STUDENTS' ESTIMATES OF EARNINGS BY MAJOR: ASSESSING THEIR USEFULNESS IN THE CLASSROOM AND IMPLICATIONS OF THEIR ACCURACY

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ABSTRACT

This research project introduces a short in-class learning exercise involving students' forecasting the likely earnings for their selected major that has been very well reviewed by the students. The data collected establishes that for this sample from a regional public university, many students make sizable errors when estimating median earnings for their selected major. The evidence weakly supports the view that students with business-related majors have more accurate earnings forecasts than do students with non business-related majors. Stronger support is found for the hypothesis that students selecting lower earning majors are more likely to overestimate earnings for their major than are students selecting higher earnings majors. There does not appear to be any robust linkage between students' grade outcomes and the accuracy of their earnings forecasts. The potential implications for students of large earnings forecasts errors also is examined.

Keywords: earnings forecasts, college major

INTRODUCTION AND LITERATURE REVIEW

This research paper introduces a time-effective, well-received, in-class active learning exercise that introduces students to comprehensive data on earnings by college major. The students' responses are then analyzed to assess the accuracy of students' estimates of earnings for their selected undergraduate major. This pilot research project has findings relevant to several strands of recent research literature: the need for, and benefits of, motivating students with real world examples and applications; the impact of rising student loan debt and a weak labor market in recent years for new college graduates; and, the accuracy of students' estimates of earnings in their selected majors and occupational choices.

In the early 1990s, Krueger (1991) led a comprehensive overview of the state of graduate education in economics and emphasized "our major concern focuses on the extent to which graduate education in economics may have become too removed from real economic problems" (p. 1039). Their primary recommendation was "that graduate education can be improved if relatively more emphasis is given to providing students applications of the tools of economics to economic problems" (p. 1052). This report on graduate education in economics was motivated in part by growing dissatisfaction with the all lecture and all theory approach so common in undergraduate economics education. In a comprehensive overview of current practices in undergraduate economics instruction, Becker (1997) found that fewer than 25% of professors in introductory economics courses assigned materials from outside the textbook or related problems

workbook. Summarizing relevant literature, Becker (1997) argues that having students "actively engaged in the learning process, through discussion and small-group activities, encourage(s) persistence and appear(s) to be conducive to learning, especially if combined with rapid feedback and positive reinforcement" (p. 1370). A follow-up study by Becker and Watts (2001) largely confirms earlier findings on the infrequency of outside the textbook materials being incorporated into introductory economics classes. As noted by Becker (2000), a major concern is "that for many students, textbook discussions of markets are often too hypothetical and do not involve current events and observable phenomena…. More headline-grabbing material, however, needs to be in prominent places" (pp. 111-112). As explained in the methodology section, the student exercise that generated the data for this research project very much involved current events, observable phenomena, and for the students was "headline grabbing," all of which help to motivate student interest in, and learning of, economics.

In addition to helping motivate student interest in the economics course itself, another important reason for doing the exercise was to increase the information set for students as they decide upon their likely undergraduate major. While most students taking the introductory economics course in the classes that were surveyed already have a declared major, many of them will change majors before graduating. Since most students are in their first three semesters when taking the course, some flexibility remains for them to switch majors if they decide it is in their best interests to do so. It has been increasingly well documented that student loan debt has risen sharply in recent years, and at the same time the labor market for new college graduates has been amongst the weakest seen in the past 50 years. In such a world, there is definite value-added from using some class time to have students examine data on earnings by major. Having a realistic sense of the likely earnings path of their major is necessary information to compare against the student debt load to be accrued in pursuit of that major. Reed and Cochrane (2012) analyzed student loan debt data for Class of 2011 graduates that was voluntarily reported by 1,057 public and private nonprofit four-year colleges. They estimate that 66% of 2011 graduating seniors had student loan debt, with an average of $26,600 for those with loans. The average debt load is higher than this for students in Pennsylvania, which is behind only New Hampshire in the state rankings of average student loan debt. Moreover, the average debt of 2011 graduates at Indiana University of Pennsylvania (IUP), the institution at which this research was completed, ranked in the Top 20 of all public universities in the 1,057 colleges data set. In 2011, 83% of IUP graduates had student loan debt and the average debt of these graduates was $32,416 (College Insight, 2013). These students need to be as fully informed as possible about the earnings potential of various majors as they decide upon their path through college.

The weak labor market for new college graduates, combined with the growing student loan repayment obligations, has resulted in sharp increases in student loan default rates. Reed and Cochrane (2012) estimate an 8.8% unemployment rate in 2011 for young college graduates, a modest improvement from the 9.1% rate in 2010. This unemployment rate underestimates the slack labor existing for new college graduates, as they estimate that up to 19.1% were either working part-time involuntarily or had given up looking for work. Of the student loan borrowers who entered repayment in 2010, 13.0% at public and 8.2% at nonprofit colleges had defaulted on their loans by 2012. Students who are unaware that they are selecting a low earnings path major are more likely to struggle with loan repayments as they are less likely to be carefully evaluating debt repayments against likely earnings.

