THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF ECONOMICS

POLICY IMPLICATIONS FOR OVERMATCH

STEPHEN RAKOCZY
SPRING 2017

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Economics
with honors in Economics

Reviewed and approved* by the following:

Russell Cooper
Liberal Arts Research Professor of Economics
Thesis Supervisor

Russell Chuderewicz
Senior Lecturer
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

The purpose of this paper is to determine how public policy influences overmatch, wherein low ability individuals attend college. Overmatch is not defined as bad but rather unexpected, given the lower payoff of attending college for a low ability individual. Low ability individuals might be more inclined to attend college if public policy eases the cost of college, whether through grants or scholarships, student loans, institutional subsidies, or the creation of lower cost public colleges, which could all increase overmatch. Even though college attendance looks more attractive, lower ability individuals could face greater employment difficulty in the future compared to high ability individuals and may have been better off financially not attending college. The paper uses previous estimates of overmatch across 21 OECD countries along with several public policy variables to perform regressions and determine if there is a connection. The most significant variables in regards to overmatch are what percent of college costs are public rather than private, which captured the effects of all the different subsidies, and what percentage of students attend public universities. Both have quadratic relationships with the estimated overmatch variable, wherein at lower values overmatch falls and at higher values overmatch increases. This relationship holds even after removing Japan and Korea from the regressions, which may have been skewing the data. Even though higher levels of these variables are correlated with higher overmatch, there is evidence they could potentially decrease undermatch, wherein high ability individuals do not attend college. This is the tradeoff a nation faces when it considers how involved it becomes in higher education.

TABLE OF CONTENTS

LIST OF FIGURES iv

LIST OF TABLES v

ACKNOWLEDGEMENTS vi

Chapter 1 Introduction 1

- Two Period Discrete Model of College Decision 2
- Clarifications about Overmatch 3
- Overmatch in US and Japan Compared to Denmark 5

Chapter 2 Overmatch: Student Decision Factors 7

- Public Spending on College 7
- Taxes and Grants 9
- Student Loans 11
- Tuition 12
- Current Overmatch Equation 15

Chapter 3 Overmatch: Institutional Decision Factors 19

- Public College Attendance 19
- Public Spending Directed Towards Institutions 22
- New Overmatch Equation 25

Chapter 4 Undermatch 26

- Overmatch Variables 27
- Scholarships and Grants for Tuition 28
- What Proportion of Money Goes Towards Higher Education 30
- Undermatch Equation 31

Chapter 5 Focus on Japan and Korea 33

- The Importance of Student Decision 34
- What Drives High Overmatch in Japan and Korea 36
- Regressions without Japan and Korea 37

Chapter 6 Conclusion 40

Appendix A Data Tables 44

Appendix B Regression Result Tables 47

BIBLIOGRAPHY 51

LIST OF FIGURES

Figure 1.1. Overmatch vs Public, (Cooper and Liu, 2016, 40) (OECD, 2016b).....8

Figure 1.2. Overmatch vs Grants, (OECD, 2011, 264).....10

LIST OF TABLES

Table 1. Estimated vs Actual Overmatch....16

Table 2. Estimated vs Actual Overmatch with StudPub....25

Table 3. Estimated vs Actual Undermatch....32

Table 4. Data Table 1....44

Table 5. Data Table 2....45

Table 6. Data Table 3....46

Table 7. Regressions on Overmatch (Public, TaxRateSpending, Grants)....47

Table 8. Regressions on Overmatch (Public, TaxRateSpending, Grants, Studentloans)....48

Table 9. Regressions on Overmatch (Public, TaxRateSpending, Grants, Tuition)....48

Table 10. Regressions on Overmatch (Public, TaxRateSpending, Grants, StudPub)....48

Table 11. Regressions on Overmatch (Public, Grants, StudPub, Institution)....49

Table 12. Regressions on Overmatch (Public, Grants, StudPub, NSGfTmod)....49

Table 13. Regressions on Undermatch (Public, Grants, StudPub)....49

Table 14. Regressions on Undermatch (NSGfTmod, EdSpendingSpending, EdSpendingGDP, StudPub)....50

Table 15. Regressions on Overmatch without Japan and Korea....50

Table 16. Regressions on Undermatch without Japan and Korea....50

ACKNOWLEDGEMENTS

I would like to thank the Penn State Economics Department, which has treated me with nothing but respect and kindness, both as a student and as a TA.

Chapter 1

Introduction

Economists assume people choose to attend college based on ability. High ability individuals can learn with less effort than low ability individuals. Therefore, low ability individuals may find it a more profitable use of time to enter the workforce directly while high ability people use college to enhance their skills before entering. However, mismatch can occur, both with high ability individuals not attending college (undermatch) and low ability individuals attending college (overmatch).

This study will use data from 21 OECD countries to explore the phenomena of overmatch. Overmatch is calculated in the countries as the percent of college degree holders whose predicted probability of not attending was below the 20^{th} percentile of all predicted probabilities (Cooper and Liu, 2016, 8). The predicted probability of attending college is based on the Programme for the International Assessment of Adult Competencies (PIAAC), which performs "an OECD sponsored assessment of adult skills" (Cooper and Liu, 2016, 1). In this study a higher score indicates higher ability. For example, Denmark and Japan had a similar overmatch rate of 10.5% and 10.8% respectively but US had a lower rate of 4.5% (Cooper and Liu, 2016, 40). While overmatch can have several causes, the purpose of this paper is investigating how policy can impact overmatch. Moreover, while most policymakers are primarily concerned with undermatch, even policies to reduce undermatch can influence overmatch.

It should be noted that in literature, mismatch has been defined differently. Dillon and Smith focused on mismatch in America based on the type of colleges attended. In their paper, undermatch is a high ability individual attending a lower quality university while overmatch is a lower ability individual attending a high quality university (Dillon and Smith, 2013, 2). In contrast, the present paper defines mismatch based on whether or not the individual attended college.

Two Period Discrete Model of College Decision

The following two period discrete education choice model helps explain overmatch. An individual chooses to attend college today based on if the discounted present value of income from attending college is higher than that of not attending college. The respective incomes from not attending and attending college are:

$$Y(0, \theta)= \omega 1 + \frac{\omega 2 * h(0)}{R} + B$$

$$Y(\bar{e}, \theta)= \omega 1 * (1 - \bar{e}) - p\bar{e} + \frac{\omega 2 * h(\bar{e}) * \theta}{R} + B$$

The symbol $\bar{e}$ is the fraction of potential work time the individual spends in college (hence it must be between 0 and 1), θ is the individual's ability level, $h(\bar{e})$ is the return from attending college, $h(0)$ is the return from not attending college, $\omega 1$ is the wage earned in period 1 when the individual chooses whether or not to attend college, $\omega 2$ is the wage earned in period 2 after the individual has finished college (or not if they chose not to attend), p is tuition, B is an individual's initial endowment, and R is the rate by which period 2 earnings are discounted back to period 1. Assuming the individual knows their ability, they attend college if their ability is higher than θ^*, where:

$$\theta^* = \frac{h(0)}{h(\bar{e})} + \frac{(\omega 1 + p)\bar{e}R}{\omega 2 * h(\bar{e})}$$

The minimum ability θ* goes up as $\omega 1$, p and R increase but falls as $\omega 2$ increases.

Based on this equation, the high overmatch rate in a country like Denmark relative to others makes sense. The government pays for college, so while there is a cost to society in the form of taxes, the individual does not incur them until later in life when they work and pay a higher tax rate. In contrast to students paying for college like US and Japan, the Danish government pays all students $900 a month to go to college if they do not live at home (Noack, 2015). As was discussed above, θ* is directly related to the price of tuition, so if tuition is negative, θ* is very low. In other words, more low ability individuals attend college than would if they directly paid for it. While there is no immediate monetary cost besides housing (which the students would pay for even if they were not in college), there is still an opportunity cost: every hour spent studying is an hour less of potential income from working. Since 52.3% of the population surveyed for PIAAC attended college, it appears that for most individuals the benefit of "paid" college outweighed the opportunity cost of college (Cooper and Liu, 2016, 40).

Clarifications about Overmatch

This aforementioned description of overmatch does not define it as bad or even inefficient. Rather, overmatch is an unexpected decision given the tradeoff between going to college and earning more in the future versus working full-time and earning income today. One explanation is if someone does not know whether they are low or high ability. In that situation, they could make a decision different from if they had known their ability level. However, this model assumes the individual knows their ability level. This is a reasonable assumption, since

the individual knows how they performed during school and on tests in the past, which is a good indicator of ability, much like the PIAAC.

Another discussion point to help understand overmatch is peer effects. This means that the student's education depends not only on their performance but also on the performance of other students. For example, many high ability individuals in a class can makes the class more productive, improving the learning for all students. A low ability student might attend college then because the performance of higher ability individuals can improve their own experience and compensate for their ability. If the goal of attending college is to increase ability, this experience could turn a low ability individual into a high ability one. In such a case, overmatching would benefit the low ability student. Since ability is measured here by the PIAAC, peer effects do not need to be heavily considered. Since the overmatched group included low ability individuals who already attended college, a basic assumption is that, at least for those individuals, attending college did not make them high ability.

The past few points relate to why overmatch is important to study. Although overmatch is not inherently bad, a low ability student who attends college will probably have more difficulty than a high ability student. If they cannot finish college or perform poorly, it could reduce the potential earnings they expected from attending college, which might leave them worse off than if they had not attended college. If countries want to pursue policies to increase college attendance, they should understand the impacts of overmatch. Just as some policies could increase overmatch though, they could simultaneously reduce undermatch by assisting high ability individuals with low means, which is usually the main purpose of such policies. Countries can better consider the tradeoffs between the two types of mismatch with more information on the connection between policy and overmatch, which this paper seeks to do.

