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PRESENT VALUE ANALYSIS OF PENNSYLVANIA TUITION SUBSIDIES

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Abstract

This paper answers the question does Pennsylvania's investment in Penn State students pay off? This analysis is done by looking at the tuition subsidy (out-of-state tuition less in-state tuition) and comparing the incremental cash flows to Pennsylvania in the form of additional income taxes and sales taxes on a present value basis. This will be affected by the retention rate of in-state graduates, tax rates, college major, and discount rate. An "average" student is the basis of the calculation (e.g. an average high school student versus an average Penn State Student.) In most cases the tuitions subsidy did not yield a positive net present value.

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Chapter 1

Introduction

Each sequential year there is an increase in the Pennsylvania State University's tuition. Every year there are articles about the appropriation to Penn State from the Commonwealth of Pennsylvania. A representative of the university might make a case about how much the university contributes to the state. This got me to think about the situation in a different way. I wondered how I could come up with a way to estimate value created by the university. Being a finance major, I thought about present value analysis. This led me to think, "Does the tuition subsidy at Penn State have a positive net present value?"

In my journey to find an answer to this question I reviewed literature. One article spoke of the value of an undergraduate degree. It included the starting pay after graduation and the value of the option to attend graduate school. I decided not to include this option into my paper due to the complicated nature of the additional uncontrolled variables it implies. Another article discussed the financial returns of education based on the quality of the school and the quality of the individual. Because I chose just one university I did not need to worry about comparing values of different universities: I set my primary focus to Penn State and Penn State alone. As for the ability of the individual, I chose to take an average student from their respective degrees of education. Dividing students into different groups would not have helped me gather the total value added of the university. Another paper discussed a project that a professor assigned his economics class. He had his students figure out what their college degree is worth. The students calculated the total tuition paid and then projected their earnings into the future and made adjustments for life plans and promotions. Then, they approximated what they would have made with just a high school degree. After that, the students calculated the rate of return on their

investment in education. This paper led me to think about tuition subsidies on an individual basis. Using averages would provide me with a general answer and set a generic baseline for degrees in each major.

For my project, I uncovered a lot of data about the university. I traveled throughout campus to different offices to find facts and figures. At Penn State Career Services I discovered a report on post-graduation activities. This report included average starting salaries broken down by college and major. In the library, I found a census expert who helped me mine data on lifetime earnings of high school graduates and growth rates of college graduates. I was able to locate past tuition information online. The difference between in-state tuition and out-of-state tuition is what I considered the tuition subsidy. I found tax rates and long term interest rates online as well. I could make assumptions as to what percentage in income would be subject to sales tax. I could also make assumptions as to how many in-state students stayed in Pennsylvania after graduation.

After gathering the data I put it together to calculate a present value of the tuition subsidy. I made a lot of assumptions and came up with a “base case” off of which to set a guideline for further analyses. This base case had a negative net present value. After this I went further. I substituted the overall average starting salary with average salaries of different majors. Some of the more skilled majors had positive net present values to the Commonwealth of Pennsylvania. Most majors led to negative net present values. I created a sensitivity analysis with retention rate of in-state students, the percentage of income subject to sales tax, and the discount rate. Only a few cases led to positive net present values.

Chapter 2

Related Papers

In this chapter I will discuss some of the literature related to costs and benefits of college education. There are a large number of papers that deal with the value of a higher education while others deal with the value of simply a degree. Others deal with nonmonetary benefits of a degree. Others deal with the value of a degree in terms of preparedness for graduate school.

“The Role of the Option Value of College Attendance in College Major Choice” by Eric Eide and Geetha Waehrer (1998) looks into choices of undergraduate majors and what those students plan to do with that degree. The authors say that one factor in choice of major is the expected earnings from a job that they can get with that degree. Another factor is to prepare for post-graduate school. The value of the ability to attend graduate school and earn subsequently higher returns in the labor market is referred to as the option value. Their research found that the higher the present value of future income streams of a particular career, the more likely students were to choose a major that allowed them to enter that career. More specifically, skill oriented majors (business, engineering and computer science) tend to lead to higher paying jobs out of college. Other fields develop broader skill sets that lend themselves to graduate school. The authors combine the option value with the value of the discounted expected future earnings from a particular major and find that when one value is high, the other tends to be low. There also seems to be a difference in choice of majors between the sexes. Women were more likely to choose majors with skills that would be less likely to atrophy due to pregnancies and child-rearing.

Another paper, “What’s Your College Degree Worth? A Research Project for the Labor Economics Course” by Robert J. Thornton (2009) describes a project that he assigned to his

students at Lehigh University. He had his students calculate the rate of return on their respective degrees. The professor mentions that it's interesting due to the eclectic variety of majors in his classes. He outlines four steps in this process: 1. Projecting the growth of students' expected future earnings stream over their expected working life, 2. Calculating the costs of a college degree, 3. Discounting earnings and costs, and 4. Making spreadsheet calculations. In the first step students assume a retirement age, a salary growth rate, and a career path. In the second step, the student calculates the cost of attending college which includes tuition and fees and also the opportunity cost of attending college. The next step is discounting cash flows to their present value using long-term interest rates found in the *Wall Street Journal*. These rates are also compared to their rate of return (ROR) estimates found in the fourth step. The final step is to make spreadsheet calculations in order to find the rate of return. After his students submitted their reports he compiled a summary table of the rates of returns of the different degrees to be earned. He noted that the values the students found for specific majors are mostly within the broad range found in published research (about 10-20 percent.)

