

Double majoring: Is it worth it?

Vy Ha Hoang

DePauw University

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Abstract

Double majoring is common in about 20% of college graduates and the number of students majoring more than one major are increasing. This paper uses the data from the 2018 American Community Survey (ACS) from IPUMS USA to estimate whether students who have double majors in college earn more through their lifetime than those with only one major and if so, by how much more. The empirical analysis concludes that students with double majors earn 4.62% more than single majoring students, holding other variables constant.

I. Introduction

Double majoring is common in about 20% of college graduates. According to some case study reports, the share of college students choosing a double major, or even a third and fourth major, is increasing. What is the reason behind students choosing to double major and is it worth it?

Similar to going to graduate school, double majoring might be expected to increase earnings by providing students with a wider and additional range of knowledge, which can indicate accrual of more skills or signal some characteristic of the student that they can perform better in certain tasks and have better efficiency. However, a considerable amount of literature that estimates the returns of different college majors only examines the effect on earnings of only one college major. As a result, the effect on earnings of double majors is not well studied. On one hand, having double majors can be beneficial to students as they can receive a broader education and develop a wide variety of skill sets. However, on the other hand, having double majors means students have to take on additional work or challenges, or in some cases, take a longer time to graduate than others who have only one major. Additionally, the cost of having more breadth in education is less depth within one field and for some industries, that can be a disadvantage.

From a student perspective, there are some intangible benefits to adding another, such as the enjoyment of learning about some “fun” fields. This paper aims to study whether double majoring can bring some tangible and monetized benefits. This paper uses data from the 2018 American Community Survey (ACS) from IPUMS USA to provide the estimate of the effects earnings of having a double major in college.

II. Literature review

The United States has benefitted from an educated workforce that is integral to the growth in productivity and innovation in various industries. The education system allows individuals of every background to reach their productive potential. Human capital development theorists believe that education is the key to increasing productivity. Earnings profiles formulated by Mincer (1974) suggests that schooling is responsible for a significant portion of variation in earnings. The Mincer equation describes earnings as a function of the return on schooling and years of work experience, which includes a second order effect to control for declines in wages experienced later in life.

Education, a measurable element and usually a proxy for skill accumulation, is shown to increase earnings and steepen individual age-earnings profiles (Mincer, 1974). Therefore, higher education is viewed as an investment, where the student forgoes current wages to enter college in the hopes of earning higher wages in the future. The college wage premium, calculated by taking the ratio of hourly wages of college educated workers to high school educated workers, is 1.8 (James, 2012). However, over the last decade, wages for college graduates have been stagnant. Median weekly wages for full-time Bachelor degree holders declined slightly from \$1,030 in 2000 to \$1,025 in 2009 (Mishel, 2011).

Freeman and Hersch (2008) demonstrate that students tend to match their fields of study to the knowledge content and earnings potential of desired jobs. Altonji, Blom, and Meghir (2012) also confirm that college major choices are influenced by expectations of future earnings, preferences, ability and preparation. Zafar (2011) finds that a student's decision to double major

is based on expectation that their major combinations will positively impact their chances of degree completion and finding a job after graduation.

Rossi and Hersch (2016) discuss the private and social benefits of double majors where they find that double majoring is associated with 2.3% higher earnings and better job matches, provided that the double majors are across rather than within general groups and also when the second major is in a relatively technical or high paying field. For instance, students double majoring in business and STEM earn a premium over those single majors. Using data from the 2010 National Survey of College Graduates, they were able to find evidence about whether there is an economic payoff to double majoring. For males, the business–STEM double major combination is associated with the highest returns – 44% more than single education majors. For females, on the low end of returns, individuals with single liberal arts major have earnings that are 8% higher than single education majors, and at the high end, single STEM, two STEM majors, and the business and STEM double major combination all have returns close to 40% greater than the return to a single education major.