Overmatch in US and Japan Compared to Denmark

While Denmark was previously discussed, which follows "the continental European approach of state funding and provision [for college]" (The Economist, 2015), America offers an example of an alternative form of college policy. The American system is "more market based… [and consists] of mixed private-public funding and provision, with brilliant, well-funded institutions at the top and poorer ones at the bottom" (The Economist, 2015). While grants and scholarships exist, most individuals pay for their college, usually through private and federal loans. Private college tuition averaged $26,184 for 2014-2015, a 3.6% increase from the previous year, and public college averaged $6,371, a 3.3% increase (National Center for Education Statistics, 2016). An increasing tuition cost by itself would raise θ^*, meaning a higher ability is necessary for college to be the optimal decision. That means it is less common for low ability individuals to attend college, which is why overmatch is 4.5% in US as compared to 10.5% in Denmark (Cooper and Liu, 2016, 40).

Similar to US students, Japanese students pay for college, with "[t]uition fees at Japanese public universities [being] 535,800 yen, or $6,500" (International Student Insurance, 2016). Despite that, Japan has an overmatch rate 140% higher than US. It is also 2.8% higher than Denmark (Cooper and Liu, 2016, 40), where college is free. Based on this, the relation between educational policy and overmatch might be more complex than it first appeared to be based on US and Denmark.

The differences between these countries may indicate the role policy plays in overmatch. Instead of simply assuming P is lower in our model for countries like Denmark, let us instead assume P is constant but the student receives a subsidy covering 100S% of his tuition, which is

paid by a tax, T, that is levied on everyone. The discounted present value of earnings from not attending and attending college becomes:

$$Y(0, \theta) = \omega 1 + \frac{\omega 2 * h(0)}{R} + \text{B-T}$$

$$Y(\bar{e}, \theta) = \omega 1 * (1 - \bar{e}) - p(1 - S)\bar{e} + \frac{\omega 2 * h(\bar{e}) * \theta}{R} + \text{B-T}$$

The new minimum ability for college to be optimal is:

$$\theta^* = \frac{h(0)}{h(\bar{e})} + \frac{(\omega 1 + p(1 - S))\bar{e}R}{\omega 2 * h(\bar{e})}$$

Assuming S is greater than 0, the minimum ability would be lower than without S, which could lead to overmatch. The tax cancelled out, since it is paid regardless of whether or not the individual attends college. The next step is seeing if the data confirms what is expected.

Chapter 2

Overmatch: Student Decision Factors

To compare this theory to reality, let us connect the past overmatch data to policy measures. Variables in regressions performed by Stata are judged significant at the 85%, 90%, 95%, and 99% confidence level. Nothing below 85% is considered significant, though where possible 90% will be preferred. The results of the regressions are in Appendix B.

Public Spending on College

One simple measure is the percent of spending on college that is public rather than private. This serves as a proxy for S, since the government (and by default, the taxpayers) bears the cost rather than the student. By using Stata to regress Overmatch on Public, which is the percent of public college spending out of all college spending in 2012 (OECD, 2016b), Public has a negative coefficient. This would be the opposite of the expected relationship, since more public rather than private spending on education should lead to higher overmatch. However, the variable Public has a p-value of 0.52, which is too large to declare the variable significant at even the 85% confidence level. This regression would assume a linear relationship between Public and Overmatch, but if the relationship was non-linear, Public might be falsely ruled insignificant.

If the relationship was quadratic instead, Overmatch should be regressed on Public and Public2 (which is Public^2). Public and Public2 respectively have a p-value of 0.013 and 0.016, meaning both are significant at the 95% confidence level. The equation this yields is:

$$\text{Overmatch(Public)} = -0.45191*\text{Public} + 0.341*\text{Public}^2 + 0.2071351$$

By taking a derivative, the value for Public that minimizes Overmatch is around 66%. As Public approaches 66% from the left, Overmatch gets smaller; as Public increases from 66%, Overmatch increases. 15 of the 21 countries have a public spending percent greater than 66% (including Denmark at 94%) and the other 6 have a public spending percent less than 66% (including US and Japan at 37.8% and 34.3% respectively). This can be seen in Figure 1.1 below. Since the R^2 for this regression is about 30%, Public explains some of the variation in Overmatch but not all of it.

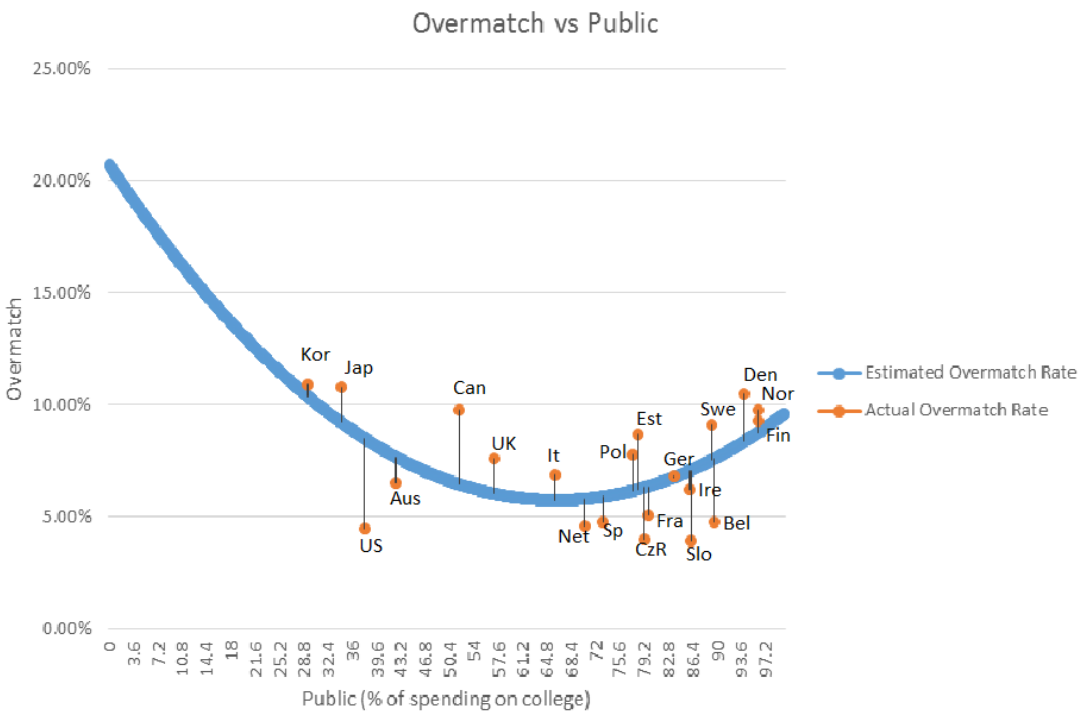

Figure 1.1. Overmatch vs Public, (Cooper and Liu, 2016, 40) (OECD, 2016b)

Taxes and Grants

Another variable to consider is taxes. In the discrete two period model, the tax was not included in the minimum ability equation because it is paid regardless of whether or not the person attends college, so it is a sunk cost. That would make sense for a flat tax, but since many countries have a progressive tax system, some people may benefit more from subsidies than they pay in taxes. At the same time, for someone paying more in taxes, it might reduce the benefits of subsides.

Our data uses a variable called TaxRateSpending, which is the tax on personal income (OECD, 2015) times how much of the country's budget is spent on college (OECD, 2016a). This should estimate relatively how much each person is contributing through taxes. By regressing Overmatch on Public, Public2 and TaxRateSpending, Public and Public2 both maintain their signs from the last regression and are significant at the 95% and 90% confidence level respectively. TaxRateSpending has a p-value of .204, which means it is not significant at even the 85% confidence level. This would seem to confirm the theory that since the taxes are a sunk cost, they are not significant in the college decision and by default overmatch. We will return to taxes again later.

We already discussed public spending on college in general but that spending can have multiple purposes. Since we are interested in how policy can affect an individual's choice to attend college, we will focus in on "subsides" such as grants and loans.

The variable Grants measures what percent of the country's expenditures on education in 2008 went towards scholarships and other grants (OECD, 2011, 264). If we regress Overmatch on Grants alone, the p-value for Grants is .407, meaning it is not significant at the 85% confidence level. By regressing Overmatch on Public, Public2 and Grants, Public and Public2

are significant at the 99% confidence level but Grants is only significant at the 85% confidence level. By regressing Overmatch on Public, Public2, Grants and Grants2 (which is $Grants^2$), Grants is now significant at the 90% confidence level but Grants2 is significant at the 85% confidence level. The next regression is Overmatch on Public, Public2 and lngrants (which is the natural log of Grants). Public and Public2 are still significant at the 99% confidence level while lngrants is significant at the 90% confidence level with a negative coefficient, which is the best regression so far.

This would indicate in this model that a country spending more on grants would have a lower overmatch rate. This is the opposite trend expected but since our R^2 is around 43%, this model does a better job explaining the variation in overmatch but still leaves much unexplained. Since Overmatch has a stronger correlation with the natural log of Grants rather than Grants itself, the curve for Overmatch shown in Figure 1.2 becomes less steep as Grants becomes bigger. Thus, if higher grants is connected to lower overmatch, grants would be most impactful when it is lower and less so as it increases. Moving from Grants of 10% to 40% in the graph only decreases Overmatch by 1 percentage point and since only two countries have a Grant variable greater than 20%, this is not the biggest contributor to overmatch. This paper will later explain how grants could potentially lead to lower overmatch.