The existence of large variation in earnings across college majors has been documented for many years, with Daymont and Adrisini (1984), Grogger and Eide (1995), and Hammermesh and Donald (2008) as informative examples of this literature. The literature assessing the accuracy of students' estimates of earnings by major or occupation is more limited, but one widely cited work is by Betts (1996). He surveys 1,269 undergraduates at UC-San Diego, with engineers oversampled, and asks them several questions including estimates for salaries for four specific engineering majors and average earnings for 25-34 year olds with "High School Diploma Only" versus "Bachelor's Degree." Across all questions asked, the median of the absolute value of the students' forecast errors was 19.6%. Dominitz and Manski (1996) surveyed 110 high school and college students about the earnings of high school and college graduates and found the median female overestimated the earnings of female high school graduates by 22% and female college graduates by 42%. Nicholson (2005) examined data on 25 different cohorts of medical students who were surveyed in both their 1st and 4th years of school and asked to estimate current physician income in six different specialties. The median student underestimated physician income by 15%, and the median absolute value of the errors was 26%. By their fourth year, medical students were 35% more accurate in their forecasts than in their first year. In this study, the accuracy of IUP students' forecasts will be compared against these prior surveys of forecast accuracy that had emphasized higher earning engineering and medical specialties.

METHODOLOGY AND FINDINGS

Obtaining Students' Earnings Forecasts: In-Class Exercises

As an in class bonus exercise, students were given a sheet of paper that on one side listed 120 different undergraduate majors and an ID number. In space provided on the other side of the paper, students entered the ID number and name of the listed major that most closely matched their selected major (or major they are considering). Next, the instructor carefully reviews the concept of the median earnings in an occupation and after that review students are instructed to write down their best guess for the median earnings nationally for people with that undergraduate major (and no other advanced degree) and approximately two years of work experience. Lastly, they write down their best guess for the median earnings nationally for people with that undergraduate major (and no other advanced degree) and approximately 15 years of work experience. These student earnings forecasts are the data evaluated in this research paper.

After collecting the students' responses, they would be given the actual data for the earnings by college major and the link to the data at www.payscale.com. Then, there would be a several minute class discussion about characteristics of relatively high paying, and low paying, college majors. This discussion would be tied into the Supply-Demand framework. To assist students in appreciating the sizable differences in cumulative lifetime earnings across different undergraduate majors, a follow-up exercise requires the students to compute estimated lifetime earnings for three different majors of interest to them. After these assignments are submitted, the class is given the estimated lifetime earnings for all of the 120 majors covered by the payscale.com data set. The Table 1 below is an extract of these lifetime earnings estimates that shows the occupations at the 90th, 75th, 50th, 25th, and 10th percentile of lifetime earnings. Lifetime earnings were estimated by assuming an individual earns the median starting salary for their major their first two years of working, then the salary rises in equal increments each year

for years 3-15 to reach the mid-career median salary estimate from payscale.com, and the person works another 30 years at the mid-career salary estimate (a 45 year work career takes a 22 year old to 67 years old at retirement). These cumulative life earnings are not discounted to present value equivalents in order to keep the time spent on the exercise relatively brief, but the exercise still conveys valuable, easily understood, information to the students on the wide variation in earnings across undergraduate majors.

Late in the semester, students completed a short evaluation sheet on several different bonus exercises done during the semester. Student evaluations of this exercise were quite strong. On a 1-5 scale of 1(strongly disagree), 2(disagree), 3(neutral), 4(agree) and 5(strongly agree), student responses to five questions are summarized in Table 2. Fifty of 59 respondents strongly agreed or agreed that the exercise was interesting, 49 of 59 that the exercise was worth the class time used, and 40 of 59 intend to make future use of the payscale.com data set. Further evidence of the positive response to the exercise is that 18 of the students already had showed the data to friends or family members, and another seven were planning to show the data to friends or family. This exercise helped to create linkages between the classroom and the "real world" and was a positive motivation for the strong majority of the class.