Lei Zhang (2009) talks about public universities in his paper, "A Value-added Estimate of Higher Education Quality of US States." Public colleges and universities are, by far, the largest higher-education segment in the United States. Zhang goes on to mention that there have been many papers written about education and its impact on finance and performance. His paper is different because it estimates a quality measure for the public colleges and universities. "The quality of a state public college system is defined as its value-added to the earnings of its college graduates relative to the earnings of college graduates from a benchmark state." She also looks into factors that possibly affect college quality and controls for self-selection based on unobserved individual characteristics. Quality was measured by the average earnings over the

first few years of employment after graduation compared to a benchmark state. A faculty of high caliber and diversity are positively correlated with college quality based on a multiple regression framework. She says that this does not necessarily reflect a causal relationship.

Weisbrod and Karpoff (1967) discuss financial returns of education in “Monetary Returns to College Education, Student Ability, and College Quality.” The authors consider two major variables relevant to earnings: “schooling variable” and “non-schooling variables.” They say that there is a self-selection factor in college education. This factor is a correlation between natural ability and the choice to go on to higher education. This may be misleading to the actual value of the education received when compared to others who have completed a lesser level of education. They take data from a large company with a large number of college graduates from a variety of school quality and from a variety of college standings and place it into a data table. The table has class rank on the Y-axis and college quality on the X-axis with earnings as the outcome. They discovered that there are positive correlations between earnings, class rank, and college quality. They reach a conclusion that college is a better investment for someone who has ability (determined by class rank) than for someone with relatively less ability in a high quality school.

This chapter discussed some of the literature related to my research. Generally, the literature finds that education adds value to graduates in the job market. Some college majors provide more monetary value than others, however, the skill of the student is more important than the quality of higher education the student receives. I did not find any literature that specifically measured the return from state subsidized tuition.

Chapter 3

Data

In this chapter I will discuss the many sources of data that I used in my analysis of the present value of tuition subsidies.

The first part of my analysis deals with the tuition subsidy. I define the tuition subsidy as the difference in tuition between in-state and out-of-state students. I found Penn State tuition information going back as far as the 2006-2007 school year. I found this on the website tuition.psu.edu (Tuition History, Penn State, n.d.). It includes tuition schedules for in-state and out-of-state status, campus status, lower and upper divisions of undergraduate degree, and statuses in the upper divisions (lower divisions including both freshmen and sophomores and using the same rate for all majors.) The upper division includes juniors and seniors and also supports different rates. One rate is for majors in business, science, information sciences and technology, and engineering. The other rate is for all other majors. For my analysis I used the University Park campus and factored in both in-state and out-of-state tuition. I used the freshman rate from the school year 2006-2007 and the following three years to simulate an incoming freshman. Year 0 is the year 2006. For the following three years I used the inflation calculator to deflate the tuition rates to 2006 price levels. I used lower division rates from the school years 2006-2007 and 2007-2008. I used upper division rates for school years 2008-2009 and 2009-2010. This applies to both in-state and out-of-state tuition rates. After I gathered all of these numbers I deflated the tuition costs to 2006 dollars. I used the Consumer Price Index (CPI) Calculator on the Bureau of Labor Statistics (BLS) website.

Appendix A shows the tuition data. The first table contains the actual tuition data. For the school year 2006-2007 the rate for a freshman from Pennsylvania was \$11,646. The rate for

the same year and standing for an out of state student was \$22,194. This means that the tuition subsidy for the year was \$10,548. For the school year 2007-2008 for sophomores in-state tuition was \$12,284, out-of-state tuition was \$23,152, and the tuition subsidy was \$10,868. In the school year 2008-2009 the junior tuition rate for business, science, engineering, and information sciences and technology was \$14,904 for in-state students, \$26,420 for out-of-state students, and the tuition subsidy was \$11,516. In 2010 senior rates for the same majors were \$15,580 for in-state students, \$27,434 for out-of-state students, and the subsidy was \$11,854. The junior rates for the 2008-2009 school year for all other majors (not including business, science, engineering, and information sciences and technology) were \$14,070 for in-state students, \$25,454 for out-of-state students, and the subsidy was \$11,384. The senior rates for all other majors in 2009-2010 were \$14,708 for Pennsylvania students, \$26,412 for students from outside Pennsylvania, and the subsidy was \$11,704.

The second table in appendix A shows the tuition rates from the first table deflated to 2006 dollars. For the school year 2006-2007 the deflated rate for a freshman from Pennsylvania was \$11,646. The rate for the same year and standing for an out of state student was \$22,194. This means that the tuition subsidy for the year was \$10,548. For the school year 2007-2008 for sophomores in-state tuition was \$11,944, out-of-state tuition was \$22,511, and the tuition subsidy was \$10,567. In the school year 2008-2009 the junior tuition rate for business, science, engineering, and information sciences and technology was \$13,955 for in-state students, \$24,738 for out-of-state students, and the tuition subsidy was \$10,783. In 2010 senior rates for the same majors were \$14,641 for in-state students, \$25,780 for out-of-state students, and the subsidy was \$11,139. The junior rates for the 2008-2009 school year for all other majors (not including business, science, engineering, and information sciences and technology) were \$13,175 for in-

state students, \$23,834 for out-of-state students, and the subsidy was \$10,659. The senior rates for all other majors in 2009-2010 were \$13,821 for Pennsylvania students, \$24,819 for students from outside Pennsylvania, and the subsidy was \$10,998.

