How Much is That Second Major Worth?

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Abstract- This study examines the difference in earnings between college graduates who select to double-major for their bachelor's degree versus those who select to only single-major. To collect a greater return on their education, students are often compelled to double-major as they pursue their bachelor's degree. Does this decision effectively increase student outcomes? At the beginning of this study, my initial assumption was that a second major would insignificantly affect the earnings of an individual. The results of this study confirm this hypothesis, providing evidence that a second major insignificantly affects earnings at the 95% confidence level, all else held constant.

Introduction

Education offers an assortment of incentives. International studies show that better educated individuals earn higher wages, experience less unemployment, and work in more prestigious occupations than their less-educated peers (Cohn 1997, Psacharopoulous 1985, Psacharopoulous 1994). The effect of education on monetary earnings is consistently established to be positively correlated (Card 1999). With these positive correlations, higher education such as undergraduate bachelor's degrees have increased in demand over the years (Kane 1999).

In pursuit of a bachelor's degree within the U.S., a student must specialize in at least one academic discipline. This specialization is commonly referred to as a "major" and can be chosen from a plethora of fields (e.g., Accounting, Engineering, English, etc.). With each major, there are certain courses that must be completed, along with a minimum number of elective courses to complete the accompanying bachelor's degree.

The decision as to what a student should study for their major is not trivial (Carnevale, Cheah, and Strohl 2013; Montmarquette, Cannings, and Mahseredjian 2002). To make themselves more sought-after candidates for employment and/or graduate programs, students are often compelled to not only study the appropriate major, but to also "double-major" as they pursue their bachelor's degree. A student who double-majors meets the requirements of two separate academic disciplines within the same bachelor's degree[1]. A primary motivation to double-major lies on the assumption that the effort offers the same aforementioned incentives of education. Though education has a significant, positive correlation to earnings, does this correlation also exist within the addition of a second major?

Many studies have investigated the monetary returns from different majors (Carnevale, Cheah, and Strohl 2013; Connley 2015). Findings show that certain majors offer better returns than others. Nevertheless, little is known about the value of a second major. In 2008, Del Rossi and Hersch provided the first estimates of the effect of a second major on earnings. Their study analyzes the 2003 National Survey of College Graduates and finds evidence that a second major increases an individual's earnings by 2.3%. In 2010, Hemelt adds to this limited literature by using the same data set, specifically controlling for differences across institutions (i.e., The availability and difficulty to double-major across institutions). This latter research finds similar results to Del Rossi and Hersch (2008), observing an earnings premium of 3.2% from the addition of a second major to a bachelor's degree. Both studies also find evidence that different combinations of certain majors yield different returns. For example, adding a second major from the fields of Business Administration, Computer Science, and Engineering appears to be the most profitable pairing (Hemelt 2010).

Research presented by Del Rossi and Hersch (2008) and Hemelt (2010) has been limited to a single survey sample from the National Survey of College Graduates. My research adds to this literature by observing a different and more expansive survey, including samples from several years. Additionally, the previous literature does not explicitly control for the

[1] A Bachelor's degree comprised of two majors is not to be confused with the achievement of two *separate* bachelor's degrees.

occupation of an individual within their estimates. The occupation of an individual is a primary influencer on earnings (Atonji 2014), and my research controls for this factor to more accurately estimate the relationship between a second major and earnings.

My hypothesis is that the addition of a second major to a bachelor's degree insignificantly affects the earnings of an individual. The following study empirically addresses this hypothesis with the aim to not only estimate the true relationship of this phenomenon, but to also provide students with further information that can be used in their decision to either single-major or double-major for their bachelor's degree.

Data

The data I used for this study came from the American Community Survey (ACS) Public Microdata Samples (PUMS), provided by the United States Census Bureau (USCB) annually. These data are collected on a continuous basis and include information on a variety of characteristics across individuals and households, such as income, employment status, housing costs, housing conditions, etc. The ACS PUMS reports can be found on the USCB website (www.census.gov).