Stock (2017) documents the trends in bachelor's degree conferred in first and second majors by discipline, gender and race/ethnicity over the period 2001-2014. The author finds that from 2001 to 2014, the number of second majors conferred annually for women rose by 74 percent, while the number conferred for minorities grew by 150 percent. Stock also finds the economics of second majors have increased over time, not only among students generally, but also among females and minorities. Moreover, the research paper also confirms that double majoring across relatively dissimilar disciplines yields higher returns to graduates than double majoring across relatively closely related fields.

Ma (2013), using datasets from the Survey of Income and Program Participation which tracks fields of study in college and income, confirms that Medicine & Dentistry, Law, Computer Science, and Engineering majors had higher earnings than other groups. Moreover, he also discovered that during the post-Great Recession period, average wages for Bachelor's degree holders remained stagnant, but Computer Science and Engineering degrees saw wage growth. As a result, students who double major in STEM fields and other fields outside of STEM, especially Economics, receive the highest returns for their education.

However, there are no college majors that perfectly connect to their respective occupation. Carnevale, Strohl and Melton (2011) report that some majors have high connectivity with their respective occupations. For example, 82 percent of nursing majors are in health practice occupations. Most majors are not linked to one particular occupation; instead, their skills are applied to other jobs. Carnevale, Strohl, and Melton (2011) find that 18 percent of Liberal Arts majors hold management positions, while 19 percent of Physics majors are in Computer Science fields. Consequently, these evidence show that it is beneficial for students to be majoring in two or more disciplines.

However, variation in earnings between different age-earnings profiles also come from a multitude of factors, many of them immeasurable. Throughout an individual's life, elements of chance, opportunity, innate biological and physiological abilities, may augment or enhance productivity and earnings. Mishel, Bernstein and Shierholz (2009) report that roughly 60 percent of wage inequality can be explained by within-group inequality, making the explanation of wage inequality go beyond skill, education and experience. This may point to the immeasurable factors such as ability, upbringing, luck and opportunity.

III. Theoretical Analysis

There are two different theories that can be used to explain how double majoring can increase one's earnings: Human Capital theory and Comparative Advantage theory. The result of empirical analysis will be explained deeply based on these theories.

Human capital theory is a theory of earnings. First developed by Becker and Mincer, this theory explains both individuals' decisions to invest in human capital (education and training) and the pattern of individuals' lifetime earnings. Individuals' different levels of investment in education and training are explained in terms of their expected returns from the investment. As more investment in education is made, such as spending more time studying, majoring in more than one discipline, or spending more years in school, earnings accumulate rapidly.

In economics, society's productivity can be measured by the following function:

$$\frac{Y}{L} = A \cdot f\left(\frac{K}{L}, \frac{H}{L}, \frac{N}{L}\right)$$

where Y is the quantity of output, L, the quantity of labor, A, technological knowledge, K, the quantity of physical capital, H, the quantity of human capital, and N, the quantity of natural resources. Double majoring provides students with an additional credential that can indicate accrual of more skills or that signals some inherent characteristic of the individual that is positively correlated with productivity. In other words, double majoring affects productivity directly through the increase in technological knowledge and human capital per worker.

Moreover, the model used in this paper is based on the Mincer earnings function — a single-equation model that explains wage income as a function of schooling and experience. The logarithm of earnings is modelled as the sum of years of education and a quadratic function of

"years of potential experience" (Mincer, 1974). By using the semi-log functional form, the coefficients represent the estimated percent change in the dependent variable for a unit change in the independent variable.

Another explanation for the positive correlation between double majoring and earnings is from the comparative advantage theory. Comparative advantage is an economy's ability to produce a particular good or service at a lower opportunity cost than its trading partners. A comparative advantage gives a company the ability to sell goods and services at a lower price than its competitors and realize stronger sales margins. In an individual's perspective, comparative advantage is the ability to complete a task at a lower opportunity cost. According to Teulings (2005), highly skilled workers have a comparative advantage in complex jobs, especially in tasks that require knowledge and skills from more than one field. Overall, based on these two theories, double majoring can increase one's earnings. However, it is unclear how impactful a second major could be on one's income.

