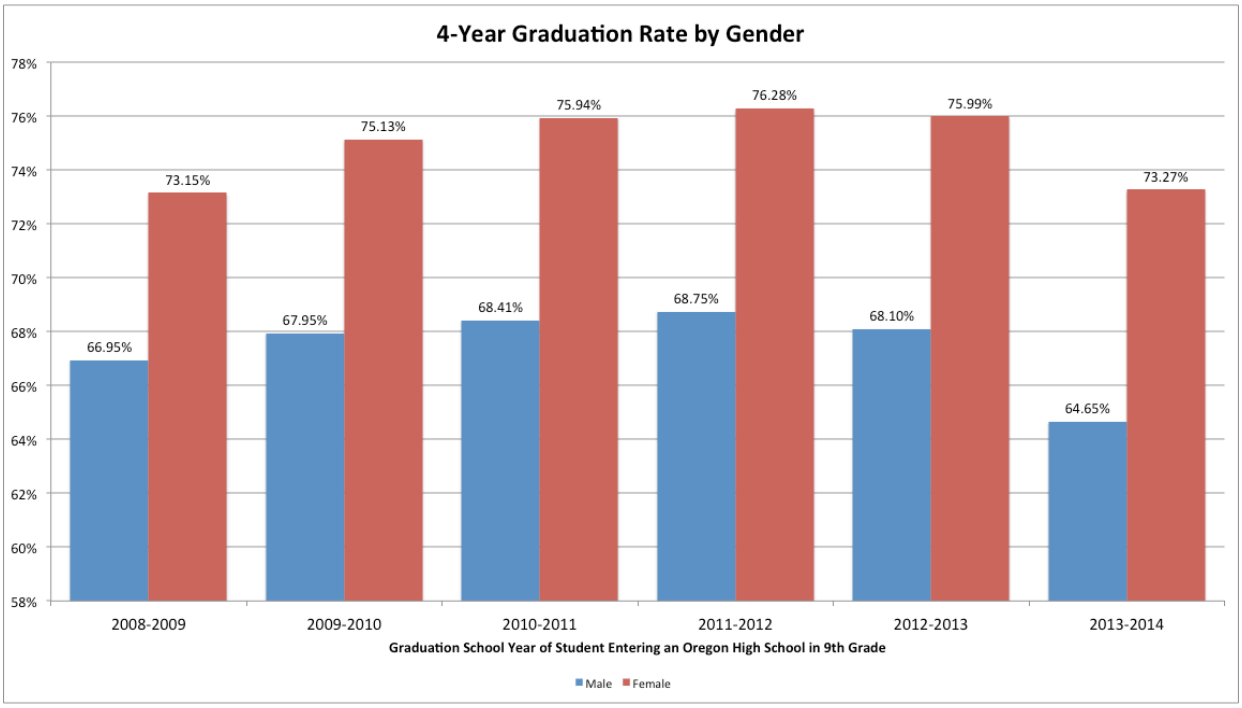


Table 1

VARIABLES	(1) HS Diploma	(2) HS Diploma	(3) HS Diploma	(4) HS Diploma	(5) HS Diploma	(6) HS Diploma
10th Grade Graduation		0.000987***	0.000900**	0.000759**	0.000704**	0.000524
		(0.000349)	(0.000382)	(0.000371)	(0.000316)	(0.000340)
Gender * 10th Grade Grad.			0.000167	0.000258		0.000338
			(0.000252)	(0.000260)		(0.000251)
Economic Disadvantage		-0.176***	-0.171***	-0.134***	-0.0840***	-0.0829***
		(0.00337)	(0.00400)	(0.00337)	(0.00229)	(0.00302)
Gender * Econ. Dis.			-0.00937**	-0.00351		-0.00170
			(0.00434)	(0.00454)		(0.00420)
Special Education		-0.167***	-0.175***	-0.0332***	-0.0382***	-0.0424***
		(0.00356)	(0.00485)	(0.00508)	(0.00342)	(0.00466)
Gender * Special Ed			0.0131***	-0.00641		0.00633
			(0.00474)	(0.00493)		(0.00469)
ESL		-0.00546	-0.000531	0.0595***	0.0239***	0.0277***
		(0.00545)	(0.00663)	(0.00641)	(0.00408)	(0.00612)
Gender * ESL			-0.00876	-0.00637		-0.00685
			(0.00665)	(0.00689)		(0.00664)
Male	-0.0725***	-0.0517***	-0.0572***	-0.0512	-0.0528***	-0.155**
	(0.00258)	(0.00229)	(0.0204)	(0.0646)	(0.00212)	(0.0691)
Other Race		0.00451	0.00192	0.00442	-0.00536*	-0.00634
		(0.00588)	(0.00662)	(0.00563)	(0.00311)	(0.00439)
Gender * Other Race			0.00507	0.00445		0.00215
			(0.00650)	(0.00634)		(0.00563)
Black		-0.0534***	-0.0494***	0.0157*	0.00260	0.00143
		(0.00642)	(0.0101)	(0.00918)	(0.00518)	(0.00824)
Gender * Black			-0.00762	0.000570		0.00237
			(0.0115)	(0.0104)		(0.0105)
Hispanic		-0.0140***	-0.00428	0.0232***	0.0107**	0.0194***
		(0.00537)	(0.00636)	(0.00628)	(0.00428)	(0.00597)
Gender * Hispanic			-0.0177***	-0.00890		-0.0158**
			(0.00675)	(0.00688)		(0.00683)
Attendance Rate					0.0189***	0.0190***
					(0.000217)	(0.000286)
Gender * Attendance						-0.000100
						(0.000381)
Discipline					-0.0974***	-0.104***
					(0.00247)	(0.00411)
Gender * Discipline						0.00952*
						(0.00556)