Using the individual ACS single-year PUMS data for the years 2012-2017, I created a pooled cross-sectional data set to observe individuals across six years. Every individual within the data set is considered to observably be included only once across these six years. The raw ACS PUMS data that I pulled from the USCB included over 250 characteristic variables of over eight million individuals. Since this study pertains to only those who have received a bachelor's degree, this data set was trimmed to remove individuals who had received less than or greater than a bachelor's degree. After the removal of these observations, the data set includes 1.7 million observations.

The outcome variable of interest in my analysis is earnings. The "earnings" used in my estimations are the recorded wages/salary income that an individual received during the 12 months prior to their survey date. It is important to note that my research is primarily interested in this feature, and does not account for an individual's total income or wealth (e.g., Dividends, interest, inheritance, savings, etc.)

The distribution of earnings within the data set can be reviewed in Figure 1, with average earnings being $63,542. As seen in Figure 1, the data are skewed to the right, with outliers reporting earnings over $250,000. These outliers were removed from the data set in preparation for OLS regression analysis.

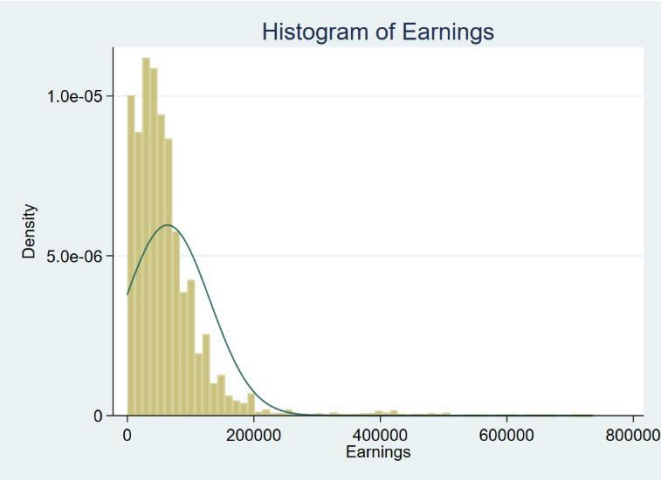

Figure 1.

The average age of the participants included in the data set is 49.6 years, with a minimum age of 18 years and a maximum age of 97 years. A scatter plot of the average earnings for each age group found in the data set can be seen in Figure 2. According to Figure 2, age is parabolic in relation to earnings, with outliers lying below the ages of 21 years and above 76 years. We can see that the data set is affected by heteroskedasticity in the latter half of Figure 2. Observations that were 65 years (i.e., The traditional age of retirement) or older were removed from the data set in preparation for OLS regression analysis.

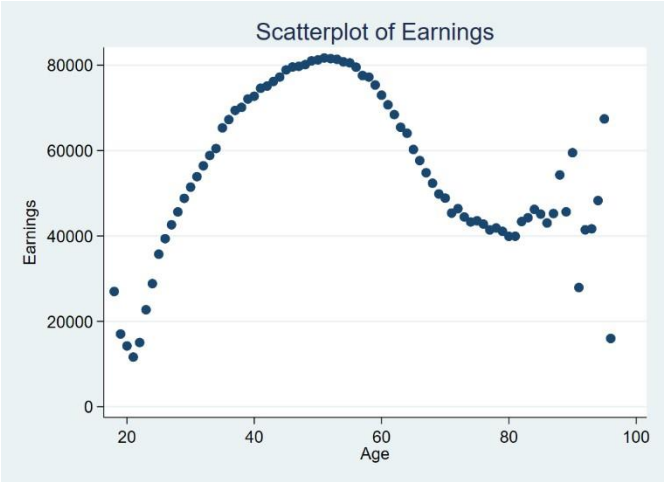

Figure 2.