IV. Empirical Analysis

A. The data

Table 1: Summary Data Table

	Mean	SD	Min	Max
Income Wage	86593.43	90994.83	1100.00	718000.00
Female	0.52	0.50	0.00	1.00
Age	43.28	11.27	25.00	64.00
White	0.79	0.41	0.00	1.00
Black	0.07	0.25	0.00	1.00
Asian	0.10	0.30	0.00	1.00
Other races	0.04	0.20	0.00	1.00
Hispanic	0.08	0.27	0.00	1.00
Experience	20.50	11.24	1.00	42.00
Full-time workers	0.97	0.17	0.00	1.00
Years of Education	16.78	0.97	16.00	18.00
Double Majoring	0.12	0.32	0.00	1.00
Observations	24090			

Source: IPUMS USA 2018 ACS Sample, employed and have Bachelor's degree persons, age 25 to 64.

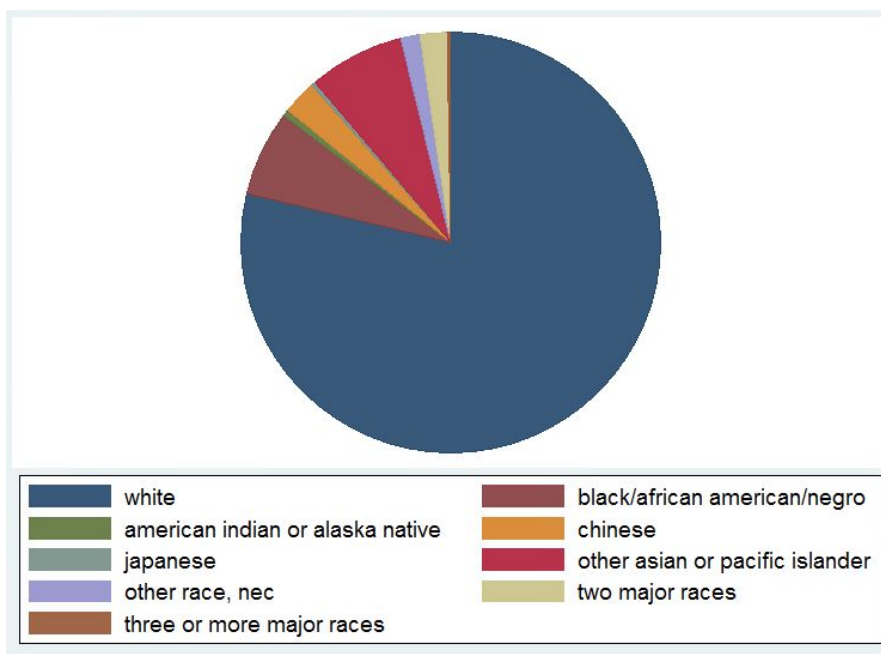
Before comparing how different regression models perform in analyzing the relationship between double majoring and income, it is important to describe some independent variables and explain some details of the data set, which is summarized in Table 1. All data were collected from 2018 ACS from IPUMS USA - the individual-level population database which consists of microdata samples from the United States. Since the data collecting process of this complex survey does not meet the requirement of Classical Econometric Model, which is simple random sampling, unequal probability will be taken into account in this paper by not only Ordinary Least Squares (OLS), but also Probability Weighted Least Squares (PWLS) will be used in this empirical analysis. As mentioned in the Theoretical Analysis, the dependent variable, which is wage and salary income (earnings) was regressed in the semi-log functional form. Moreover, only observations with age 25 to 64 were selected as this is the typical labor force, which consists of individuals that had obtained their Bachelor's degree. Additionally, any observations

that have income from wages and salaries less than \$1000 the previous year and did not have any majors in college are deleted.

