Invention Rate Estimates by College Students' Parental Income in the United States

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Abstract

This report is an analysis of the relationship between the parental incomes of students of various college institutions and invention rates among these students. The college institution that the student attended is measured by which institution the child attended for the most amount of time during which the student was ages 19 to 22 years old. The college students are represented by one of the five parent income quintiles (the first quintile being students of the least wealthy parents, and the fifth quintile being students of the wealthiest parents). The individual is considered an inventor if they were listed on a patent application between the years of 2001 and 2012, or granted a patent between the years of 1996 and 2014. The key question of this report is as follows: among various college institutions, do students with higher parental income have higher rates of invention?

Introduction

Economic growth occurs when a country's economy experiences a positive change in gross domestic product per capita (Reamer 3). One large component of economic growth is an increase in the rate of invention. An invention is "the process of devising and producing by independent investigation, experimentation, and mental activity something which is useful and which was not previously known or existing" (Reamer 2).

Because increased innovation and invention is such a crucial part of economic growth, it is assumed that most students/children would have equal access to educational opportunities that would allow them to become inventors. However, multiple studies demonstrate that an invention gap exists; there are relevant disparities between innovation and parental income (Varathan).

In this report, I will focus on the relationship between the number of students who become inventors (if they were granted a patent) and the parent income quintile which they represent. The key question is: are college students with higher parental income more likely to become inventors?

Lastly, I hypothesize that college students with higher average parental income are more likely to become inventors. I also hypothesize that there will be a greater number of college students that have wealthy parents as compared to less wealthy parents. I assume this because students with wealthier parents experience greater rates of intergenerational mobility and have increased access to educational opportunities (such as assistance with college applications or utilization of test preparation) that would allow them to reach the potential to attend college or eventually become an inventor (Varathan). Thus, I am hypothesizing that there is a positive correlation between parental income and rates of invention among college students.

Data/Resources

The data used in this report was acquired from several sources. The data on where students attended college is obtained from a roster of attendance at various colleges in the U.S. from the years of 1999 to 2013. This data was obtained from information on the IRS Form 1098-T, as well as the Department of Education's Pell Grant records (Bell 11).

The data on the college students' parental incomes is extracted from the federal government; specifically, federal tax records ranging from the years of 1996 to 2012 (Bell 7).

The data on the patent records was obtained from a public database on Google, which contains information on patents which were granted in the U.S. from the year 1976 to today. Furthermore, data on 1.6 million patent applications between the years 2001 and 2012 were extracted from the Strumsky Patent Database (Bell 7).

Because I am focusing on parental income and invention rates, I will not be using specific college names which are represented in the data. In this report, I will only be focusing on the demographics of the students (parental income quintile, if they became an inventor, etc.) rather than which college they attended.

The following table simplifies the variables which are analyzed in this dataset:

Data Dictionary

Variable Name	**Description of Variable**
super_opeid	Institution OPE ID number (Office of Postsecondary Education Identification)
count	Number of students
[order]q	Number of students with parents in quintile [quintile] of the income distribution
inventor	Portion of inventors among college students

[order]iq	Portion of inventors among college students with parents in quintile of income distribution
top5cit	Portion of students with total patent citations in the top 5% of their birth cohort among all inventors in a certain college institution
total_patents	Total number of granted patents to college students

The dependent variable (total_patents) I am investigating in this report is the rate of invention among the college students represented in the data; this is measured by whether or not the individual was listed on a patent application between 2001 and 2012, or a patent grant between 1996 and 2014. Furthermore, an individual is a highly-cited/successful inventor if they are found in the 5% of inventors (most patent citations by 2014) among their birth cohort (Bell).

The independent variable I am investing in this report is the parent income quintile which the college student falls under (firstq or fifthq). The fifth parent income quintile demonstrates the 20% of college students with the highest parental income. On the other hand, the first parent income quintile demonstrates the 20% of college students with the lowest parental income. It is important to point out that this dataset does not include each college in the U.S., meaning that the data presented might not fully represent the sample of the average invention rates among college students. The dataset includes 423 American universities, while there are about 5,300 universities in total (throughout America).

Table 1: Summary Statistics for Colleges

Variable	Obs	Mean	Std. dev.	Min	Max
firstq	423	833.0473	1077.522	12	10815
fifthq	423	3745.6	3437.395	213	27656
firstiq	423	.005976	.0136486	0	.1666667
fifthiq	423	.0101544	.0174163	0	.1417323

The first table in this report represents the summary statistics for the various variables in the data. Based on this table, there is a higher average number of college students with parents who come from the fifth parent income quintile as compared to the first parent income quintile. There is an average of 833.05 college students which represent the first parent income quintile (lowest income), and an average of 3,745.60 college students which represent the fifth parent income quintile (highest income). It is important to remember that there were only 423 observed universities in this dataset, which could allow for the skewing of results.