The next challenge was to find earnings of high school graduates living in Pennsylvania. I used “Education and Synthetic Work-Life Earnings Estimates” (Julian and Kominski 2011) produced by the United States Census Bureau. This report was based on the American Community Survey produced by the United States Census Bureau. It contained information on education and earnings, gender and earnings, race and earnings, and age and earnings. My goal was to find a combination of age, education, and earnings. It did not contain that information. I used a database called IPUMS-USA (Ruggles et al., 2010) to find specific data from the American Community Survey. The data includes highest level of education attained, age, and average earnings of Pennsylvanians. I used these figures to estimate the earnings of a Pennsylvanian with either a high school diploma or a Graduate Equivalency Degree over his working life. I deflated these streams to 2006 dollars using the CPI calculator on the BLS website.

Appendix B contains data on the average earnings of Pennsylvanians whose highest level of education is either a high school or high school equivalency in the form of a Graduate Equivalency Degree (GED). The left column contains age. The second column contains the average earnings in 2010 dollars of high school graduates or the equivalent at the specified age on the left. The third column is the same information in the middle column deflated to 2006 dollars. For instance, the average 36-year-old high school graduate from Pennsylvania would have earned \$25,470 in 2010 dollars or \$23,548 in 2006 dollars. The fourth column contains the year in relation to the present value analysis. The fifth column contains the present value of

middle column given a 2 percent discount rate. The fourth and fifth columns will be discussed more in the next chapter.

Next, I had to find information on salaries of Penn State graduates. The best information I could find came from Penn State Career Services. They generate a report called “Post-Graduation Activities.” This report contains information on average starting salaries by major and college among other things based on surveys of recent graduates (Courtney Wozetek, Assistant Director, Career Information Management, provided me with the report for graduates from December 2009 through August 2010). I got data on starting salaries from this report. Some of this information is summarized in Appendix C. The left column contains the colleges of the university. Below some of the colleges are specific majors of that college (centered and marked with an asterisk). The highlighted colleges and majors indicate that they fall under higher tuition rates on the tuition schedules. The average starting salaries for graduates of those colleges in 2010 dollars are presented in the middle column. The right column contains the average starting salaries deflated to 2006 dollars. For instance, the average starting salary for a graduate from the Smeal College of Business would have been \$48,051 in 2010 and \$44,425 in 2006 dollars. The average finance major (in the Smeal College of Business) made \$53,048 in 2010 and \$49,045 in 2006 dollars. The fact that these two rows are highlighted indicates that the higher tuition rate was applied.

The next thing I had to do was to estimate lifetime earnings of these graduates. I used data from the American Community Survey on Pennsylvanians whose highest education was a bachelor’s degree (Ruggles et al. 2010). I averaged rates of change of earnings over five-year periods starting at age 21 (i.e. 21-25, 26-30, etc.). I got this idea from “What’s your college degree worth?” by Robert J Thornton (2009). I gave an arbitrarily low growth rate of three

percent to the first few years (through age 25 assuming graduation and start of work at age 22) after college because the rates averaged well over twenty percent. This could have been due to college graduates finally finding employment after a long job search. Additionally, I assumed an arbitrary retirement age of 66. I extended the growth rate of the final age group bracket through age 66. These rates were already adjusted for inflation because they came from a survey that put all figures into 2010 dollars. The data that I used and the adjustments that I made are in Appendix D. The left column contains age. The second column from the left contains the average earnings of Pennsylvanians with bachelor degrees as their highest educational level in 2010 dollars. The center column contains the percentage change in earnings year over year. For instance, the average earnings change between age 25 and 26 is 7.08% increase. The second column from the right contains 5 year average change in earnings. Between the ages of 26 and 30 the 5 year average rate of change was 5.55%. In the right column are the growth rates I used from my analysis. N/A means that it was not applicable to my analysis. Until age 25 I used an arbitrary rate of 3%. Between ages 26 and 65, I used the 5 year average growth rates as the growth rate. For age 66 I continued using the same rate as the previous 5 years (between ages 60 and 65) of negative 10.21 percent.

Another thing that I needed to consider was the discount rate. I used real rates because the data that I used came from sources that were already inflation-adjusted. I found real rates on long-term treasury bonds. These varied quite a bit throughout 2006 (U.S. Department of the Treasury, n.d.). The treasury defines the long-term real rate average as “the unweighted average of bid real yields on all outstanding TIPS with remaining maturities of more than 10 years and is intended as a proxy for long-term real rates.” TIPS stands for Treasury Inflation-Protected

Securities. For my base case I chose to use a two percent discount rate. I chose to use sensitivity analysis for the discount rate for other cases due to the variability of the real rate.

I kept the tax rates constant. I found the income tax rate from the Commonwealth of Pennsylvania's website. It is 3.07% of gross income. Pennsylvania also has a sales, use, and hotel occupancy tax. The tax rate is six percent added onto the price of sales. Clothing and most food are exempt from sales tax. The implicit rate of sales tax per dollar spent by the consumer is approximately 5.66% ($1 - (1/1.06)$). Another factor is the amount of income subject to sales tax. For my base case thirty percent was the percentage of income subject to sales tax. Different people will likely budget themselves differently. That's why I used sensitivity analysis to estimate the portion of income subject to sales tax.