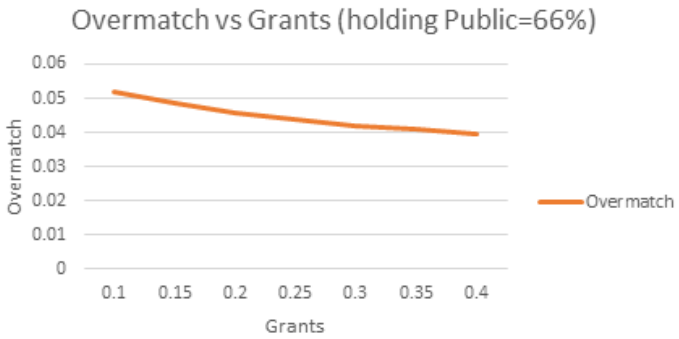

Figure 1.2. Overmatch vs Grants, (OECD, 2011, 264)

So far, Public, Public2 and lngrants were significant in a regression on Overmatch. The proxy tax variable, TaxRateSpending, was not significant. However, if a regression is performed on Overmatch for Public, Public2, lngrants and TaxRateSpending, all the variables, including the tax variable, are significant at the 95% confidence level. This seems to counter the past belief that the tax rate was not important when discussing overmatch. If the same regression is performed using the tax rate on personal income (OECD, 2015) instead of the variable TaxRateSpending, each variable is still significant at the 95% confidence level. In both cases, the tax variable has a positive coefficient, meaning a higher tax rate is associated with higher overmatch. This relationship might reflect correlation but not causation. For example, Scandinavian countries have both higher overmatch rates and higher tax rates, such as Denmark with the third highest overmatch rate at 10.5% (Cooper and Liu, 2016, 40) and the highest tax rate on personal income at 23.8% (OECD, 2015).

Student Loans

Another form of student aid is loans. StudentLoans measures what percent of the country's expenditures on education in 2008 were loans to college students (OECD, 2011, 264). Regressing Overmatch on StudentLoans shows StudentLoans has a positive coefficient and a p-value making it significant at the 90% confidence level. If that same regression is performed with Public and Public2, StudentLoans is significant at the 85% confidence level. Adding lngrants to the regression makes StudentLoans not significant at the 85% confidence level. If the regression was performed with the natural log of StudentLoans instead of StudentLoans (which is the variable lnloans), lnloans is even less significant than StudentLoans.

Based on these regressions, student loans (at least based on the current measure used) are not significant in regards to overmatch. To understand why, a new equation for the discounted present value of earnings of a college graduate is shown below:

$$Y(\bar{e}, \theta) = \omega 1 * (1 - \bar{e}) - p(1 - L)\bar{e} + \frac{\omega 2 * h(\bar{e}) * \theta}{R} - \frac{ip\bar{e}L}{R} + B$$

The symbol L is the percent of tuition covered by the loan, which means $p\bar{e}L$ is the total amount of the loan. The symbol i is the accumulated value of $1 over one period at the interest rate charged on a student loan. $ip\bar{e}L$ then is how much the student repays in the second period after graduation. If the interest rate charged on the student loan is close to the rate at which the student discounts their earnings, we can assume R=i, so the equation simplifies to:

$$Y(\bar{e}, \theta) = \omega 1 * (1 - \bar{e}) - p\bar{e} + \frac{\omega 2 * h(\bar{e}) * \theta}{R} + B$$

The symbols L and i drop out of the equation. Since the above equation did not change, the equation for the minimum ability that makes college optimal did not change either, so student loans do not contribute to more low ability individuals attending college. Thinking of student loans as a subsidy then is a mistake, since it is more of an investment. This explanation only works if R=i though.

Tuition

Another variable to test is the binary variable, Tuition (OECD, 2011, 266). If there is tuition, the variable is 1. If there is no tuition, like in Denmark, the variable is 0. For perspective, "[i]n eight OECD countries, public institutions charge no tuition fees, but in one-third of countries with available data, public institutions charge annual tuition fees in excess of [$1500] for national students" (OECD, 2011, 256). One consideration is that a country could have no

tuition at public universities but allow private universities to charge tuition. When Tuition is regressed on Overmatch along with all the other variables previously found to be significant, the other variables remain significant for at least the 90% confidence level. Tuition however has a p-value of 0.904, making it highly insignificant.

This result might seem surprising, since a lower tuition price lowers θ*, the minimum ability for college to be optimal. With no tuition, the price is zero and θ* should be at its lowest possible point for the country, barring students being paid to attend college. One reason for this result is that Tuition is a redundant variable. Public measures what percent of college costs are borne by the government and this variable should be higher, everything else equal, if the government ended tuition and paid the students' costs itself. The correlation coefficient of -0.5773 between the two variables supports this assumption. Thus, Public already captures the effect of no tuition.

Another reason is that even if there is tuition, there still may be price controls that keep the price low and close to zero (relative to what it would otherwise be). There also might be an inconsistent application of tuition policies. For example, since 2005 the 16 German *Länder* (similar to states in the United States) were allowed to determine tuition. Some *Länder* allowed tuition but there is variation in the rates, so one might have high tuition while another has tuition at effectively zero. Furthermore, most *Länder* do not impose any tuition for initial education, so despite there being no national policy banning tuition, that is the reality for most students (OECD, 2011, 266). Given the problems inherent in the variable Tuition, Public is a much better variable that captures the same impacts.

A better variable than Tuition might be NSGfT. This acronym stands for No-Scholarships/Grants-for-Tuition and is the percentage of students by country in academic year

2010-2011 who did not receive scholarships or grants in support of tuition fees (OECD, 2013, 234). Essentially, it is the percentage of student who do not benefit from subsidies to help pay for their tuition. Based on theory, if a country has more students that do not benefit from these programs, overmatch should be lower. The OECD also lists as variables the percentage of students who benefit from scholarships or grants in amounts greater than tuition fees, equal to tuition fees, or less than tuition fees. These variables would be more insightful than how many students did not receive any assistance, since it would show how different levels of assistance relative to tuition could influence tuition. We do not use them because they are not listed for most countries and thus do not provide insight. NSGfT has the most country data provided so it is used. However, even this variable is limited because it only provides data for 10 of the 21 listed countries, so it is also not very insightful.

Tuition is not a good variable because it did not capture potential tuition price ceilings or subsidies in each country and NSGfT is not a good variable because of lack of data. However, the two variables could be combined into NSGfTmod, which has a value of 0 if there is no tuition and the value of NSGfT if there is tuition. If a country has no tuition, it is logical that NSGfT would be zero because all students would be receiving support for tuition. This measure provides data for 16 of the 21 countries, which provides more reliable results. A potential issue is that students might view scholarships or grants differently than a student would view "free" education. Since the student sees how much money they receive in a scholarship, they might view it as a social investment in them by society. "Free" tuition is also a social investment by society but since the student does not see how much money they receive and instead just knows they are not paying, the student may view it as an entitlement. We will ignore this potential

distinction because if the student is making the decision based on how much they are paying or not paying (irrespective of what type of policy it is under), the effects should be the same.

A regression of NSGfTmod on Overmatch gives a p-value of 0.500, which is not significant at the 85% confidence level. However, the coefficient on NSGfTmod is negative, meaning that if more students are not benefitting from the tuition subsidies, overmatch should be lower. For a regression run using NSGfTmod and variables already found to be significant, the sign of NSGfTmod is positive and its p-value is 0.808, which is still not significant at the 85% level. Every other variable is significant at the 5% level besides lngrants, which has a p-value of 0.532. This is most likely because NSGfTmod looks at how many students did not receive scholarships or grants for tuition, so the effect of lngrants is captured in NSGfTmod and lngrants loses significance.

To test if the relationship between NSGfTmod is quadratic rather than linear, the variable NSFfTmod2 is created, which is NSGfTmod squared. The previous regression is run again including NSGfTmod2 but excluding lngrants. Every other variable is significant at the 95% confidence level but NSGfTmod and NSGfTmod2 respectively have p-values of .250 and .285, which is better than before but not strong enough to prove significance. For this reason, NSGfTmod will not be included in the equation for overmatch and lngrants will. However, we will revisit this variable with a different outcome later in our discussion on undermatch.

Current Overmatch Equation

The equation for overmatch as it now stands is:

$$\text{Overmatch} = -0.3625817*\text{Public} + 0.2749699*\text{Public}^2 - 0.012351*\ln(\text{Grants}) + 6.248445*\text{TaxRateSpending} + 0.1307406$$

The tax variable has a positive relationship with Overmatch, Grants has a negative relationship, and Public has a negative relationship when it is below 66% and a positive relationship when it is above 66%. The R^2 of this regression is about 58%, so the regression explains over half of the variation in Overmatch.

With this regression in mind, let us return to our initial discussion on Denmark, Japan, and US. Below is Table 1 with the variable values and estimation of overmatch from the above equation, which gives a closer look at how well this regression models the countries:

Table 1. Estimated vs Actual Overmatch

(OECD, 2016b) (OECD, 2011, 264) (OECD, 2015) (OECD, 2016a) (Cooper and Liu, 2016, 40)

Country	Public	Grant	TaxRateSpending	Estimated Overmatch	"Actual" Overmatch	Difference
Denmark	94.0%	24.0%	0.8806%	10.553%	10.5%	0.053%
Japan	34.3%	0.6%	.0990%	10.810%	10.8%	0.010%
US	37.8%	15.5%	.3220%	7.612%	4.5%	3.112%

The regression explains Japan and Denmark well but US has a relatively large difference of over 3 percentage points between its estimated overmatch rate and the one from the data. Based on this, Denmark's high Public value might well explain its high overmatch rate, since Denmark's Public is well above the 66% threshold.

By that same logic, since Japan and US have Public variables below the 66% mark, their overmatch rates should increase as Public gets smaller. Despite having similar Public values, Japan has an estimated overmatch rate more than 3 percentage points higher than US, which might relate to how much higher the Grant variable is for the US. Since both Japan and US have education systems where students pay tuition, if grants are very low like in Japan, overmatch might be higher because in the absence of assistance, only wealthier individuals would attend college, including some that are not high ability. This is counter to the model, which says that endowments from parents (B) do not influence the decision to attend college. Also, if low ability wealthier individuals were attending college, it would counter the model's assumption that college is only an investment based on ability. A taste term, ε, which indicates enjoyment from attending college besides higher earnings, could rectify this.