The variable “firstiq” represents the share of inventors among college students which represent the first parent income quintile (lowest income). The variable “fifthiq” represents the share of inventors among college students which represent the fifth parent income quintile (wealthiest parents). From the results, we can see that the average number of inventors among students of the fifth parent income quintile (wealthiest parents) is greater than the average number of inventors among students of the first parent income quintile (least wealthy parents). This is because an average of 0.010544 of the inventors seen in our data come from the fifth parent income quintile, while an average of 0.005976 of the inventors seen in our data come from the first parent income quintile. So far, this estimation supports my hypothesis that students with wealthier parents have higher rates of invention.

Figure 1: Average Number of Students from the Top and Bottom Parent Income Quintiles

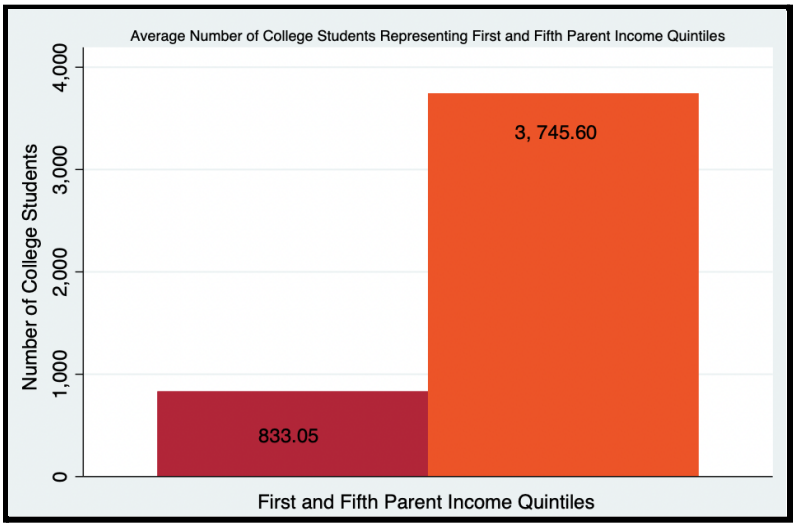

Figure 1 is a bar graph which demonstrates a part of the summary statistics found in table 1. Once again, there is a greater average number of college students in the data that represent the fifth parent income quintile (3, 745.60) as compared to the average number of college students that represent the first parent income quintile (833.05). Next, I will investigate whether the students who are a part of the fifth parent income quintile are more or less likely to become inventors compared to their peers. It is possible that this dataset contains universities with higher than average parent incomes, allowing for different rates of opportunity for students to attend college/be exposed to a path which would allow them to be an inventor.

Method and Results

In order to analyze the relationship between the dependent variable and the independent variables, I created scatterplots. Figure 2 is a scatterplot which demonstrates the relationship between college students whose parents are a part of the fifth parent income quintile (wealthiest) and the rates of invention among these students (if they obtained a patent).

Figure 2: Inventions Among College Students Representing the Fifth Parent Income Quintile

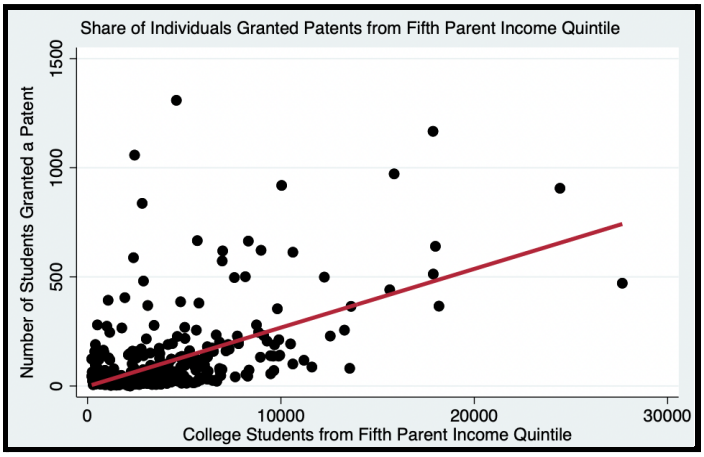

Figure 2 is a scatterplot which demonstrates the relationship between college students whose parents are a part of the fifth parent income quintile (highest income) and the rates of invention among these students. Because the line of best fit is upward sloping in figure 2, we can deduce that there is a clear positive correlation between college students who represent the wealthiest parent income quintile group and rates of invention among these students. A positive correlation means that as the independent variable increases, the dependent variable also increases (and vice versa).