Table 1. Earnings by Major, 2011

Percentile Rank	Major	Starting Salary	Mid-Career Salary	Estimated Lifetime Salary
90th	Computer Science	$56,200	$97,700	$4,043,750
75th	Chemistry	$42,400	$83,700	$3,415,450
50th	Geography	$39,600	$71,200	$2,935,400
25th	Photography	$35,100	$61,200	$2,532,150
10th	Education	$35,100	$54,900	$2,302,000
Starting & Mid-Career Salaries from payscale.com, lifetime estimate as described in text				

Table 2. Summary of Student Evaluations of the Earnings by Major Exercise

	Interesting	Worth Class Time	Make Future Use of	Showed to Friend/Family	Will Show to Friend/Family
# 5's	20	19	12	7	11
#4's	30	30	22	11	14
#3's	9	8	18	9	19
#2's	0	1	6	21	6
#1's	0	1	1	11	9
SUM	59	59	59	59	59

Evaluation of Students' Earnings Forecasts

A total of 74 students completed the initial in-class bonus exercise where they estimated the median earnings at two years and 15 years of work experience for their selected undergraduate major (with no additional degrees earned). These student estimates were compared against the payscale.com data and the forecast error for each student is estimated as:

(forecasted earnings – actual earnings) / actual earnings

The distribution of students' forecast errors are summarized in Table 3. Students were roughly equally likely to underestimate as overestimate starting salaries with 36 students underestimating and 38 students overestimating median starting salaries. Those students overestimating starting salaries, however, were notably more likely to have a larger forecast error than those students underestimating median starting salaries. Of the 36 forecasts underestimating starting salaries, 15 of the forecasts were within 10% of their actual value. In contrast, only eight of the 38 forecasts overestimating median starting salaries were within 10% of their actual value. Defining large forecast errors as greater than 30%, we see that only five of the 36 underestimating forecasts were large errors while 15 of the 38 overestimating forecasts were large errors.

Table 3. Distribution of Student Forecast Errors of Median Earnings for Their Selected Major
(Error = (Forecasted Value – Actual Value) / Actual Value)

Forecast Error Range	# of Starting Salary Errors	# of Mid-Career Salary Errors		Forecast Error Range	# of Starting Salary Errors	# of Mid-Career Salary Errors
< -40%	2	3		> 40%	13	12
-40% to -30%	3	13		40% to 30%	2	4
-30% to -20%	5	5		30% to 20%	5	7
-20% to -10%	11	9		20% to 10%	10	2
-10% to -5%	10	9		10% to 5%	2	4
-5% to 0%	5	2		5% to 0%	6	4
TOTAL	36	41		TOTAL	38	33

While students were not likely to have large underestimates of median starting salaries, they were much more likely to have large underestimation errors for their forecasts of median mid-career earnings as 16 of the 41 underestimates had large errors of more than 30%. While fewer students, 33 of 74, overestimated mid-career median earnings than underestimated, 41 of 74, the fraction of students overestimating mid-career earnings who were making large errors was nearly 50% as 16 of the 33 overestimates had errors of 30% or more. Both the large underestimation and large overestimation errors are potentially quite damaging to students. A student with a large underestimation of the likely earnings path for their selected major will be more likely to drop out of college when confronted with academic, financial, or personal challenges that are in fact surmountable since their expectation of future earnings from completing the major is falsely low. Conversely, those students with large overestimations of the likely earnings path for their selected major will be more likely to accrue student loan debts that are too large to be manageable given the likely earnings of the selected major. While the latter scenario has garnered most of the attention in the popular press, both types of large forecast errors have the potential to be significant policy problems. The data in Table 3 prompts several follow-up questions:

- Does forecast accuracy vary by course grade?

- Does forecast accuracy vary by selected major?

- Are students selecting lower paying majors more likely to overestimate earnings?

Table 4 below contains results of tests for difference in proportion of either large underestimate errors of more than 30% (too pessimistic) or large overestimate errors of more than 30% (too optimistic) in students' forecasts of median starting salaries across grades received by students. The "Too Optimistic" column utilizes for each grade level the null hypothesis that is that there is no difference in the proportion of students with that grade outcome having overestimation errors larger than 30% as compared to the proportion of students with all other grades having overestimation errors larger than 30%. Values for the chi-square test statistic > 2.71 (3.84) lead to a rejection of this null hypothesis at the 10% (5%) significance level in favor of the alternate hypothesis that students with that grade outcome are more likely to have large overestimation errors. As none of the test statistics even exceed 1.0 in value, we find no evidence that students with any particular grade outcome are more likely to be excessively optimistic about median starting salaries. Similarly, the "Too Pessimistic" column shows the test statistics for the null hypothesis that is that there is no difference in the proportion of students with that grade outcome having underestimation errors larger than 30% as compared to the proportion of students with all other grades having underestimation errors larger than 30%. Given the 10% (5%) critical value of 2.71 (3.84), students with an "F" grade outcome are the only grade category for which the null of equal proportions is rejected in favor of the alternate hypothesis that students with an "F" grade are more likely to be too pessimistic about median starting salaries. Overall, the results in Table 4 suggest that there is no substantial link between student's grade outcome and the likelihood of large salary estimation errors.

