Implications: WHY IS MATH CHEAPER THAN ENGLISH? UNDERSTANDING COST DIFFERENCES IN HIGHER EDUCATION

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Of course both math and English are invaluable tools for engineering and the other design professions. But a recent publication with that catchy title has important implications for engineering education and the engineering profession. The National Bureau of Economic Research, a non-profit research entity with an impressive list of contributors and publications, issued a draft paper with that title. (http://www.nber.org/papers/w25314). The authors examined data from many colleges and identified "instructional costs" by department. Instructional costs are the salaries of instructors and staff, as well as direct costs such as laboratories. By assuming the indirect costs, such as physical plant and administration, are common to all programs, they were able look at the per credit costs of 20 different programs, including electrical engineering, English, and mathematics. Using English as a baseline, they found the startling fact that a math credit cost 20% less than an English credit. But more to our interest, they found that an engineering credit ($410 for Electrical Engineering) was twice as expensive as an English credit ($201). The NBER research found that this difference had two main drivers, the cost of faculty salaries and the size of classes. Some departments had high salaries, but offset that with large class size. Faculty salaries are driven by employment markets, while class size is dictated by the subject matter and the school's commitment to quality. It was remarkable that the numbers were so consistent over the 500 schools studied.

But next the authors approach the "social cost" of the credits. They note that some of the highest per credit costs were in "high demand" fields such as engineering and nursing. Further, that some states have initiatives to direct funding to these high demand fields. Then the authors question if there is a net positive to society from subsidizing education in these high demand fields. Engineering, Nursing, and other "STEM" fields earn more money than other fields, implying a shortage of labor with those skills, and thus justifying more education dollars be allocated to training in those fields. The implication of the NBER paper is that since the costs to society (that is, costs regardless of the source of funding) per credit are twice as high for engineering, it is not really a high value degree – or more moderately, the value of the degree needs to be compared with costs.

NBER found the instructional costs for each program, English, for example, were quite similar across many colleges, but clearly the tuition colleges charge is not similar. Therefore difference is in non-instruction costs - indirect and administrative costs. With the assumption that those costs are the same between the various degree programs within each college, we need only look at the difference between the program costs and the lifetime income to determine the benefit of perusing the higher cost program.

So what is the net benefit to society from an engineering degree? We can approach that by looking at the lifetime earnings of an engineer compared with other majors. The Hamilton project, an economic policy initiative of the Brookings Institution, has some data on the career earnings of college majors by discipline (http://www.hamiltonproject.org/charts/career_earnings_by_college_major/). Using their data, we can compute the lifetime annual income of the graduates with the specified degree,

and compare that to costs. Using UAF as an example, for English, the instruction cost of the120 credit BS is $ 24, 000, while for electrical engineering the cost of the 135 credit degree is $43, 000. (You can access these and other calculations via: http://www.raperkins.net/Presentations/Return_on_Engineering_Education.xlsx.) Those numbers account for the fact that many of the courses required for an engineering degree are liberal arts and natural science courses which cost less than engineering.

The incremental instructional cost of the electrical engineering BS degree over an English degree is $19,000. For that $19,000, the difference in present value of the earnings is $602,000, based on a discount rate of 6%. To avoid the necessity of estimating the discount rate, I did a rate of return analysis of the increment, the extra expense and income of the electrical engineering degree for 44 years, four years of college expense and 40 years of earnings. The rate of return on that incremental cost, the difference in instructional costs between English and EE, is 88%. In the UA system, there is a surcharge for engineering courses. Adding the cost of that surcharge to instructional costs, the rate of return is still very high, 79%.

So, is an investment by society that returns 79% worthwhile? Clearly, the societal costs of instruction for the engineering degree compared to the English degree are more than offset by the benefit to society of the engineering degree. How about the total college costs? Hamilton has projected earnings from a high school degree. Using the UAF numbers for tuition, fees, room and board, compared with the high school graduate, even with their four years of extra income, the English degree returns about 9% on the investment of time and money. The electrical engineering degree, including the surcharge, returns 24%, and even more if the engineering student works summers.

So, is society's investment in "high demand" fields, like engineering, justified? Commenting only on the tangible economics, the engineer earns more salary and spends more in the community and pays more in taxes. One could speculate that if society's investment produced many more engineers, at some point the salary of engineers would decline. That seems unlikely, since the amount of work that student engineers put into their degree limits the numbers of college students willing to peruse engineering.

The NBER selected English as the benchmark because it was a program common to all colleges and its instruction costs were at about the midpoint. Also, contrary to the joke about the English major saying, "Do you want fries with that?" the Hamilton project shows their earnings are substantially higher than many majors and much higher than a high school graduate. And I'll add that, based on my 20-year career in engineering followed by a 20-year career in engineering education, communications skills are a basic and important requirement for success in the engineering profession. Certainly there is a substantial societal benefit to students in all fields from English instruction, but this benefit is included in the salaries of those fields.

The NBER study is both interesting and informative and it prompted me to follow their suggestion that we take a closer look at the government initiatives that encourage education in the "high demand" fields. I have satisfied myself that society's extra investment in engineering has a very high return. And likewise an individual's personal investment in an engineering education has a very high return.