Figure 3: Inventions Among College Students Representing the First Parent Income Quintile

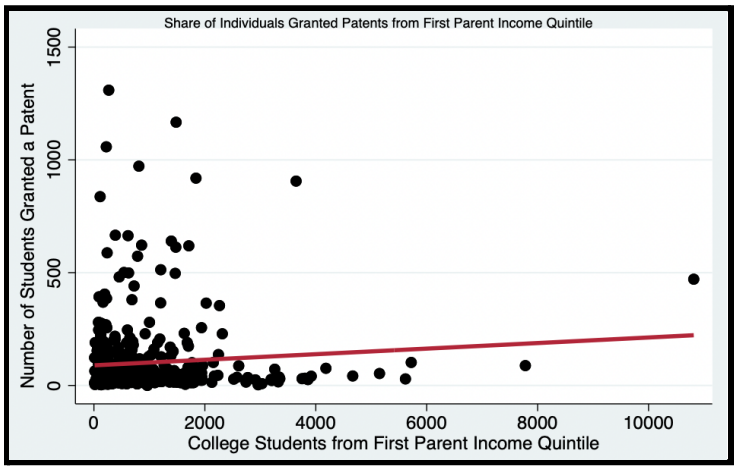

Figure 3 is a scatterplot which demonstrates the relationship between college students whose parents are a part of the first parent income quintile (low income) and the rates of invention among these students. Although figure 3 also illustrates a scatterplot with a slightly upward sloping line of best fit, it shows that the two variables are not as positively correlated as they are in figure 2. Because these are simply visualizations, I wanted to conduct a statistical analysis of the variables. I conducted the regression results of the variables, which provides statistical information for the data presented in figures 2 and 3. This analysis provided me with the magnitude of slope coefficient as well as the P-value.

Table 2: Regression Results for College Students in the First and Fifth Parent Income Quintiles

	(1)	(2)
VARIABLES	5th Quintile	1st Quintile
Patents Granted	11.05***	0.498
	(0.828)	(0.309)
Constant	2,646***	783.4***
	(162.7)	(60.65)
Observations	423	423
R-squared	0.297	0.006

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

In table 2, I conducted a regression for college students among the fifth parent income quintile group. Looking at the results for students from the fifth parent income quintile, we can deduce that the slope coefficient (11.04706) is highly statistically significant, as the P-value is

zero. This means that there is a positive relationship between invention rates and students whose parents fall under the fifth parent income quintile group.

I also conducted a regression for college students who fell under the first parent income quintile group. Looking at the results, we can deduce that the slope coefficient (0.498) is not statistically significant, because the P-value of the regression is 0.107. When the slope coefficient is not statistically significant, it can be assumed that the relationship between the variables might simply be a pattern or a weak trend. Furthermore, the results for the fifth parent income quintile group have a much greater slope coefficient than for the first parent income quintile group (the magnitude of the slope is higher).This means that the correlation between students of the wealthiest parent income quintile group and rates of invention is stronger than the correlation between students of the least wealthy parent income quintile group and rates of invention.

Once again, the regression I conducted shows that the findings for students in the fifth parent income quintile groups are highly statistically significant, while the findings for students in the first parent income quintile group are not. This analysis shows that there is a positive relationship between rates of inventions and students among the wealthiest parent income group; college students with wealthier parents are more likely to become inventors.

Discussion and Conclusion

Before conducting the linear regressions of the variables, I hypothesized that there would be a positive relationship between students of wealthier parents and invention rates. Although there was also a positive relationship between college students of parents of the least wealthy income quintile group and invention rates, the evidence of a strong relationship is weak.

The results of my models and the regressions I performed confirm the hypothesis which I stated in the introduction: college students of wealthier parents are more likely to become inventors than college students of low income parents.

It is important to analyze this disparity, as it demonstrates the unfair influence which parental income and wealth have on student success and their ability to become an inventor (Varathan). It would be interesting to see further research conducted on whether providing low income students with more money would eventually lead to higher rates of invention among those students, or if there are other factors to take into consideration other than parental income.

Other factors to consider include the assumption that children of wealthier parents are given more educational opportunities and face less adversity, which allows them to gain the skills and opportunities needed to become inventors. We can also assume that wealthier parents are more likely to push their children to attend university, whereas low income parents are not. Another factor to take into account is that wealthier parents might be more educated than low income parents. This would allow them to assist their children in their studies or have more background knowledge on certain subjects taught in school. Wealthier parents might also act as an educational mentor for their children, giving their children more opportunities to excel in school and eventually become inventors.

There is a clear difference between invention rates among students who come from high income parents and students who come from low income parents. In order to close this invention gap, educational policies and resources can be implemented in schools that have greater amounts of low income students. Some policies to take into consideration include providing low income students with incentives to utilize more educational resources, implementing school activities

that raise awareness on the importance of innovation and invention, and providing low income students with free test preparation (such as for the SAT) or college application assistance.

Invention is crucial to economic growth, and we must consider implementing policies throughout schools in order to ensure that all students (no matter which parent income quintile they fall under) have equal opportunities to become inventors. This would allow for economic growth and a healthy economy which promotes productivity, longevity, and progression for all individuals in America.

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