Much of the variance in earnings across individuals is correlated with their college majors and the associated occupations that such majors lead to (Atonji 2014). Because of this, it is important to control for the variety of majors that a student might select for their bachelor's degree, along with an individual's occupation. There is a total of 173 different majors represented within the data set. If a survey respondent had received a bachelor's degree, they must record at least one major associated with the degree. Additionally, there is a total of 479 different occupations represented within the data set.

The main independent variable of interest for my analysis is an indicator of whether an observation recorded a second major in their survey response, thus having double-majored for their bachelor's degree. I created a dummy variable to observe this within my upcoming econometric models. Within the scope of this study, the first major recorded by respondents is referred to as the "primary major", while the second major recorded is referred to as the "secondary major". 10% of the observations within the data set double-majored and were assigned a flag indicating so.

Method

Functional Form

To address the hypothesis of this research, I first applied the following naïve model shown in equation (1) to establish a baseline relationship between a second major and earnings:

$$earnings_i = \beta_0 + \beta_1(doubleMajor)_i + u \quad (1)$$

Inspired by the human capital earnings function (Mincer 1974), I applied a final, log-linear model on earnings, including a dummy variable for individuals with a second major, along with other control variables. This final model is shown below in equation (2) and provides the final estimations from this research:

$$\begin{aligned}\log(earnings)_{ijtsm} &= \beta_0 + \beta_1 doubleMajor_{ijtsm} \\ &+ \beta_2 Sex_{ijtsm} + \beta_3 Age_{ijtsm} \\ &+ \beta_4 Age2_{ijtsm} \\ &+ \beta_5 maritalStatus_{ijtsm} \\ &+ \beta_6 Race_{ijtsm} \\ &+ \beta_7 hoursWorked_{ijtsm} \\ &+ \beta_8 weeksWorked_{ijtsm} + \theta_j \\ &+ \lambda_t + \alpha_s + \varepsilon_m + u\end{aligned} \quad (2)$$

$\boldsymbol{\theta}$ represents Occupation

$\boldsymbol{\lambda}$ represents Survey Year

$\boldsymbol{\alpha}$ represents State of Residence

$\boldsymbol{\varepsilon}$ represents Primary Major

Control Variables

To estimate the effect of a second major on earnings, it is important to control for relevant factors such as sex, race, age, and marital status (Altonji 1999). Because of this, control variables were added to the above model in suit. Age-squared was also included to control for the parabolic nature of the data set shown in Figure 2. Lastly, when estimating earnings, it is intuitively important to control for the numbers of hours worked weekly and the number of weeks

worked for a given individual in the past 12 months prior to their survey date.

As previously mentioned, it is imperative to control for the variety of majors and occupations represented in the data set. Majors, along with their associated careers/fields, vary in difficulty, flexibility, and popularity (Carnevale, Cheah, and Strohl 2013). Additionally, students sort into college majors and careers relative to their idiosyncratic capabilities, motivations, and preferences (Arcidiacono 2003). By controlling for each major and occupation represented within the data set, I account for these differences and control for the varied abilities and selection preferences of each observation.

To account for these heterogeneities, I applied separate fixed effects within my model, iteratively controlling for each primary major and occupation represented within the data set. I also applied fixed effects to control for the state that an observed respondent lived in at the time of their survey date, along with the year that they were surveyed. These last two fixed effects were applied to control for the cost of living associated with an individual's earnings, along with inflation and fluctuations in the economy over time.

Limitations & Assumptions

There are limitations to the model shown in equation (2). Though the model explicitly controls for the primary major of an individual, it does not control for the variety of double-major combinations that an individual might pursue for their bachelor's degree. As stated earlier, individuals within the data set that double-majored are flagged with a dummy variable. However, this dummy variable does not indicate what academic discipline the secondary major was (e.g., Finance, Communications, Graphics Design, etc.). Because of this, the model does not explicitly control for the idiosyncratic effects of certain secondary majors or specific double-major pairings on earnings.