This theory is backed by research published by Dillon and Smith on mismatch based on the type of college attended in America. Their paper used the alternative definition of overmatch in which a low ability individual attends a high quality university, but it is still applicable. Based on their measure of mismatch (which used different data than the PIAAC), 15% of those they defined as "very overmatched" belonged to the lowest wealth quartile, called wealth quartile 1. 20% were from quartile 2 and 24% were from quartile 3. Most of the "very overmatched" group though belonged to the highest wealth quartile, which constituted 41%, almost twice as much as the previous quartile (Dillon and Smith, 2015, 41). Their research showed both higher household income and higher parental education (which they interpreted as a proxy for wealth) relating to higher overmatch (Dillon and Smith, 2015, 21-22). Such students are more informed in Dillon and Smith's opinion, causing the students to think the benefits "associated with overmatch overshadow any negative effects" (Dillon and Smith, 2015, 4). Another explanation could be that

given the success of his parents, the student feels inclined to attend a better college even if they are low ability, which reflects a taste term.

Dillon and Smith's research explains why wealthier individuals could overmatch under their definition by attending high quality universities despite being low ability. Based on this, it is reasonable to assume wealthier individuals could also overmatch under the present paper's definition by attending college despite being low ability. If high ability individuals with less means are unable to attend college, given a low level of policy assistance, but low ability wealthier individuals can, the expected overmatch rate would be higher. This would fit the aforementioned results in this paper, where countries with a lower Public variable have a higher overmatch rate.

Chapter 3

Overmatch: Institutional Decision Factors

The past discussion has primarily focused on why low ability individuals attend college based on policy, leading to overmatch. However, for those individuals to attend college, the institutions must be willing to accept them. For this reason, the next discussion point is how public policy affecting institutions impacts overmatch.

Public College Attendance

One new variable is StudPub, which measures the percent of students enrolled in a public university in academic year 2008-2009 (OECD, 2011, 266-267). If a government is pursuing a policy of higher college attendance but private universities are not willing to increase attendance, more students could attend public universities. In this scenario, the public universities would have a lower standard for entrance than other institutions, such as community colleges in the United States compared to Ivy League Universities. If this were the situation, there would be a matching between the lower ability individuals wanting to attend college and these colleges looking to attract such individuals. Based on this assumption, there would be more overmatch if a higher percentage of the students were attending public universities.

While the above paragraph explains how institutional public policy can lead to overmatch, there are a few problems to discuss. The first problem is it assumes public universities always have a lower entrance standard than private universities. However, in many

countries public universities hold a prestigious reputation. For example, the seven former imperial universities, of which the University of Tokyo is the most famous, are considered the "elite" universities in Japan (Kitagawa and Oba, 2010, 515). These universities, like others in Japan, require the students to pass a college entrance exam before they are accepted (Nakamura, 2003, 199) so these public universities do not have a lower entrance standard. A better way to understand is that there are at least two types of public universities: those whose goal is high quality education for high ability individuals, like the former imperial universities of Japan and Penn State; and those with the political goal of increasing college attendance rates, which may involve accepting lower ability individuals and increasing overmatch. Since it is hard to separate the two based on the given data, StudPub will suffice for now.

Another issue is that the discussed model assumed there is a clear distinction between public and private universities. In terms of funding, that distinction can be blurry. Of the 21 countries studied, only three (US, Japan, and Korea) had more than 15% of their students attend a private university that is not dependent on the government (OECD, 2011, 266-267). The rest of the students attend either a public university or a private university that is dependent on the government. As such, those private institutions may function similarly to public universities. For example, if a government is pursuing higher college attendance, it could influence acceptance rates at private universities based on funding appropriations. This issue could be resolved by later examining the level of funding for institutions rather than just the percent of students attending.

With the discussion on the variable and its issues concluded, a regression is performed on Overmatch using StudPub and the past variables found to be significant. StudPub has a p-value of 0.881, well below the 85% confidence level. One possible reason for this result is that the

relationship between StudPub and Overmatch could be something besides linear, like how Public had a quadratic relationship with Overmatch. To test this, the same regression is performed, except using both StudPub and StudPub2, which is StudPub squared. Now StudPub and StudPub2 have respective p-values of 0.080 and 0.078, making both significant at the 90% confidence level. Public, Public2, and lngrants are significant at the 98% confidence level but TaxRateSpending now has a p-value of 0.149, which is almost not significant at the 85% confidence level.

Based on this, the regression is performed again without TaxRateSpending. Every variable, including both StudPub and StudPub2, are significant at the 95% confidence level. It was previously discussed that TaxRateSpending should not be significant based on theory but was in a past regression, possibly due to a correlation from a lurking variable rather than a causality. By including StudPub, it removes some omitted variable bias and TaxRateSpending loses significance. The R-squared value is also 64.14% for this regression, which means this regression does the best of those discussed so far at explaining the model.

The new equation for overmatch is:

$$\text{Overmatch} = -0.6842436*\text{Public} + 0.5300349*\text{Public}^2 - 0.0107007*\ln(\text{Grants}) - 0.1717461*\text{StudPub} + 0.1657883*\text{StudPub}^2 + 0.2595538$$

Since StudPub has a negative coefficient but StudPub2 has a positive coefficient, the relationship between Overmatch and StudPub changes at different values. By taking a derivative of the above equation in terms of StudPub, the value of StudPub minimizing Overmatch is 51.8%. As StudPub approaches 51.8% from the left, Overmatch falls; as StudPub increases from 51.8%, Overmatch starts to rise.

This trend is similar to the one seen with Public and might have a similar explanation. In the absence of any public university, lower income high ability individuals might have difficulty affording school but higher income individuals could attend, including some who are low ability but attend for reasons besides a future investment, leading to overmatch. If more people are able to attend public universities, the budget constraint is less strict for low income, high ability individuals. After a certain level, the public universities are not attracting additional high ability individuals but lower ability individuals, increasing overmatch.

This explanation helps with the previously discussed conflation between the two types of public universities with different goals. If there is a lower percentage of students attending public universities, like in Japan where the rate is 25% (OECD, 2011, 267), a reasonable assumption is that the public universities' goals is offering a high quality education to high ability individuals. If the percentage is much higher, a reasonable assumption is that while there may be many public universities operating with the aforementioned goal, there are also many operating with the political goal of increasing college attendance.

Public Spending Directed Towards Institutions

Another variable to consider is Institution, which measures direct public expenditures to institutions as a percent of total spending on education in that country in 2008. Notice that this variable does not differentiate between expenditures to public institutions and expenditures to private institutions. Poland has the highest measurement at 98.4% and UK has the lowest at 46.7%. Among the three main countries we have used as examples (Denmark, Japan, and US), the rates are 71.6%, 74.6%, and 79.7%, which means all of them appropriate roughly the same

proportion of resources to colleges (OECD, 2011, 269). If this variable is higher, the colleges in that country are more subsidized, which should expand supply of education all else equal. If these subsidies make colleges willing to supply more education, meaning they are willing to accept more students, then that could explain why low ability students are accepted. Once again, the low ability students choose to apply for college but the schools must be willing to accept them.

To test this theory, Institution is regressed on Overmatch. Institution has a negative coefficient but if more expenditure to institutions is expected to increase overmatch, the expected sign is positive. This variable has a p-value of 0.264, so it is not significant at the 85% level. A new regression is performed to include all the past variables found to be significant (Public, Public2, lngrants, StudPub, StudPub2). Public, Public2 and lngrants are all significant at least at the 95% level but StudPub, StudPub2 and Institution have p-values respectively of 0.236, 0.172, and 0.651, making none of them significant at the 85% level.

It should be noted that the variables influencing the student's decision to attend college are all significant but the variables relating to institutions were insignificant. This might indicate that overmatch is more related to a decision by the student than by an institution. We will revisit this theme later. It should also be noted that this regression does not disprove the previously found significance of StudPub. If there more students attend public universities, meaning StudPub is higher, public spending towards institutions should also be higher since the government directly finances public universities. This interaction effect could be the reason StudPub looks relatively insignificant now under the new regression. The p-values for StudPub and StudPub2 were both at least 40 percentage points lower than the p-value for Institution, so StudPub is relatively significant compared to it.

This regression is run again to include Institution2, which is Institution squared. Like the last regression, the variables impacting the student's decision are significant at the 95% level but the variables relating to the college's are not. StudPub and StudPub2 have p-values of 0.237 and 0.189 while Institution and Institution2 have p-values of 0.666 and 0.629, indicating that while all are insignificant at the 85% level, variables relating to StudPub are at least more significant. The R-squared value of this regression is 0.5297, which is less than the R-squared value 0.6568 in the last regression. Based on these results, Institution2 is not only insignificant but also reduces how well the regression models the data. For these reasons, Institution and Institution2 should not be included in the equation for Overmatch.

To further reinforce this decision, the regression is performed once more to include Institution and Institution2 and none of the StudPub variables. The p-values for Institution and Institution2 are 0.378 and .308, indicating that even after removing the interaction effect of StudPub, Institution is still insignificant. If the regression is performed with Institution and not Institution2, Institution has a p-value of 0.158, which is more significant but misses the cutoff to be considered significant at the 85% confidence level. Since regressing Institution without StudPub is not significant but regressing StudPub and StudPub2 without Institution is significant, the latter will be used for our Overmatch equation.