Table 1 summarizes the variables that were used in the regression analysis. Control variables are experience, experience squared, years of education, race variables, and sex. Experience variable was calculated as age minus schooling minus 6 (the typical age to begin school in the U.S.) and the quadratic term was also included (Mincer, 1958). According to the Human Capital theory mentioned earlier in the theoretical analysis, the relationship between earnings and experience is curved as little experience yields lower income, while too much experience or being too old reduces earnings. The most important independent variable of this study is double majoring. Double majoring is coded to show how many people in this sample had double majors in college, with 1 meaning yes and 0 meaning no. From this sample, about 12% of the sample had two majors during their undergraduate. According to the Mincer Earnings function, natural log should be applied to income. Moreover, using semi-log functional form also helped reduce heteroskedasticity in the data.

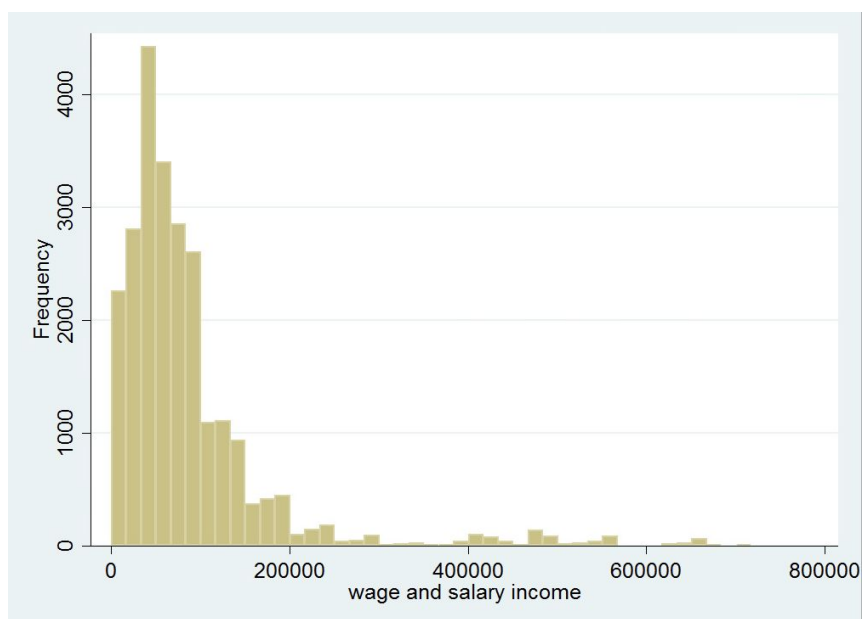
Figure 1 below shows the demographics of the sample, white people made up the majority at about 78%. Figure 2 below shows the annual income frequency distribution in this sample. The distribution is skewed to the right with the skewness of 3.3. These two figures show that the sample used in this regression analysis represents the general population in the U.S. well in terms of demographics and income.

Figure 1: The racial demographics of the sample



Source: IPUMS USA 2018 ACS Sample, age 25 to 64.

Figure 2: Annually Income Frequency Distribution of the sample



Source: IPUMS USA 2018 ACS Sample, age 25 to 64.