Another issue is the state retention rate of Penn State students, that is, how many in-state students continue to live in-state after graduation. This is crucial to the analysis because a student who takes advantage of in-state tuition and leaves the state afterwards is not contributing tax revenue to the Commonwealth of Pennsylvania. Those who stay in-state are contributing taxes to the state. I could not find a retention rate of in-state students who chose to stay in Pennsylvania after graduation. I did find in the "Post-Graduation Activities" report (Penn State Career Services, 2010) under the Geographic Mobility of Employed Graduates that 49.9% of employed graduates are located in Pennsylvania. However, this does not consider unemployed graduates or those seeking further education. My model assumes that all graduates begin working after graduation. Also, this report does not mention the former residency status (in-state or out-of-state) of graduates. The Penn State University Budget Office (n.d.) keeps track of enrollment by residency. For the fall of 2006 74.5% of undergraduate students at the University Park campus were in-state students. This does not have a further breakdown by class standing.

These data are not directly linked to the data from “Post-Graduation Activities” which includes all graduates of Penn State. Some students might like to stay close to home and therefore stay in Pennsylvania whereas other students may choose to leave Pennsylvania. For my base case I will assume that 67% of in-state students will stay in-state after graduation. This percentage is approximately 49.9% (from geographic mobility of employed graduates) divided by 74.5% (from percentage of in-state students at Penn State in Fall 2006). This is a variable that requires sensitivity analysis.

In this chapter, I discussed the various sources of data that I will use in my analysis. They include tuition subsidies, earnings of Pennsylvania high school graduates, earnings of Penn State graduates, discount rates, tax rates, and retention rates. In the next chapter I will use this data to calculate the present value of the tuition subsidy to the state.

Chapter 4

Analysis and Results

This chapter presents the analysis and results of my analysis of Penn State tuition subsidies, finding that in most cases the Pennsylvania tuition subsidy is greater than the extra revenue that graduates generate. It presents results for multiple analyses. My analysis contains three main parts: present value of the tuition subsidy, present value of difference in taxes from lifetime earnings, and present value of the difference of income subject to sales tax. The combination of these three analyses will formulate the value of the tuition subsidy to the Commonwealth of Pennsylvania.

For the first part of my analysis, let us look at the present value of the deflated tuition subsidies in appendix A using a discount rate of 2%. This is within the range of the real long-term rates of 2006 found on the treasury website and is the present value of the tuition subsidy to the Commonwealth of Pennsylvania. To the state it is an expense, so it is negative. Appendix E shows the present values of the deflated tuition subsidies given a 2% discount rate. For business, science, engineering, and information science and technology majors the present value of in-state tuition is \$50,565, the present value of out-of-state tuition is \$92,334, and the present value of the subsidy (the difference between the two) is negative \$41,769. For all other majors the total present value of in-state tuition is \$49,042, the total present value of out-of-state tuition is \$90,560, and the present value of the subsidy is negative \$41,517. The average of the two subsidies is negative \$41,643. This is the number I used for my base case.

The second part of my analysis is the present value of the difference in income taxes from lifetime earnings. This has two parts: earnings from Penn State graduates over a lifetime and earnings from high school graduates or GED holders over a lifetime. What matters to the state is

the difference in the present value of their earnings over a lifetime for tax purposes. I took the average starting salaries of Penn State graduates from the Post-Graduation Activities report (Penn State Career Services, 2010) and estimated growth rates based on the American Community Survey (ACS) data on Pennsylvania college graduates. I used the overall average starting salary of \$42,160 in 2006 dollars for my base case. This is found in Appendix C. I deflated the all starting salaries to 2006 dollars. The growth rates that I used are in Appendix D. The growth rates in the ACS data were already inflation adjusted. After this I discounted the stream of earnings by using the discount rate. In my example it is 2%. The present value of lifetime earnings was \$1,871,574. Appendix F shows how I got this result. The left column is age. The second column from the left has average salary of a Penn State graduate in 2006 dollars. The first number is the overall average earnings found in Appendix C. The following earnings are increased by the growth rates found in Appendix D. The third column contains the years of the cash flows that matter to the present value calculation. The right column has the present values of the cash flows found in the second column given the 2% discount rate. The last cell in this column is the sum of the present values, \$1,871,574.

Next, I multiplied the present value of the earnings by the retention rate. In my example it is 67%. This is the taxable income to Pennsylvania, \$1,253,955. Finally, I multiplied the taxable income by the tax rate to come up with the present value of income tax, \$38,496.

The second part of the income tax differential is the present value of income tax from high school grads and GED holders as highest level of education attained. I estimated the lifetime earnings from the ACS data broken down by age, highest education attained, and earnings. These data are presented in Appendix B. At the bottom of this column is the total present value over working life, \$584,748. Next, I multiplied this by the tax rate, 3.07%, to get

the present value of taxes to be received by the Commonwealth of Pennsylvania, \$17,952. I took this value from the value of tax received from a PSU grad. This gave me the present value of the difference of tax income received from a Penn State grad over that of a high school grad, \$20,545.

The third part of my analysis is the difference of the present value sales tax to be received from a Penn State graduate less that of a high school graduate or GED holder. I started with the taxable income that I found for high school graduates and GED holders, \$584,748, found in Appendix B and Penn State graduates, \$1,871,574, found in Appendix F. I multiplied these numbers by the percentage of income subject to sales tax, 30% in my base case, and by the sales tax rate of 5.66%. The present value of sales tax from a Penn State graduate, \$21,294, less the present value of sales tax revenue generated from high school graduates, \$9,930, is \$11,364. This gives me the third and final piece of the present value analysis.