Certain variables of interest have been omitted from this model due to limitations of the data set used in this research. The years of experience that an observation might have in the work force is not specifically accounted for in this model. Despite this omission, the control variables accounting for age, hours worked weekly, and weeks worked serve as proxies. Additionally, the institution that an individual graduated from is not included in the data and is omitted within the model. Prior research has accounted for institutions and found resulting double-major effects (Hemelt 2010).

Along with limitations to this model, there are also further limitations to the data set used in this research. The data set does not indicate which major of a double major bachelor's degree is of preference and used in an individual's career. The assumption made in this study is that the first major that an individual recorded in their survey response is their major of preference and is thus indicated as the primary major of the individual. Additionally, the data does not explicitly flag individuals who have obtained multiple bachelor's degrees. Future research, coupled with more extensive data, could remove such observations to further ensure that β_1 is unbiased.

In my analysis, a total of six OLS regressions were estimated to observe the effect of a second major on earnings – Latter regressions expound upon the former by adding further control variables. To review the results of each regression, see Table I on the next page.

Table I

OLS Regression Estimates of the Effect of a Second Major on Earnings

	Dependent Variable: log(earnings)					
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Double Major (1 = yes)	-0.0444***	0.0128***	0.00615***	-0.00673***	-0.00651***	0.00161
	(0.00263)	(0.00244)	(0.00176)	(0.00160)	(0.00158)	(0.00160)
Female (1 = yes)	--	-0.410***	-0.169***	-0.117***	-0.115***	-0.105***
		(0.00148)	(0.00110)	(0.00112)	(0.00111)	(0.00115)
Age	--	0.163***	0.0783***	0.0647***	0.0653***	0.0645***
		(0.000498)	(0.000365)	(0.000336)	(0.000332)	(0.000332)
Age^2	--	-0.00175***	-0.000794***	-0.000641***	-0.000649***	-0.000641***
		(5.81e-06)	(4.26e-06)	(3.91e-06)	(3.86e-06)	(3.87e-06)
Married (1 = yes)	--	0.121***	0.109***	0.0666***	0.0803***	0.0772***
		(0.00166)	(0.00120)	(0.00110)	(0.00109)	(0.00109)
Black (1 = yes)	--	-0.132***	-0.109***	-0.0560***	-0.0619***	-0.0644***
		(0.00297)	(0.00214)	(0.00196)	(0.00197)	(0.00198)
Hispanic (1 = yes)	--	-0.139***	-0.101***	-0.0387***	-0.0835***	-0.0884***
		(0.00280)	(0.00201)	(0.00184)	(0.00188)	(0.00188)
Other (1 = yes)	--	-0.0355***	0.0415***	0.0166***	-0.0510***	-0.0658***
		(0.00243)	(0.00175)	(0.00162)	(0.00167)	(0.00168)
Avg. Hours Worked Weekly	--	--	0.0329***	0.0289***	0.0290***	0.0289***
			(5.15e-05)	(4.90e-05)	(4.84e-05)	(4.84e-05)
Weeks Worked	--	--	-0.359***	-0.331***	-0.332***	-0.332***
			(0.000435)	(0.000403)	(0.000399)	(0.000398)
Constant	10.58***	7.250***	8.089***	8.481***	8.299***	8.236***
	(0.000843)	(0.00978)	(0.00753)	(0.00698)	(0.00830)	(0.0124)
Fixed Effect (Occupation)	No	No	No	Yes	Yes	Yes
Fixed Effect (Year)	No	No	No	No	Yes	Yes
Fixed Effect (State)	No	No	No	No	Yes	Yes
Fixed Effect (Primary Major)	No	No	No	No	No	Yes
Observations	1,738,999	1,738,999	1,738,999	1,738,999	1,738,999	1,738,999
R-Squared	0.000	0.143	0.556	0.632	0.641	0.643

Note: Standard errors are shown in parentheses. P-values are indicated as follows:
*** p<0.01, ** p<0.05, * p<0.1

Results

Models (1), (2), and (3) in Table I apply traditional control variables such as age, marital status, race, work hours, and weeks worked. Models (4), (5), and (6) build upon the prior analyses by sequentially introducing additional fixed effects. Model (6) shows the estimations of the model introduced in equation (2) and produces the final results for this study.