B. The Results

Table 2: Regression Results for Double Majoring

	(1) OLS ln(Earnings)	(2) OLS ln(Earnings)	(3) OLS ln(Earnings)	(4) OLS ln(Earnings)	(5) PWLS ln(Earnings)
Double Majoring	0.0420* (0.0191)	0.0410* (0.0185)	0.0425* (0.0171)	0.0410* (0.0167)	0.0452* (0.0215)
Years of Education		0.155*** (0.00609)	0.149*** (0.00563)	0.151*** (0.00550)	0.150*** (0.00678)
Experience		0.0632*** (0.00228)	0.0593*** (0.00211)	0.0582*** (0.00206)	0.0580*** (0.00258)
Experience Squared		-0.00121*** (0.0000523)	-0.00110*** (0.0000484)	-0.00110*** (0.0000471)	-0.00109*** (0.0000602)
Full-time workers			2.084*** (0.0326)	1.992*** (0.0319)	1.952*** (0.0486)
Female				-0.351*** (0.0107)	-0.333*** (0.0132)
White				0.248*** (0.0216)	0.252*** (0.0235)
Asian				0.254*** (0.0266)	0.251*** (0.0311)
Other races				0.144*** (0.0339)	0.156*** (0.0419)
Hispanic				-0.150*** (0.0202)	-0.169*** (0.0244)
Constant	10.97*** (0.00652)	7.740*** (0.103)	5.830*** (0.100)	5.870*** (0.100)	5.913*** (0.125)
Observations	24090	24090	24090	24090	24090
Adjusted R^2	0.000	0.068	0.203	0.245	0.232

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In total, four regressions were completed and analyzed. Model (1) was run to measure raw differentials, the dependent variable being $\ln\text{INCWAGE}$ and the independent variable being only doubleMajoring . Model (2) and Model (3) include some other additional control variables: years of education, experience, experience squared and full-time workers. Model (4) adds other core demographic control variables into it. Lastly, Model (5) was identical to model (4) in terms of the independent variables, but also utilizes PWLS regression rather than OLS. Model (4) has the highest adjusted R^2 equalling 0.245- which measures the goodness-of-fit of the regression by penalizing the number of predictors. Using many variables in the regression analysis can increase the goodness-of-fit of the regression because a number of predictors can be used to explain the dependent variable. Moreover, by using the PWLS regression, which takes into account the

sample survey design of IPUMS where there is an unequal probability of selection, we can achieve better and consistent standard errors and coefficients. Thus, even when the adjusted R^2 for Model (4) (0.245) is higher than R^2 for Model (5) (0.232) as Model (5), Model (5) performs the best in this paper, and will be the result discussed in this paper.

According to Model (5), the coefficient estimate of Double Majoring variable is $e^{0.0452} - 1 \approx 0.0462$ as the dependent variable is wrapped using natural log. In other words, by holding constant other dependent variables, it is found that double majoring can increase earnings by 4.62%. The standard error of the estimated coefficient of double majoring is 0.022. Also, it is important to note that this standard error is the robust standard error. The 95% of confidence interval constructed as $4.62\% \pm 2.2\%$ covers the true parameter value of the effect on earnings of double majoring. Moreover, this fact means we can reject the null hypothesis that double majoring does not have any impact on earnings.

However, one of the limitations of this regression analysis is that the paper does not take into account the different combinations of majors, and whether the combination of majors is from the same field or not, which can significantly change the effect of double majoring on earnings. An article by Del Rossi and Hersch (2007) found that double majoring increases earnings by 2.3 percentage points, compared to those who only have a single major during college. More importantly, they also found that majors combining business and science or math have returns more than 50% greater than the returns to having a single major in these fields. Additionally, “graduates who combine an arts, humanities or social science major with a major in business, engineering, science or math have returns 7–50% higher than graduates with a single major in arts, humanities or social science.” (Del Rossi and Hersch, 2007). As a result, only

looking into the fact whether a student has a second major or not does not fully tell the whole picture of how impactful a second major could be to the person's earnings.

V. Conclusion

This econometric analysis was carried out with the intention of determining the effects of double majoring on earnings. Using the data from 2018 ACS from IPUMS USA, this paper concludes that, holding other controlling variables constant, students who have double majors during college earn estimateably $4.62\% \pm 2.2\%$ more than those who have a single major. This finding aligns with prior studies mentioned in the Literature Review section as overall double majoring has a positive impact on an individual's income.

Further research can be conducted with data on the effect of different combinations of double majors, and even third or fourth, on earnings and find what the best majors combinations are. These studies can be very useful for students who are considering whether it is worth a second and what majors can be complimenting to their current declared major.

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