These three pieces compose my net present value analysis. Appendix G contains my results for a base case analysis. My assumptions include a discount rate of 2%, a retention rate of 67%, average starting salary of a Penn State graduate of \$42,160, percentage of income subject to sales tax of 30%, sales tax rate of 5.66%, and a state income tax rate of 3.07%. The net present value to the Commonwealth of Pennsylvania is negative \$9,735. The summary of this calculation is in Appendix G. Under the Outcome section there are three parts. The first part is the present value of the tuition subsidy, negative \$41,643. It is the average of two tuition rate subsidies. The present value of tuition rate subsidies are \$41,769 for majors in business, science, engineering, and information sciences and technology and \$41,517 for all other majors. The second part contains the income tax component. The first number is the present value of income taxes from a Penn State graduate to Pennsylvania, \$38,496. The second number is the

present value of a high school graduate to Pennsylvania, \$17,952. The difference is \$20,545.

The third part is the sales tax component. The present value of sales tax revenue from Penn State graduates is \$21,294 to Pennsylvania. The present value of sales tax revenue from High School graduates is \$9,930. The difference is \$11,364. The three net components of negative \$41,643, \$20,545, and \$11,364 add up to negative \$9,735.

The previous case was an average. Holding most things equal and changing the major creates quite different results. My assumptions are a discount rate of 2%, a retention rate of 67%, income tax rate of 3.07%, sales tax rate of 5.66%, and 30% of income subject to sales tax. The following cases are based on Appendix G with changes to the starting salary based on major and present value of the tuition subsidy. For the major of finance with a present value of tuition subsidy of \$41,769 and a starting salary of \$49,045 the total present value is negative \$97. For the average Computer science major in 2006 with a \$41,769 tuition subsidy and a starting salary of \$58,717 the total present value is \$13,620 to Pennsylvania. For a Petroleum and Natural Gas Engineering major with the same subsidy as the previous two examples and starting salary of \$62,512 would have a total present value to the Commonwealth of Pennsylvania of \$19,003. On the other end of the spectrum a theatre major with a tuition subsidy of \$41,517 and a starting salary of 13,036 would have a total present value of negative \$50,912. In the middle of the spectrum an English major with a starting salary of \$28,866 and a tuition subsidy of \$41,517 would have a net present value of negative \$28,462.

Appendix H summarizes the results of the previous paragraph, colleges, and other majors. The first column lists the colleges and some specific majors. The second column contains the average starting salary in 2006 dollars. The third column contains the present value of the tuition subsidy for that particular college or major in 2006 dollars. The fourth column

contains the net present value using the assumptions in the previous paragraph in 2006 dollars. For example, an accounting major with an average starting salary of \$45,248 and a present value of the tuition subsidy of negative \$41,769 would have a net present value of negative \$5,482 to the Commonwealth of Pennsylvania in 2006 dollars.

Another way to analyze the data is to keep the average starting salary and tuition subsidy constant and change some of the variables. I used sensitivity analysis with respect to the discount rate, retention rate, and percentage of income subject to sales tax. I made three tables using two of the three variables while keeping third variable the same as the base case.

For the first table (Appendix H) my assumptions were income tax rate of 3.07%, sales tax rate of 5.66%, starting salary of a Penn State graduate of \$42,160, 30% of income subject to sales tax, and a present value of the tuition subsidy of \$41,643. The variables selected for sensitivity analysis were the discount rate and retention rate. I used discount rates of 0%, 1%, 2%, 3%, and 4%. I used retention rates of 0%, 25%, 50%, 67%, 75%, and 100%. The base case result of negative \$9,735 has a blue background. The positive results have green backgrounds. The negative results have red backgrounds. For example, a discount rate of 1% and a retention rate of 75% would have a total present value of \$7,854 and a green background. The total present value is positively correlated with the retention rate and negatively correlated with the discount rate. The majority of the cases result in a negative total present value.

For the second table (Appendix I) my assumptions were retention rate of 67%, income tax rate of 3.07%, sales tax rate of 5.66%, with the starting salary of a Penn State graduate of \$42,160, and a present value of the tuition subsidy of \$41,643. The variables selected for sensitivity analysis were the discount rate and the percentage of income subject to sales tax. I used discount rates of 0%, 1%, 2%, 3%, and 4%. I used percentages of income subject to sales

tax of 0%, 10%, 20%, 30%, 40%, and 50%. The base case result of negative \$9,735 has a blue background. The positive results have green backgrounds. The negative results have red backgrounds. For example, a discount rate of 1% and 40% of income subject to sales tax would have a total present value of \$3,659. The total present value is positively correlated with the percentage of and negatively correlated with the retention rate. The majority of the cases result in a negative total present value.

For the third table (Appendix J) my assumptions were discount rate of 2%, income tax rate of 3.07%, sales tax rate of 5.66%, starting salary of a Penn State graduate of \$42,160, present value of the tuition subsidy of \$41,643. The variables selected for sensitivity analysis were the retention rate and the percentage of income subject to sales tax. I used percentages of income subject to sales tax of 0%, 10%, 20%, 30%, 40%, and 50%. I used retention rates of 0%, 25%, 50%, 67%, 75%, and 100%. The base case result of negative \$9,735 has a blue background. The positive results have green backgrounds. The negative results have red backgrounds. For example, with 40% of income subject to sales tax and a 75% retention rate the total present value would be \$2,040. The total present value is positively correlated with retention rate and generally positively correlated with the percentage of income subject to sales tax. The majority of the cases result in a negative total present value.