New Overmatch Equation

Since Institution is not significant but StudPub is, the equation still stands as:

$$\text{Overmatch} = -0.6842436*\text{Public} + 0.5300349*\text{Public}^2 - 0.0107007*\ln(\text{Grants}) - 0.1717461*\text{StudPub} + 0.1657883*\text{StudPub}^2 + 0.2595538$$

With this in mind, let us see if this new variable improves our estimates of overmatch in the Table 2 below:

Table 2. Estimated vs Actual Overmatch with StudPub (OECD, 2016b) (OECD, 2011, 264, 266-267) (Cooper and Liu, 2016, 40)

Country	Public	Grant	StudPub	Estimated Overmatch	"Actual" Overmatch	Difference
Denmark	94.0%	24.0%	100%	9.402%	10.5%	-1.098%
Japan	34.3%	0.6%	25%	10.939%	10.8%	0.139%
US	37.8%	15.5%	68%	5.647%	4.5%	1.147%

StudPub is unavailable for Denmark but 100% is used because while there are private universities in Denmark, the government covers all tuition costs so these institutions can be considered to function similar to public universities. Both Denmark and Japan have a larger difference than last time but the values are small enough for the estimates to be considered close. The difference for US is almost 1 percentage point, which is better than the 3 percentage points it was for the last estimate. Since these estimates are close and the R-squared value is above 60%, this model succeeds at explaining at least some of the variation in overmatch across countries.

Chapter 4

Undermatch

The above estimates show that at least for higher levels of public spending on college, there is a correlation with higher overmatch, though lower levels of public spending have the opposite trend. However, even if more public support for college greatly increased overmatch, a counterargument is that it reduces undermatch by helping high ability individuals with low incomes. To see if there is merit to this counterargument, we can run regressions on Undermatch, similar to how we ran regressions on Overmatch. Undermatch is calculated in each country as the percent of non-college attendees whose predicted probability of attaining a college degree exceeded the 80th percentile of predicted probabilities (Cooper and Liu, 2016, 8). A possible assumption is that countries with higher overmatch must have less undermatch. However, the correlation coefficient for the measures of undermatch and overmatch used here is -0.047, so while the relationship between the two variables is negative, it is very weak.

For perspective, the average value of Undermatch is 9.20% and the standard deviation is 2.43%. Denmark, Japan and US respectively have rates of 9.30%, 7.80% and 5.50% (Cooper and Liu, 2016, 40). Denmark exemplifies a country expected to have higher overmatch because it has no tuition. By that logic, it should also have lower undermatch by removing the financial constraint that would prevent poorer high ability individuals from attending college. Instead, Denmark has an undermatch value almost the same as the average. US and Japan are counterexamples because students both pay tuition and have less costs covered by the government compared to other countries. For example, on average 71.33% of spending for tertiary education is public rather than private but both Japan and US have less than 40% of tertiary education spending as public (OECD, 2016a). Since the students pay a greater cost

compared to other countries, undermatch should be higher since some poorer high ability students could likely not afford to attend college. However, both Japan and US had lower undermatch than average, indicating the model is not explained so simply. To get more perspective, regressions are needed

Overmatch Variables

The first regression performed on Undermatch is all the variables previously found to be significant in regards to Overmatch (Public, Public2, lngrants, StudPub, StudPub2). None of these variables are significant at the 85% confidence level. Public and Public2 both have p-values over 0.90 while lngrants has a p-value of 0.723. StudPub and StudPub2 have p-values of 0.292 and 0.214 respectively, indicating that they are relatively more significant than the other variables. To test if StudPub has true significance, StudPub and StudPub2 are regressed alone on Undermatch, giving respective p-values of 0.211 and 0.125. StudPub is not significant at the 85% confidence level but StudPub2 is and has a positive sign. Regressions using Public, Public2 and lngrants in a variety of different combinations fail to show significance for these variables and thus are not used to model undermatch.

The significance of StudPub2 with a positive sign would imply that if more students attend public universities, there is higher undermatch. If there were more public universities created with the goal of offering low cost education, undermatch should be lower since high ability individuals with low incomes could better afford the low cost public universities. One reason that relationship is not seen is because many public universities are not created for the political goal of lower cost education. Rather, they are profit-maximizing schools that happen to

be public. Another reason is that if a college is created with the political goal of low cost education, it might be in response to a high undermatch rate. This would mean that because undermatch is high in that country, the government creates more public universities. In that case, the undermatch rate influences the variable StudPub and not vice versa.

Scholarships and Grants for Tuition

A better variable to measure undermatch could be NSGfTmod. As a reminder, the acronym NSGfT stands for No-Scholarships/Grants-for-Tuition and is the percentage of students by country in academic year 2010-2011 who did not receive scholarships or grants in support of tuition fees (OECD, 2013, 234). If more students do not benefit from this assistance, undermatch could be higher since poorer high ability individuals would face greater difficulty attending college. The variable NSGfTmod is measured such that if there is no tuition in that country, the variable is 0 since all students are fully assisted in regards to paying for school. If there is tuition, this variable takes on the value of NSGfT.

Regressing NSGfTmod on Undermatch shows that the sign of NSGfTmod is positive, indicating that if fewer students receive scholarships or grants, undermatch is higher. However, its p-value is 0.829, which is too high to declare significant. A second regression is performed on Undermatch using NSGfTmod and NSGfTmod2, which is NSGfTmod squared. The two variables have respective p-values of 0.063 and 0.050, making both significant at the 90% confidence level. This regression gives the equation:

$$\text{Undermatch} = 0.1405474*\text{NSGfTmod}^2 - 0.121718*\text{NSGfTmod} + 0.0955729$$

By taking a derivative and setting it equal to zero, an NSGfTmod value of 43.3% minimizes Undermatch. As NSGfTmod approaches 43.3% from the left, Undermatch gets smaller. As NSGfTmod moves away from 43.3% and grows larger, Undermatch increases. We expect the latter trend, since undermatch should be higher if less people benefit from tuition assistance. This regression has an R-squared value of 0.2660, so it models at least some of the variation in Undermatch. The surprising result is that at lower values of NSGfTmod, Undermatch is decreasing. However, this might just be a result of the variable's definition. All countries without tuition have a value of zero for this variable but they could vary in other ways that would influence undermatch, even though the current measurement says they are the same.

The six countries with an NSGfTmod value of 0 have an average Undermatch value of 9.60%, while the other countries with NSGfTmod greater than 0 have an average Undermatch value of 9.11%. Based on the average, the countries without tuition are not very different from the countries with tuition. However, those countries with NSGfTmod greater than 0 have an average NSGfTmod value of 69.10% and if a country is below the average, Undermatch has an average of 6.20%. If a country is above the average of NSGfTmod when the variable is greater than zero, average Undermatch is 9.84%. This indicates that countries with smaller non-zero values of NSGfTmod have lower Undermatch values, which is expected. Since only three countries are below the average NSGfTmod, there might not be enough data for the estimate to be credible. If the median non-zero NSGfTmod value of 81.00% is used instead, countries below the median have an average Undermatch value of 6.96% while those above or at the median have an average of 10.54%. This supports the aforementioned assumption that less students benefitting from tuition assistance would lead to higher undermatch.

What Proportion of Money Goes Towards Higher Education

Another variable to consider is how much public money the country allocates towards tertiary education. We said previously Public is not significant, so the variables EdSpendingSpending and EdSpendingGDP might be better. The former measures what percent of the country's public spending was allocated towards tertiary education in 2012 and the latter measures how much money was allocated towards tertiary education in 2012 as a percent of GDP (OECD, 2016a). Both measurements offer advantages. Finding the allocation as a percent of the budget indicates what level of importance higher education holds in that country. However, a country can allocate a higher percent of its budget towards higher education but if the budget itself is small, the spending might be negligible. Finding the allocation as a percent of GDP could be better, since it shows how impactful that money can be relative to how much the country produces. In either case, a higher level of spending should decrease undermatch, since the government is investing more in college and potentially reducing the financial burden students face to attend college.

The first regression on Undermatch uses EdSpendingSpending as well as NSGfTmod and NSGfTmod2 (which were previously shown to be significant). Both NSGfTmod and NSGfTmod2 are significant at the 95% confidence level and retain their previous signs. EdSpendingSpending has a p-value of 0.080, making it significant at the 90% confidence level. It also has a negative sign, indicating that higher spending towards tertiary education correlates with lower undermatch, as expected. The same regression is performed with EdSpendingGDP in place of EdSpendingSpending. NSGfTmod and NSGfTmod2 are now significant at the 99% confidence level, making their relationship with Undermatch stronger. EdSpendingGDP has a p-value of 0.028, making it significant at the 95% confidence level, which is stronger than

EdSpendingSpending. The sign of its coefficient is negative, so the expected relationship holds. For this reason, EdSpeningGDP will be included in the equation for Undermatch, which now has an R-squared value of 0.5177, which is higher than the value of 0.2660 the regression has when it only includes NSGfTmod and NSGfTmod2.

Since StudPub2 by itself is significant at the 85% confidence level, it is included in the next regression run to see if it still holds significance when combined with the other variables. NSGfTmod and NSGfTmod2 are significant at the 95% confidence level while EdSpendingGDP is significant at the 90% confidence level. All three of these variables retain their signs from the past regression. StudPub2 still has a positive sign like it did before but it now has a p-value of 0.379, which is insignificant. For this reason, it is not included in the equation for Undermatch.

Undermatch Equation

The current Undermatch equation is:

$$\text{Undermatch} = -0.1996183*\text{NSGfTmod} + 0.1979279*\text{NSGfTmod}^2 - 3.38624*\text{EdSpendingGDP} + 0.1581091$$

To see how well this equation matches the data, the equation's estimate for Undermatch is generated for Denmark, Korea and US. Korea is used in place of Japan because Japan does not have a value for NSGfTmod, but Korea has similar educational policies, cultural customs, and mismatch values compared to Japan, which will be explored more later. The results are displayed in the Table 3 on the next page:

Table 3. Estimated vs Actual Undermatch

(OECD, 2013, 234) (OECD, 2011, 266) (OECD, 2016a) (Cooper and Liu, 2016, 40)

Country	NSGfTmod	EdSpendingGDP	Estimated Undermatch	"Actual" Undermatch	Difference
Denmark	0%	2.20%	8.361%	9.3%	-0.939%
Korea	57%	0.90%	7.816%	8.3%	-0.484%
US	37%	1.40%	6.394%	5.5%	0.894%

Based on these values, it appears Denmark is the most generous to its students, because it does not have tuition and spends the most on college of the three relative to its GDP. US is the second most generous and Korea is the least generous, since US spends more on higher education and also has a smaller percent of students not benefit from scholarships or grants. Denmark would be expected to have the least undermatch but it does not, whether because there is information missing in the model or there is an error in estimating undermatch, which was subjectively measured rather than being a concrete number. However, since US is more generous than Korea, it is expected to have less undermatch, as shown in both the estimate and given value of undematch. Korea's estimate is less than half of a percentage point different from its given value and Denmark and US have estimates less than one percentage point different from their given values, so the model succeeds in explaining at least some of the variations in undermatch.