VARIABLES	(1) HS Diploma	(2) HS Diploma	(3) HS Diploma	(4) HS Diploma	(5) HS Diploma	(6) HS Diploma
8th Grade Reading Score				0.00441***	0.00369***	0.00378***
				(0.000247)	(0.000183)	(0.000231)
Gender * 8th Grade Reading Score				-0.000194		-0.000139
				(0.000285)		(0.000265)
8th Grade Math Score				0.00790***	0.00526***	0.00494***
				(0.000240)	(0.000160)	(0.000217)
Gender * 8th Grade Math Score				9.22e-05		0.000517**
				(0.000279)		(0.000250)
Non-Regular High School		-0.244***	-0.257***	-0.0513***	0.185***	0.177***
		(0.0126)	(0.0142)	(0.0142)	(0.0115)	(0.0130)
Gender * Non-Regular High School			0.0239**	0.0196*		0.0165
			(0.0108)	(0.0113)		(0.0106)
School Year Fixed Effects		Y	Y	Y	Y	Y
School Fixed Effects		Y	Y	Y	Y	Y
Observations	263,000	217,221	217,221	196,754	196,706	196,706

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2

Variable	Definition
Demographic Controls	
Unique student ID	Random number assigned to each student as an identifier
School year	The year the school year starts in
Enrolled grade	Grade that the student is enrolled in for that school year
Attending School	School that educates the student
Male*	Gender indicator of the student (1 if male, 0 if female)
Economically Disadvantaged*	Student comes from economically disadvantaged family, and is classified as such
Special Education (Sped)*	Student received special education services

English as a Second Language (ESL)*	Student is in Student in an English as a Second Language Program at some point in
Achievement Controls	
Chronic absenteeism*	Student missed more than 10% of school days for a year
Number of days present	Number of days that a student attended school.
Number of days absent	Number of days a student was absent.
In School Suspension (ISS)*	Whether a student received In School Suspension
Out of School Suspension (OSS)*	Whether a student received an Out of School Suspension
Student Expelled*	Whether a student was expelled
Discipline days	Number of days a student was disciplined, zero if expelled
Math score on standardized test	Score that a student received on the math standardized test in that year.
Read score on standardized test	Score that a student received on the reading standardized test in that year.
Science score on standardized test	Score that a student received on the science standardized test in that year.
Writing score for test students took	Based on the test taken
Race/ethnicity	
American Indian/Alaska Native*	Student Identifies as American Indian/Alaska Native.
Asian*	Student Identifies as Asian.
Asian and Pacific Islander*	Student Identifies as Asian and Pacific Islander
Pacific Islander and Hawaiian*	Student Identifies as Pacific Islander and Hawaiian
All Asian, Pacific Islander and Hawaiian*	All students who identify as Asian, Pacific Islander, and Hawaiian
Hispanic*	Student Identifies as Hispanic
White*	Student Identifies as white
Black*	Student Identifies as black
Multiracial*	Student Identifies as Multi-racial

Decline*	Student declined to report ethnicity. Since 2009, teachers are encouraged to fill in best guess of student's ethnicity.
Omitted Variables	
Talented and Gifted (TAG)*	Student is in the Talented and Gifted Program
Limited English Proficiency (LEP)*	Student is in the Limited English Proficiency program (interchangeable with ELL, but not with ESL)
Pregnant or parenting program*	Participants in a program for pregnant or parenting students, not all students who are pregnant or parenting
Homeless*	Student was homeless at some point in the year (only collected from 2012 school year, onward)
Freshman On Track*	Student is classified as on track in their freshman year. The percentage of students in their first year of high school, based on their high school entry (cohort) year, who have earned a minimum of 6 credits or 25% of the number required for high school graduation, whichever is higher, by the end of their first year of high school. This may be higher in districts that require more credits to graduate than the state's minimum (only collected from 2011 school year, onward)
Graduation Outcomes	
Outcome 1*	Adult high school diploma
Outcome 2*	Alternative Certificate
Outcome 3*	Continuing enrollment – past 4-year cohort
Outcome 4*	Deceased
Outcome 5*	Extended diploma
Outcome 6*	GED
Outcome 7*	Modified Diploma
Outcome 8*	Modified High School Diploma
Outcome 9*	Dropout/Non-completer
Outcome 10*	Regular 4-year High School Diploma
Outcome 11*	Regular High School Diploma (earned but not received) – includes students enrolling in community college courses
Outcome 12*	Transfer out of state/country
Outcome 13*	Transfer to a private school/home school

* Indicates a dummy variable where 1= the definition, 0= not in the group

Table 3

School Type	Description
ac	Alternative K-12 school
ae	Alternative elementary school
ah	Alternative high school
aj	Alternative junior high school
am	Alternative middle school
ap	Separate class group designed to best serve students' educational needs and interests
cc	Charter combined school
ce	Charter elementary school
ch	Charter high school
cm	Charter middle school
e	Provides regional educational services to school districts located within its territory
ep	ESD program
hp	Hospital program
le	K-8 school district
lh	9-12 school district
lu	K-12 school district
or	ODE operated school
pp	Private alternative program
ps	Private school
rc	Regular K-12 school
re	Regular elementary school
rh	Regular high school
rj	Regular junior high school
rm	Regular middle school
st	State agency acting as district
yc	Youth corrections school

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