This chapter presented the analysis and results of my study of Penn State tuition subsidies. I found that in most cases the Pennsylvania tuition subsidy is greater than the extra revenue that graduates generate. The presented results for multiple analyses including my base case and sensitivity analysis. My analysis contained three main parts: present value of the tuition subsidy, present value of difference in taxes from lifetime earnings, and present value of

the difference of income subject to sales tax. The combination of these three analyses formulated the value of the tuition subsidy to the Commonwealth of Pennsylvania.

Chapter 5

Conclusion

In most cases the net present value of the tuition subsidy to the Commonwealth of Pennsylvania was negative. This means that in most cases this investment in education should not be taken. This is simply looking at the state as if it were a business. This is a unique way of looking at the situation but in this case I found it useful. Through sensitivity analysis I found that the retention rate was one of the strongest factors in determining whether or not the result of the run ended up positive or negative. If there were a contract that required in-state students to stay in state, then the end result would much more likely be positive.

I made some assumptions in order to get the answers I sought. One of them was that a student would not have gone to Penn State if it weren't for the subsidy. I'm sure that some students would be willing to pay more to come to Penn State. This might alienate others. There certainly are substitutes.

I also ignored the value of the option to attend graduate school. Many majors that would have a negative net present value in my analysis might be positive in an analysis that included this variable. There also is a self-selection bias among individuals: More outgoing and talented students tend to go to college more often than those with less talent and ambition.

In future studies one might look into subsidized loans as an investment. Another aspect that could be looked at is financial aid in the form of need-based grants and merit-based grants. Need-based grants are typically based on family income. One could look for correlation between family income and post-graduation success. Merit-based aid is typically based on previous academic achievement. It could be interesting to see if this previous success will continue into

college and translate into higher earnings after graduation. Would these result in a net present value to the state or federal governments?

The only value I considered was monetary. It is entirely possible that there are other values to society and government beyond this measure. Lower crime rates, a better economy, and a more civil society could be the benefits of education subsidies. Perhaps measurements of these positive externalities could be included in a future analysis of this sort.

Chapter 6

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Appendix A

Tuition Data

Year	Standing (used for tuition)	PA	nonPA	Subsidy
2006-07	Freshman	11,646	22,194	10,548
2007-08	Sophomore	12,284	23,152	10,868
2008-09	Junior/BusSciEngIST	14,904	26,420	11,516
2009-10	Senior/BusSciEngIST	15,580	27,434	11,854
2008-09	Junior/Other	14,070	25,454	11,384
2009-10	Senior/Other	14,708	26,412	11,704

Deflated to 2006 dollars				
Year	Standing (used for tuition)	PA	nonPA	Subsidy
2006-07	Freshman	11,646	22,194	10,548
2007-08	Sophomore	11,944	22,511	10,567
2008-09	Junior/BusSciEngIST	13,955	24,738	10,783
2009-10	Senior/BusSciEngIST	14,641	25,780	11,139
2008-09	Junior/Other	13,175	23,834	10,659
2009-10	Senior/Other	13,821	24,819	10,998

Appendix B

Pennsylvania High School Graduate or Graduate Equivalency Degree Holder Earnings by Age

Age	Average Earnings HS/GED in PA (2010 dollars)	Average Earnings HS/GED in PA (2006 dollars)	Year	Present Value
18	3,342	3,090	0	3,090
19	5,552	5,133	1	5,032
20	9,416	8,705	2	8,367
21	10,813	9,997	3	9,420
22	12,665	11,709	4	10,817
23	14,578	13,478	5	12,207
24	16,539	15,291	6	13,578
25	17,868	16,520	7	14,382
26	18,681	17,271	8	14,741
27	19,760	18,268	9	15,286
28	20,000	18,491	10	15,169
29	20,121	18,603	11	14,961
30	20,390	18,851	12	14,864
31	21,805	20,160	13	15,584
32	21,029	19,442	14	14,735
33	23,685	21,897	15	16,270
34	22,038	20,375	16	14,842
35	24,471	22,624	17	16,157
36	25,470	23,548	18	16,487
37	25,072	23,179	19	15,911
38	24,704	22,840	20	15,370
39	26,351	24,362	21	16,074
40	25,785	23,839	22	15,420
41	25,335	23,423	23	14,854
42	24,951	23,068	24	14,342
43	26,501	24,501	25	14,934
44	26,231	24,251	26	14,492
45	26,539	24,536	27	14,375
46	27,574	25,493	28	14,643
47	27,421	25,352	29	14,276
48	27,763	25,668	30	14,171

49	26,936	24,903	31	13,479
50	27,983	25,871	32	13,728
51	26,943	24,909	33	12,959
52	25,749	23,806	34	12,142
53	26,332	24,345	35	12,173
54	25,127	23,231	36	11,388
55	24,576	22,722	37	10,920
56	24,831	22,957	38	10,817
57	22,506	20,808	39	9,612
58	20,950	19,369	40	8,772
59	20,892	19,316	41	8,576
60	19,791	18,297	42	7,965
61	17,889	16,539	43	7,058
62	15,694	14,510	44	6,071
63	12,244	11,320	45	4,644
64	11,092	10,255	46	4,124
65	8,415	7,780	47	3,067
66	6,719	6,212	48	2,401