Chapter 5

Focus on Japan and Korea

Since we now have a basic understanding of how overmatch and undermatch relate to policy, Japan and South Korea deserve particular attention. Both are countries with a low amount of public support for higher education. For example, Japan and Korea have the lowest amount of money allocated to higher education as a percent of GDP (OECD, 2016a). Korea and Japan also respectively have the lowest percent of college spending that is public compared to private (OECD, 2016b). Based on this, they would be expected to have the lowest overmatch and the highest undermatch if more public assistance decreases undermatch while increasing overmatch. As we saw previously, that relationship is not always clear cut, and unexpectedly, these countries have an undermatch rate about one percentage point below the average and the highest overmatch rate. The fact that higher overmatch is observed for lower levels of the variable Public when Public is below 66% was discussed previously. One explanation is higher overmatch among wealthier students without being offset by higher ability, low-income students who could not afford college. However, Japan and Korea might be generating the quadratic relationship between Public and Overmatch because they have different qualities from other countries observed.

The Importance of Student Decision

The regressions on Overmatch show more significance among the variables relating to the student's decision than the college's decision. This might reflect that in most countries, overmatch is largely determined by student choices and less so institutional decisions. The aforementioned paper by Dillon and Smith similarly concludes that mismatch in America is based on student decisions and has little connection with institutions (Dillon and Smith, 2015, 4). It probably also holds true in the United Kingdoms, where "[s]tudents once competed for a limited number of spaces; now universities do battle to enroll as many scholars as they can" (The Economist, 2017). This is in part reflects reforms in 2012 that tripled the maximum tuition universities could charge, which made them willing to accept more students and led to more competition between universities (The Economist, 2017). Due to this high competition, student choice is a big factor in higher education and is likely to influence the overmatch decision. These two examples give power to the assumption that overmatch is largely determined by factors influencing student choice.

Japan and South Korea might be exceptions then and exemplify countries where student choice is less important. This might be due to the importance of college entrance exams in their cultures. In Japan, the National Center Test for University Admissions is "required for applicants to the 82 national universities and 74 municipal universities as the first stage of the screening process" and tests the students on five main categories: Japanese, social studies, foreign language, science and math (Kimaya, 2017). Performance on the center exam determines entrance to public universities but private colleges, which "account for more than 70 percent of all Japanese college students", also have their own exams (Kimaya, 2017). In South Korea, the exam is called the College Scholastic Ability Test, or *Suneung*. Unlike the US, where exams

such as the SAT or ACT are one small factor considered when applying for colleges, exams in Korea and Japan are the determining factor for entrance. Those who do not pass may retake the exam in a year. Some Koreans can obtain entrance through the *Susi* process, which focuses on GPA, extracurricular activities, essays and interviews, but this process is frowned upon for being "the easy way" (Diamond, 2016).

In South Korea, "more than 70 percent of high school graduates enter university" (New York Times, 2013). This is similar to the PIAAC data, which showed that 64.8% of those surveyed in Korea attended college, as well 59.7% of those surveyed in Japan. These are the highest college attendance rates of the 21 OECD countries observed, which have a respective mean and median college attendance rate of 43.9% and 45.5% (Cooper and Liu, 2016, 40). One perspective is that this shows how successful Japan and Korea are in promoting higher education among its population. Another perspective is that this reflects difference in cultural attitudes towards education. Whereas other countries such as US believe a person can still be successful without attending college (though attending college improves market outcomes), Korea and Japan emphasize college and particularly the entrance exams as the pathway to success. One Korean student said "[m]ost teachers emphasize that if [students] failed [the] *Suneung*, the rest of [their] lives would be failure[s], because the test is the first (and last) step to [their] successful lives" (Diamond, 2016). The New York Times theorized that the pressure from these exams contributed to the 50% increase in suicide rates among young adults from 2000 to 2010 in Japan and also worsened the high poverty rate among the elderly in South Korea, who could not save for retirement due to the high cost of educating their children (2013). Many students also attend cram schools in addition to regular school to improve their performance on the exams (Diamond, 2016). Since attending college is more of an expectation rather than a discrete choice in these

two countries and there is such high pressure associated with the entrance exams, overmatch might be less connected to factors influencing student choice such as subsidies.

What Drives High Overmatch in Japan and Korea

An important question to ask is if public assistance is not behind high overmatch in Japan and Korea, what is? A possible explanation is that the definition used to define Overmatch based on PIAAC created high values. Two points help explain this. The first is the high prevalence of cram schools to pass the entrance exams in East Asia. The second is that "[i]n Japan, where almost all college students graduate, [it is] quite common for students to be asked only to parrot back lecture notes. Rigorous thinking, reading and writing too often is simply not expected" (New York Times, 2013). As was previously discussed, the main goal in these countries is to pass the entrance exam but if students pass because they went to cram school but then are not challenged in college itself, there may not be a high retention of the material as the students age. The PIAAC survey is performed on individuals aged 16 to 65, so it includes many who already graduated and possibly no longer retain what they knew from the entrance exams. If these individuals did poorly on the PIAAC questions for that reason, their generated probability of attending college given their score would be lower. Since said individual attended college, they are classified as overmatched. However, if that same person was surveyed in the PIAAC right after gaining admittance to college, their score might be higher and then they would not be classified as overmatched.

Another factor to consider is that college attendance in Japan and Korea might not automatically mean that person is high ability. The basic assumption for the college decision is

that high ability individuals attend because college will improve their future earnings while low ability individuals will not because they will not be able to achieve the same earnings. This views college as an investment but the college decision can also be the result of tastes. Japan and Korea might be countries with higher tastes for college due to high pressure their culture puts on attending college. Many individuals who are low ability still take the entrance exam to satisfy the cultural expectation but many of them most likely do not pass and thus do not attend school. If a low ability person passes the entrance exam, whether because of luck or another reason, they might still be expected to attend college due to societal pressure even though they know they are low ability. Both this explanation and the previous one describe why Japan and Korea could have high overmatch for reasons besides public policy assistance.

Regressions without Japan and Korea

To better determine if Japan and Korea are skewing the data, regressions are performed without them. The first regression is on Overmatch using the variables that were significant before: Public, Public2, lngrants, StudPub, and StudPub2. The Public variables are significant at the 95% confidence level while the other three are significant at the 90% confidence level. When Japan and Korea were included, the Public variables were significant at the 99% confidence level and the other three were significant at the 95% confidence level. One reason these variables are less significant is that without Japan and Korea, there is less data, which lowers the calculated standard error in the regression for each variable and makes insignificance harder to reject. Another reason could be that the quadratic trends previously seen in Public and StudPub are less apparent and thus less significant without Korea and Japan.

The next regression is on Overmatch using Public and Public2. When this regression was run with Japan and Korea, the two variables were significant at the 95% confidence level. Without those two countries, Public and Public2 have respective p-values of 0.272 and 0.221, making neither significant at the 85% confidence level. Since no other variables were included in the regression, there are no controls and thus Public could still have a significant quadratic relationship with Overmatch but clearly, it is less significant than before.

Similarly, StudPub and StudPub2 were both significant at the 90% confidence level with Japan and Korea in the data. Without the countries, a regression of StudPub and StudPub2 on Overmatch shows that the variables have respective p-values of 0.315 and 0.278, making neither significant at the 85% confidence level. Once again, without control variables there may be omitted variable bias making the variables look insignificant. However, the variables have lost significance since Japan and Korea were removed.

Some other variables have gained significance since removing Japan and Korea. When the binary variable Tuition was previously regressed on Overmatch, it had a p-value of 0.291, making it insignificant. The new regression has a p-value of 0.085, which is significant at the 90% confidence level. The coefficient is -.0185769, implying that by having tuition, a country should see a drop in Overmatch just under two percentage points. When Tuition is regressed on Overmatch along with Public, Public2, lngrants, StudPub, and StudPub2, every variable besides lngrants and Tuition is significant at the 90% confidence level. The variable lngrants is significant at the 85% confidence level but Tuition has a p-value of 0.825, which is too high to be considered significant. The other variables do a better job explaining the variation in Overmatch, especially because the effects of no tuition are captured in Public. This means that

despite losing some significance, the original equation for Overmatch is still the best estimate. However, the positive correlation between higher Overmatch and no tuition is clearer.

While there were changes to the significance of variables related to overmatch, the variables related to undermatch changed very little. When Japan and Korea were in the regression, NSGfTmod and NSGfTmod2 were significant at the 99% confidence level and EdSpendingGDP was significant at the 95% confidence level. After removing Japan and Korea, the p-values for the NSGfTmod variables are higher but both are still significant at the 99% confidence level. EdSpendingGDP also retained its significance. The previous R-squared value was 0.5177 and now it is 0.5178, so the model did not lose any power in regards to how well it explains variation in Undermatch.

Chapter 6

Conclusion

The purpose of this paper is to see how policy can impact overmatch, wherein low ability individuals attend college. Overmatch is not necessarily bad, just unexpected. Given how college is an investment to receive a higher future income, a minimum ability level is needed to make the cost of college (both tuition and opportunity cost) worth the investment. If a government is subsidizing a student, whether through a scholarship or a grant or cancelling tuition, it lowers the minimum ability that makes college optimal and may result in more low ability individuals attending college. While this makes college more attractive, low ability individuals could face greater difficulty in the future job market compared to high ability individuals and thus would have been better off not attending college. Alternatively, these subsidies could reduce undermatch, allowing more high ability individuals to attend college and be of greater service to society. Given this tradeoff, different countries can make different choices based on their preference.