The control variables introduced in equation (2) can be reviewed on the far-left hand side of Table I (Note: White is the omitted dummy variable for the control on race). The first line of coefficients in the table show the estimated relationship of a second major on earnings. These estimations are the primary interest of this study.

The statistical significance of each estimate included in Table I is overinflated due to the sheer amount of data analyzed. Nevertheless, a large data set is vital in this analysis to control for the large number of majors and occupations represented within the data set. Because of this inflation, it is appropriate to weigh the economic significance of each coefficient value, rather than merely its statistical significance.

Results from Table I reflect the general relationship of a second major on earnings. Based on the results of model (6), my initial hypothesis of the effects of a

second major on earnings is correct. Overall, a second major insignificantly affects earnings at the 95% confidence level. Additionally, coefficient estimates in prior models that reflect a statistically significant relationship are not economically significant. These findings provide evidence that students who double-major for their bachelor's degree do not make more in earnings than those who choose to only single-major, all else held constant. The results from model (6) explain 64% of the variation within earnings.

Models (4) and (5) even find a negative correlation between a second major and earnings. Under the assumption that education is skill-building, as opposed to signaling, these findings might suggest that students who single-major focus specifically on an acquired skill set, arguably being more prepared for a specified profession or graduate program than their double-major counterparts. This preparation allows a greater return in earnings relative to their greater capabilities (Arcidiacono 2003). According to Hemelt (2010), the percentage of double-major graduates has steadily declined since the 1970s. This might be due to the results found in these estimations, that obtaining a second major has become more difficult or less profitable over time.

Conclusion

Students anticipate a return on their investment in education. This anticipated return is most commonly an increase in earnings. Research has consistently shown that the relationship between education and earnings is positively correlated. Nevertheless, the results of this study suggest that students who choose to add an additional major to their undergraduate education do not significantly increase their earnings compared to their single-major counterparts.

Though double-majoring might not increase one's earnings, this does not suggest that a second major does not have value. The value of a second major primarily depends on a student's motivations. Outside of monetary motivations, there are a number of reasons why a student might decide to double-major. Examples entail recreational pursuits, signaling, career flexibility, etc. Nevertheless, the findings of this research suggest that students should not decide to double-major solely on an anticipation to collect a greater return in earnings.

Some of the reasons why a student would choose to double-major warrant further research and can build upon the current literature. A variety of settings might find direct or indirect premiums from double-majoring. For example, do students who double-major experience less unemployment, greater career flexibility, or more attractive opportunities than their single-major counter parts? Additionally, future literature can explore the presence of alternatives that might better capture the anticipated returns of a second major (i.e., Greater earnings, job security, career flexibility, opportunities, etc.), such as graduate school or work experience.

Del Rossi and Hersch (2008) and Hemelt (2010) find evidence that a second major offers earning premiums from specific double-major pairings, along with an indirect effect on further education in graduate level programs. Further research should analyze the more expansive data set used in this study to see if such findings are reproducible. Lastly, employers and/or graduate programs would be interested in additional research pertaining to the productivity of students who double-major. A candidate with a second major might signal a higher motivation, greater breadth of knowledge, and a more dynamic skill set.

In closing, students should make informed decisions on the trade-offs and potential returns of their investment in education. It isn't always an easy task for a student to decide on what they should study, let alone on whether they should single-major or double-major for their bachelor's degree. If a student is interested in adding a second major to their degree, they should appropriately weigh their reasons pertaining to their interests and long-term goals. In respect to earnings, students can rest assured that there is most likely no difference.

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