Total Present Value

584,748

Appendix C

Starting Salary Data

College	Average Starting Salary (2009-2010)	In 2006 dollars
College of Agricultural Sciences	33,044	30,550
College of Arts and Architecture	35,006	32,364
*Theatre	14,100	13,036
Smeal College of Business	48,051	44,425
*Finance	53,048	49,045
*Accounting	48,941	45,248
College of Communications	31,997	29,582
*Journalism	30,163	27,887
College of Earth and Mineral Sciences	47,569	43,979
*Petroleum and Natural Gas Engineering	67,615	62,512
College of Education	35,636	32,947
*Rehabilitation and Human Services	24,986	23,100
College of Engineering	57,003	52,701
*Computer Science	63,510	58,717
College of Health and Human Development	35,577	32,892
*Human Development and Family Studies	28,353	26,213
College of Information Sciences & Technology	54,885	50,743
*Security and Risk Analysis	54,144	50,058
College of the Liberal Arts	35,715	33,020
*English	31,222	28,866
*Sociology-Bachelor of Arts	29,250	27,043
Eberly College of Science	38,219	35,335
*Math-Bachelor of Science	48,731	45,053
Average Starting Salary for PSU Graduates-Bachelor	45,601	42,160

Indicates higher tuition rates as senior and junior
*Designates specific major in a college

Appendix D

Growth Rates used for Penn State Graduates

Age	Average Earnings of PA bachelor degree holders (2010 dollars)	Change in Earnings YOY	5 Year Average Change in Earnings	Growth Rates Used in My Analysis
19	4,709		n/a	n/a
20	5,949	26.33%	n/a	n/a
21	6,455	8.50%	41.87%	n/a
22	10,674	65.37%		n/a
23	19,353	81.32%		3%
24	25,083	29.60%		3%
25	31,249	24.59%		3%
26	33,462	7.08%	5.55%	5.55%
27	36,751	9.83%		5.55%
28	39,002	6.13%		5.55%
29	39,421	1.07%		5.55%
30	40,861	3.65%		5.55%
31	43,884	7.40%	4.48%	4.48%
32	43,821	-0.14%		4.48%
33	46,084	5.16%		4.48%
34	46,544	1.00%		4.48%
35	50,721	8.98%		4.48%
36	50,793	0.14%	2.56%	2.56%
37	51,625	1.64%		2.56%
38	50,237	-2.69%		2.56%
39	54,207	7.90%		2.56%
40	57,356	5.81%		2.56%
41	56,216	-1.99%	0.66%	0.66%
42	58,963	4.89%		0.66%
43	59,005	0.07%		0.66%
44	57,560	-2.45%		0.66%
45	59,155	2.77%		0.66%
46	59,405	0.42%	0.43%	0.43%
47	61,330	3.24%		0.43%
48	63,246	3.12%		0.43%
49	62,095	-1.82%		0.43%

Age	Average Earnings of PA bachelor degree holders (2010 dollars)	Change in Earnings YOY	5 Year Average Change in Earnings	Growth Rates Used in My Analysis
50	60,340	-2.83%	0.43%	0.43%
51	60,707	0.61%	-2.97%	-2.97%
52	58,191	-4.14%		-2.97%
53	55,726	-4.24%		-2.97%
54	55,964	0.43%		-2.97%
55	51,754	-7.52%		-2.97%
56	48,854	-5.60%	-3.50%	-3.50%
57	47,452	-2.87%		-3.50%
58	46,486	-2.04%		-3.50%
59	47,269	1.69%		-3.50%
60	43,169	-8.67%		-3.50%
61	44,180	2.34%	-10.21%	-10.21%
62	39,776	-9.97%		-10.21%
63	29,888	-24.86%		-10.21%
64	29,129	-2.54%		-10.21%
65	24,456	-16.04%		-10.21%
66	17,536	-28.30%	n/a	-10.21%

Appendix E

Present Value of Tuition Subsidies for Students Entering in 2006

Discount Rate	2.00%
BusSciEngIST Majors	
total present value of PA resident	\$50,565
total present value of nonPA resident	\$92,334
present value of subsidy	\$(41,769)
Other Majors	
total present value of PA resident	\$49,042
total present value of nonPA resident	\$90,560
present value of subsidy	\$(41,517)
Average of the two subsidies	\$(41,643)

Appendix F

Projected Average Lifetime Earnings of a Penn State Graduate

Age	Average Salary PSU graduate (2006 dollars)	year	Present Value
18	-	0	-
19	-	1	-
20	-	2	-
21	-	3	-
22	42,160	4	38,949
23	43,425	5	39,331
24	44,728	6	39,717
25	46,069	7	40,106
26	48,627	8	41,503
27	51,327	9	42,948
28	54,177	10	44,444
29	57,185	11	45,992
30	60,361	12	47,594
31	63,064	13	48,750
32	65,888	14	49,935
33	68,839	15	51,148
34	71,921	16	52,391
35	73,763	17	52,679
36	75,652	18	52,968
37	77,589	19	53,259
38	79,576	20	53,552
39	81,613	21	53,846
40	83,703	22	54,142
41	84,254	23	53,430
42	84,809	24	52,727
43	85,367	25	52,034
44	85,929	26	51,350
45	86,495	27	50,674
46	86,865	28	49,893
47	87,237	29	49,124
48	87,611	30	48,367
49	87,986	31	47,622
50	88,362	32	46,888
51	85,735	33	44,602

52	83,185	34	42,427
53	80,712	35	40,358
54	78,312	36	38,390
55	75,983	37	36,518
56	73,324	38	34,549
57	70,758	39	32,686
58	68,282	40	30,924
59	65,892	41	29,257
60	63,586	42	27,679
61	57,092	43	24,365
62	51,261	44	21,448
63	46,026	45	18,880
64	41,325	46	16,619
65	37,104	47	14,629
66	33,315	48	12,877
Total Present Value			1,871,574