Cooper and Liu previously estimated overmatch over 21 OECD countries using data from PIAAC, which enabled comparison to different policy measures. The regressions show a quadratic relationship between the estimated overmatch values and the percentage of college costs that were public rather than private, referred to as Public in the regression. At values of Public below 66%, a higher Public correlates with lower estimated overmatch. Above 66%, higher Public correlates with higher estimated overmatch. One explanation offered is that at lower values of Public, wherein most students rely on either personal or family income or private

institutions to pay for college, many high ability individuals with lower income do not attend college. Wealthier individuals, some of whom are low ability but attend college because of societal pressure or other reasons, do attend. Because there is a smaller sample of people attending college, some of whom are low ability, and they are not offset by less wealthy high ability individuals, the proportion of low ability individuals attending college would be greater.

Estimated overmatch also has a quadratic relation with the fraction of students attending public universities, called StudPub. When StudPub is below 52%, a higher value correlates with lower estimated overmatch and above 52%, a higher value correlates with higher estimated overmatch. This could express the difference between the two types of public universities: those that act like a normal college and attract high ability individuals; and those politically designed to enable higher college attendance, even to low ability individuals. A significantly higher StudPub value might indicate a greater presence of the politically designed universities, leading to higher overmatch.

It is possible that the presence of Japan and Korea in the data skewed these quadratic relationships, since both countries have high estimated overmatch rates but low values for Public and StudPub. Whereas overmatch in other countries is likely connected to factors subsidizing the student, overmatch in Japan and Korea is likely influenced by the high importance of college entrance exams and the high pressure the countries put on college education. While excluding Japan and Korea from the regression reduces the significance of the quadratic relationships, the relationships are still significant enough to keep.

While these regressions show some evidence of higher policy variables correlating with higher estimated overmatch, there is also evidence higher policy variables correlate with lower estimated undermatch. The specific variables correlated to overmatch are not significant in

regards to undermatch but in countries where more students do not receive scholarships or grants, undermatch is higher. Another significant variable is the amount of public money allocated to higher education as a percent of GDP, which correlates to lower estimated undermatch.

Given the significant variables, the generated equations for estimated overmatch and undermatch are shown below. These equations are the ones generated when Japan and Korea are excluded, since it removes potential bias in the model:

$$\text{Overmatch} = 0.477995*\text{Public}^2 - 0.6106297*\text{Public} - 0.0103693*\ln(\text{Grants}) + 0.1631272*\text{StudPub}^2 - 0.1666028*\text{StudPub}$$

$$\text{Undermatch} = 0.2042629*\text{NSGfTmod}^2 - 0.2051525*\text{NSGfTmod} - 3.325963*\text{ EdSpendingGDP}$$

It should be noted that while ln(Grants) is included in the equation for overmatch because it is significant, changing the value of Grants from 10% to 40% would only change Overmatch by about 1 percentage points and since most countries do not have Grants values that high, its influence is not large.

Important takeaways are that for each additional percent of GDP spent on higher education, estimated undermatch is reduced by over 3 percentage points. If a country wishes to spend more on higher education, it can direct the money towards scholarships and grants. If these subsidies are distributed out to more students up until 50% of students are receiving them, there is evidence this correlates to lower undermatch. However, if a country spends so much that it is covering over 63% of the college costs, the regressions suggest overmatch will increase. For this reason, a country might be more cautious when cancelling tuition or creating more politically designed public colleges. However, how much overmatch and undermatch a country is willing to

accept is ultimately their decision. I hope this discussion makes it clearer how policy can impact these measures of mismatch and result in better decisions in the future.

Appendix A

Data Tables

Table 4. Data Table 1

(Cooper and Liu, 2016, 40) OECD, 2016a) (OECD, 2016b)

Country	College Attendance Rate	Undermatch	Overmatch	EdSpendingSpending	EdSpendingGDP	Public
Aus.	0.28	0.121	0.065	3.40%	1.10%	42.5%
Bel	0.421	0.067	0.048	2.50%	1.40%	89.5%
Can.	0.548	0.083	0.098	3.50%	1.30%	51.9%
CzR.	0.304	0.111	0.04	2.20%	1%	79.3%
Den.	0.523	0.093	0.105	3.70%	2.20%	94%
Est.	0.445	0.105	0.087	2.60%	1%	78.2%
Fin.	0.523	0.102	0.093	3.70%	2.10%	96.2%
Fra.	0.456	0.047	0.051	2.20%	1.20%	79.8%
Ger.	0.373	0.104	0.062	3%	1.30%	85.9%
Ire.	0.474	0.079	0.068	2.90%	1.20%	83.6%
It.	0.23	0.146	0.069	1.60%	0.80%	66%
Jap.	0.597	0.078	0.108	1.80%	0.80%	34.3%
Kor.	0.648	0.083	0.109	2.60%	0.90%	29.3%
Net.	0.412	0.084	0.046	3.30%	1.60%	70.5%
Nor.	0.494	0.081	0.098	4.50%	2.50%	96.1%
Pol.	0.429	0.101	0.078	2.60%	1.10%	77.6%
Slo.	0.25	0.139	0.039	2.50%	1.20%	86.1%
Sp.	0.399	0.079	0.048	2.10%	1%	73.1%
Swe.	0.491	0.085	0.091	3.70%	1.90%	89.3%
UK	0.462	0.088	0.076	2.90%	1.45%	56.9%
US	0.455	0.055	0.045	3.50%	1.40%	37.8%

Table 5. Data Table 2

(OECD, 2015) (OECD, 2016a) (OECD, 2011, 269) (OECD, 2011, 266-267) (OECD, 2011, 266)

Country	Tax Rate on Personal Income	Tax RateSpending	Institution	StudPub	Tuition
Aus.	10.70%	0.3638%	68.5%	97%	1
Bel	12.30%	0.3075%	86.8%	51%	1
Can.	11.10%	0.3885%	83.5%	100%	1
CzR.	3.60%	0.0792%	95.1%	87%	0
Den.	23.80%	0.8806%	71.6%		0
Est.	5.30%	0.1378%	84.9%		1
Fin.	12.50%	0.4625%	85.1%	82%	0
Fra.	8%	0.1760%	92.6%	87%	1
Ger.	9.30%	0.2790%	81.1%	97%	0
Ire.	9.10%	0.2639%	87.3%	97%	1
It.	11.70%	0.1872%	79.8%	92%	1
Jap.	5.50%	0.0990%	74.6%	25%	1
Kor.	3.70%	0.0962%	85.2%	24%	1
Net.	7.30%	0.2409%	70.8%		1
Nor.	9.70%	0.4365%	55.9%	86%	0
Pol.	4.50%	0.1170%	98.4%	87%	1
Slo.	5.70%	0.1425%	76.8%	96%	1
Sp.	7.30%	0.1533%	90.1%	87%	1
Swe.	11.90%	0.4403%	74.6%	92%	0
UK	9.10%	0.2639%	46.7%	0%	1
US	9.20%	0.3220%	79.7%	68%	1

Table 6. Data Table 3

(OECD, 2011, 264), (OECD, 2013, 234),(OECD, 2011, 266)

Country	Grants	StudentLoans	NSGfT	NSGfTmod
Aus.	10.60%	21.30%	97%	97%
Bel	13.20%	0%	81%	81%
Can.	3.1%	11.6%		
CzR.	4.90%	0		0%
Den.	24%	4.40%	0%	0%
Est.	7.40%		89%	89%
Fin.	14.70%	0		0%
Fra.	7.40%	0	69%	69%
Ger.	12.70%	6.10%		0%
Ire.	12.70%	0		
It.	20.20%	0	81%	81%
Jap.	0.60%	24.80%		
Kor.	6%	5.40%	57%	57%
Net.	11.70%	17.20%	15%	15%
Nor.	16.20%	27.90%		0%
Pol.	0.50%	1%		
Slo.	23.20%	0		
Sp.	9.20%	0.60%	65%	65%
Swe.	10.10%	15.30%		0%
UK	3.50%	27.70%	100%	100%
US	15.50%	4.80%	37%	37%

Appendix B

Regression Result Tables

Table 7. Regressions on Overmatch (Public, TaxRateSpending, Grants)

Variables	**Public**	**Public2**	**TaxRateSpending**	**Grants**	**Grants2**	R^2 value
Coefficient (p-value)	-.0169 (0.520)					.0221
	-.4519 (0.013)	.3410 (0.016)				.2986
	-.3683 (0.049)	.2660 (0.070)	3.9143 (0.204)			.3640
				-.0680 (0.407)		.0365
	-.5056 (0.006)	.3963 (0.007)		-.1230 (0.136)		.3870
	-.5009 (0.005)	.3958 (0.005)		-.4613 (0.055)	1.4003 (0.126)	.4728

Table 8. Regressions on Overmatch (Public, TaxRateSpending, Grants, Studentloans)

Var	**Public**	**Public2**	**TaxRateSpending**	**lngrants**	**Studentloans**	**Lnloans**	R^2 value
Coeff. (p-value)	-.4844 (0.006)	.3804 (0.006)		-.0091 (0.070)			.4254
	-.3626 (0.025)	0.2750 (0.031)	6.2484 (0.030)	-.0124 (0.012)			.5755
					.0959 (0.079)		.1618
	-.4465 (0.013)	.3440 (0.013)			.0773 (.123)		.438
	-.4811 (0.006)	.3821 (0.005)		-.0079 (0.098)	.0645 (0.175)		.5344
	-.5129 (.014)	.4232 (0.011)		-.0110 (0.041)		.0048 (0.285)	.6638

Table 9. Regressions on Overmatch (Public, TaxRateSpending, Grants, Tuition)