Appendix G

Example Net Present Value Analysis

Factors-Assumptions	
Discount Rate	2.00%
Retention Rate	67%
Income Tax Rate	3.07%
Sales Tax Rate	5.66%
PSU Grad Starting Salary	42,160
Percent of Income Subject to Sales Tax	30%

Outcome	
PV of PSU Subsidy	(41,643)

PV of the income tax difference between a Penn State graduate and a Pennsylvanian with a High School diploma or GED as highest education attained	
PV PSU grad to PA	38,496
LESS: PV HS/GED to PA	(17,952)
	20,545

PV income subject to sales tax multiplied by sales tax	
PV of sales tax revenue from PSU graduate	21,294
LESS: PV of sales tax revenue from PA HS/GED as highest education	(9,930)
	11,364

NPV of PA's investment in PSU	(9,735)
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Appendix H

Results of NPV Analysis with Different Colleges and Majors

College	Average Starting Salary (2006 dollars)	PV of Tuition Subsidy (2006 dollars)	NPV (2006 dollars)
College of Agricultural Sciences	30,550	(41,517)	(26,073)
College of Arts and Architecture	32,364	(41,517)	(23,501)
*Theatre	13,036	(41,517)	(50,912)
Smeal College of Business	44,425	(41,769)	(6,649)
*Finance	49,045	(41,769)	(97)
*Accounting	45,248	(41,769)	(5,482)
College of Communications	29,582	(41,517)	(27,446)
*Journalism	27,887	(41,517)	(29,851)
College of Earth and Mineral Sciences	43,979	(41,769)	(7,281)
*Petroleum and Natural Gas Engineering	62,512	(41,769)	19,003
College of Education	32,947	(41,517)	(22,675)
*Rehabilitation and Human Services	23,100	(41,517)	(36,638)
College of Engineering	52,701	(41,769)	5,089
*Computer Science	58,717	(41,769)	13,620
College of Health and Human Development	32,892	(41,517)	(22,752)
*Human Development and Family Studies	26,213	(41,517)	(32,224)
College of Information Sciences & Technology	50,743	(41,769)	2,312
*Security and Risk Analysis	50,058	(41,769)	1,340
College of the Liberal Arts	33,020	(41,517)	(22,571)
*English	28,866	(41,517)	(28,462)
*Sociology-Bachelor of Arts	27,043	(41,517)	(31,048)
Eberly College of Science	35,335	(41,769)	(19,540)
*Math-Bachelor of Science	45,053	(41,769)	(5,757)
Average Starting Salary for PSU Graduates-Bachelor	42,160	(41,643)	(9,735)

*Designates specific major in a college

Appendix I

Sensitivity Analysis Table for Variables “Discount Rate” and “Retention Rate”

		Discount Rate (%)				
		0	1	2	3	4
Retention Rate (%)	0	\$(87,302)	\$(77,157)	\$(69,524)	\$(63,679)	\$(59,121)
	25	\$(50,748)	\$(48,820)	\$(47,215)	\$(45,851)	\$(44,670)
	50	\$(14,195)	\$(20,483)	\$(24,905)	\$(28,023)	\$(30,219)
	67	\$ 10,661	\$ (1,214)	\$ (9,735)	\$(15,900)	\$(20,393)
	75	\$ 22,358	\$ 7,854	\$ (2,595)	\$(10,195)	\$(15,769)
	100	\$ 58,911	\$ 36,190	\$ 19,714	\$ 7,633	\$ (1,318)

Appendix J

Sensitivity Analysis Table for Variables “Discount Rate” and “Percentage of Income Subject to Sales Tax”

		Discount Rate				
		0	1	2	3	4
Percentage of Income Subject to Sales Tax	0	\$ (8,416)	\$(15,833)	\$(21,098)	\$(24,854)	\$(27,540)
	10	\$ (2,057)	\$(10,960)	\$(17,310)	\$(21,869)	\$(25,158)
	20	\$ 4,302	\$ (6,087)	\$(13,522)	\$(18,885)	\$(22,775)
	30	\$ 10,661	\$ (1,214)	\$ (9,735)	\$(15,900)	\$(20,393)
	40	\$ 17,020	\$ 3,659	\$ (5,947)	\$(12,915)	\$(18,011)
	50	\$ 23,379	\$ 8,532	\$ (2,159)	\$ (9,930)	\$(15,628)

Appendix K

Sensitivity Analysis Table for Variables “Percent of Income Subject to Sales Tax” and

“Retention Rate”

		Percentage of Income Subject to Sales Tax					
		0	10	20	30	40	50
Retention Rate (%)	0	\$(59,595)	\$(62,905)	\$(66,215)	\$(69,524)	\$(72,834)	\$(76,144)
	25	\$(45,230)	\$(45,892)	\$(46,553)	\$(47,215)	\$(47,876)	\$(48,538)
	50	\$(30,866)	\$(28,879)	\$(26,892)	\$(24,905)	\$(22,918)	\$(20,931)
	67	\$(21,098)	\$(17,310)	\$(13,522)	\$ (9,735)	\$ (5,947)	\$ (2,159)
	75	\$(16,502)	\$(11,866)	\$ (7,231)	\$ (2,595)	\$ 2,040	\$ 6,676
	100	\$ (2,137)	\$ 5,146	\$ 12,430	\$ 19,714	\$ 26,998	\$ 34,282

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