Var	**Public**	**Public2**	**TaxRateSpending**	**lngrants**	**Tuition**	R^2 value
Coeff. (p-value)					-.0125 (0.291)	.0584
	-.3554 (0.044)	.2679 (0.062)	6.1452 (0.047)	-.0123 (0.016)	-.0016 (0.904)	.5759

Table 10. Regressions on Overmatch (Public, TaxRateSpending, Grants, StudPub)

Var	**Public**	**Public2**	**TaxRateSpending**	**lngrants**	**StudPub**	**StudPub2**	R^2 value
Coeff. (p-value)					-.0255 (0.192)		.1041
					-.0700 (0.458)	.0408 (0.628)	.1185
	-.3692 (0.050)	.2772 (0.057)	8.0086 (0.063)	-.0125 (0.020)	-.0028 (0.881)		.6051
	-.5706 (0.010)	.4375 (0.012)	5.7632 (0.149)	-.0124 (0.013)	-.1411 (0.080)	.1327 (0.078)	.7059
	-.6842 (0.002)	.5300 (0.003)		-.0107 (0.028)	-.1717 (0.0400	.1658 (0.033)	0.6414

Table 11. Regressions on Overmatch (Public, Grants, StudPub, Institution)

Var	**Public**	**Public2**	**lngrants**	**StudPub**	**StudPub2**	**Institution**	**Institution 2**	R^2 value
Coeff. (p-value)						-.0495 (0.264)		.0653
	-.6514 (0.007)	.5042 (0.008)	-.0116 (0.035)	-.1361 (0.236)	0.1372 (0.172)	-.0233 (0.651)		.6483
	-.5872 (0.036)	.4607 (0.030)	-.0127 (0.043)	-.1423 (0.237)	0.1372 (0.189)	.2087 (0.666)	-.1583 (0.629)	0.6568
	-.3925 (0.028)	0.3216 (0.020)	-.0141 (0.024)			.3446 (0.378)	-.2763 (0.308)	0.5297
	-.4554 (0.008)	0.3630 (0.007)	-.0108 (0.035)			-.0534 (0.158)		0.4948

Table 12. Regressions on Overmatch (Public, Grants, StudPub, NSGfTmod)

Var	**Public**	**Public2**	**lngrants**	**StudPub**	**StudPub2**	**NSGfT mod**	**NSGfT mod2**	R^2 value
Coeff. (p-value)						-.0106 (0.500)		.0332
	-.6853 (0.020)	.5446 (0.021)	.0087 (0.660)	-.2444 (0.025)	.2157 (0.027)	.0046 (0.808)		.7755
	-.8083 (0.006)	.6561 (0.006)		-.3186 (0.026)	.2955 (0.029)	.0883 (0.250)	-.0849 (0.285)	.8041

Table 13. Regressions on Undermatch (Public, Grants, StudPub)

Var	**Public**	**Public2**	**lngrants**	**StudPub**	**StudPub2**	R^2 value
Coeff. (p-value)	-.0292 (0.921)	.0183 (0.936)	.0025 (0.723)	-.1316 (0.292)	.1447 (0.214)	.2414
	.1856 (0.351)	-.1341 (0.384)				.0571
	.0355 (0.567)					.0155
				-.1238 (0.211)	.1382 (0.125)	.2308
				.0269 (0.213)		.0951
					.0296 (0.121)	.1432

Table 14. Regressions on Undermatch (NSGfTmod, EdSpendingSpending, EdSpendingGDP, StudPub)

Var	**NSGfTmod**	**NSGfTmod2**	**EdSpendingSpending**	**EdSpendingGDP**	**StudPub2**	R^2 value
Coeff. (p-value)	.0036 (0.829)					.0035
	-.1217 (0.063)	.1405 (0.050)				.2660
	-.1794 (0.014)	.1856 (0.013)	-1.6961 (0.080)			.4374
	-.1997 (0.006)	.1979 (0.006)		-3.3862 (0.028)		.5177
	-.1772 (0.043)	.1842 (0.035)		-3.2069 (0.093)	.0207 (0.379)	.5692

Table 15. Regressions on Overmatch without Japan and Korea

Var	**Public**	**Public2**	**lngrants**	**StudPub**	**StudPub2**	**Tuition**	R^2 value
Coeff. (p-value)	-.6106 (0.043)	.4780 (0.036)	-.0104 (0.096)	-.1666 (0.067)	.1631 (0.054)		.4804
	-.2693 (0.272)	.2190 (0.221)					.1441
	.0301 (0.324)						.0572
				-.0863 (0.315)	.0863 (0.278)		.0919
				.0039 (0.863)			.0022
						-.0186 (0.085)	.1646
	-.5791 (0.094)	.4508 (0.092)	-.0102 (0.123)	-.1618 (0.099)	.1579 (0.085)	-.0068 (0.677)	.3170

Table 16. Regressions on Undermatch without Japan and Korea

Var	**NSGfTmod**	**NSGfTmod2**	**EdSpendingGDP**	R^2 value
Coeff. (p-value)	-.2052 (0.009)	.2043 (0.010)	-3.3260 (0.040)	0.5178

BIBLIOGRAPHY

Cooper, R., & Liu, H. (2016). Mismatch in Human Capital Accumulation. Retrieved from http://www.nber.org/papers/w19286

Diamond, A. (2016, November 17). South Korea's Testing Fixation. *The Atlantic*. Retrieved February 23, 2017 from https://www.theatlantic.com/education/archive/2016/11/south-korean-seniors-have-been-preparing-for-today-since-kindergarten/508031/

Dillon, E. W. & Smith , J. A. (2013). The Determinants of Mismatch Between Students and Colleges. Retrieved from http://www.nber.org/papers/w19286

International Student Insurance. (2016) Why Study in Japan?. Received from http://www.internationalstudentinsurance.com/japan-student-insurance/why-study-in-japan.php

Kimaya, S. (2009, January 20). 'Exam Hell' now not so Hot. *The Japan Times*. Retrieved February 23, 2017 from http://www.japantimes.co.jp/news/2009/01/20/reference/exam-hell-now-not-so-hot/#.WLPa_4WcFPZ

Kitagawa, F., & Oba, J. (2009). Managing Differentiation of Higher Education System in Japan: Connecting Excellence and Diversity. *Higher Education, 59*(4), 507-524. doi:10.1007/s10734-009-9262-5

Nakamura, T. (2003). Educational Aspirations and the Warming-up/Cooling-down Process: A Comparative Study between Japan and South Korea. *Social Science Japan Journal, 6*(2), 199-220. doi:10.1093/ssjj/6.2.199

National Center for Education Statistics. (2016) Fast Facts: Tuition Costs of Colleges and Universities. Retrieved from https://nces.ed.gov/fastfacts/display.asp?id=76

Noack, R. (2015, February 4). Why Danish Students Are Paid to Go to College. *Washington Post*. Retrieved from https://www.washingtonpost.com/news/worldviews/wp/2015/02/04/why-danish-students-are-paid-to-go-to-college/?utm_term=.236deb9c345e

OECD. (2011). How Much Do Tertiary Students Pay and What Public Subsidies Do They Receive?. *Education at a Glance,* 256-269. Retrieved from https://www.oecd.org/edu/skills-beyond-school/48631028.pdf

OECD. (2013). How Much Do Tertiary Students Pay and What Public Support Do They Receive?. *Education at a Glance*, 222-237. Retrieved from https://www.oecd.org/edu/eag2013%20(eng)--FINAL%2020%20June%202013.pdf

OECD. (2015). Tax on Personal Income. Retrieved from https://data.oecd.org/tax/tax-on-personal-income.htm

OECD. (2016a). Public Spending on Education. Retrieved from https://data.oecd.org/eduresource/public-spending-on-education.htm

OECD. (2016b). Spending on Tertiary Education. Retrieved from https://data.oecd.org/eduresource/spending-on-tertiary-education.htm

OECD. (2016c). Survey of Adult Skills (PIAAC). http://www.oecd.org/skills/piaac/

Shih, B. (2005, May 21). Japan's Colleges Ease Entrance Exams. *NPR.* Retrieved from http://www.npr.org/templates/story/story.php?storyId=46615

The Economist. (2015, March 28). The World is going to University. *The Economist.* Retrieved January 15, 2017, from http://www.economist.com/news/leaders/21647285-more-and-more-money-being-spent-higher-education-too-little-known-about-whether-it

The Economist. (2017, February 23). Growing Competition between Universities is changing Student Life. *The Economist*. Retrieved February 23, 2017, from http://www.economist.com/ news /britain/21717402-universities-must-now-battle-each-other-attract-students-how-changing-themgrowing?fsrc=scn/fb/te/bl/ed/classwarfaregrowingcompetitionbetweenuniversitiesischangi ngstudentlife

The New York Times. (2013, November 6). Asia's College Exam Mania. *The New York Times*. Retrieved February 23, 2017 from http://www.nytimes.com/2013/11/07/opinion/asias-college-exam-mania.html

ACADEMIC VITA

Academic Vita of Stephen Rakoczy
sjr5377@psu.edu

Education
Majors: Economics, Risk Management with Actuarial Science Option
Honors: Economics

Thesis Title: Policy Implications for Overmatch
Thesis Supervisor: Russell Cooper

Work Experience
Summer 2016
Actuarial Intern
Analyzed and determined causes of Prepayment on CMBSs
The Hartford, Hartford, CT
Aubrey Heilman

Fall 2016 to Spring 2017
Risk Management Teaching Assistant
Graded and reviewed material related to passing Actuarial Exams
Smeal Risk Management Department, University Park, PA
Nan Zhu

Spring 2016
Economics 412 Teaching Assistant
Graded and reviewed material related to Labor Economics
Economics Department, University Park, PA
David Shapiro

Grants Received: Economics Undergraduate Grant

Awards: Freshman Award, Sparks Award

Community Service Involvement: Alliance of Heroic Hearts member

Language Proficiency: English, German