Table 4. Tests for Differences in Proportion of Large (>30%) Student Forecast Errors for Median Starting Salaries by Student Grade Outcome

Student Grade	"Too Optimistic" Test Statistic	"Too Pessimistic" Test Statistic
A	0.731	0.087
B	0.532	0.005
C	0.790	1.265
D	0.095	0.095
F	0.863	3.744
Reject Null of = Proportion for reported grade and for all other grades combined for students with > 30% overestimation (Too Optimistic) or > 30% underestimation (Too Pessimistic) when test statistic > 2.71 (10% level) or > 3.84 (5% level)		

While there is little evidence that student earnings forecast errors are systematically related to grade outcomes, it might be the case that students in certain majors are more likely to be aware of the earnings prospects for their major. In particular, it is plausible that students in business related majors make more accurate earnings forecasts than do students in non business majors since business students are more likely to be focused upon immediate job prospects and identified career paths than are students in more traditional liberal arts majors. Fortunately, there

was sufficient diversity in majors amongst the students who completed the earnings forecast exercise that this hypothesis can be tested. As seen in Table 5, 41 of the students can be classified into Business-Related majors and 33 students into Non Business-Related majors. There is some evidence that Business-Related majors have more accurate forecasts of median starting salaries as their mean absolute value forecast error is 20.1% versus 26.8% for Non Business-Related majors and the variance of the forecast errors for Business-Related measures is only 60% as large as the variance for Non Business-Related majors. The formal hypothesis test of equal means across the two samples, unequal variances assumed, is borderline statistically significant with a p-value of 0.10. Given the relatively moderate size of each sample, and the resultant moderate power of the statistical test, these results provide some support for the view that students in Business-Related majors have a better understanding of likely salaries upon graduation than do other students. This leads to the question, not investigated in this initial research work, of whether or not early exposure in college to the data on variation in earnings across majors would impact students selection of undergraduate major. Examining the mid-career earnings forecast errors, once more the Business-Related majors have smaller average errors at 28.8% versus 38.3% for Non Business-Related majors. In addition, the variance is now much larger for the Non Business-Related majors at 34.8% versus 6.2% for Business-Related majors. This suggests that the Non Business-Related majors are responsible for more of the large forecast errors on mid-career salaries. Unsurprisingly, the large variance in forecast errors for the Non Business-Related majors leads to a failure to reject the formal statistical test of equal average forecast errors as the t-statistic is just -0.86 with a p-value of 0.19.

Table 5. Difference in Absolute Value Salary Forecast Errors
Business-Related versus Non Business-Related Majors

	Starting Salary Forecast Errors			Mid-Career Forecast Errors	
	Business-Related Majors	Non Business-Related Majors		Business-Related Majors	Non Business-Related Majors
Mean	0.208	0.268		0.288	0.383
Variance	0.037	0.062		0.062	0.348
Observations	41	33		41	33
t-statistic	-1.28			-0.86	
p-value (one-tailed)	0.10			0.19	

Another possible explanation of large overestimations of earnings is that students who select lower paying majors are more likely to be overestimating the actual median earnings for that major than are students in higher earnings majors. Are students in low earnings majors more likely to be delusional in their salary forecasts? This question is assessed by dividing the 74 student sample into the top and bottom quartiles based on actual median starting salaries for the students selected majors, and testing for a difference in the mean forecast errors. Note that this test does NOT use the absolute value of the forecast errors since the test is focused upon the likelihood of overestimating earnings and not on the symmetric accuracy of the estimates. Given the relatively small size of the two samples, the evidence reported in Table 6 strongly supports

the view that students selecting lower paying majors are more likely to be overestimating median starting salaries than are students in higher paying majors. The average forecast error for students in the highest paying quintile was less than one percent while the students in the lowest paying quintile overestimated median starting salaries by 16.4% on average. Even with the relatively large variance on the forecast errors for the bottom quintile group, the formal test of no difference in average forecast error is rejected given the p-value of 0.07.

Table 6. Difference in Median Starting Salary Forecast Errors
Majors in Top Quartile of Earnings versus Majors in Bottom Quartile

	Top Earnings Quartile Majors	Bottom Earnings Quartile Majors
Mean	0.009	0.164
Variance	0.072	0.117
Observations	18	18
t-statistic	1.51	
p-value (one-tailed)	0.07	

SUGGESTIONS FOR FUTURE RESEARCH AND CONCLUSION

The next stage for this research agenda is to collect student forecasts of earnings across a larger sample of students to see if the patterns found in this pilot study are consistent: large overestimation errors are more likely than underestimation errors, Business-Related majors have more accurate salary forecasts than non Business-Related majors, and students in lower earnings majors are more likely to overestimate future earnings. With a larger sample, another potentially important question to investigate would be if differences exist in salary forecasts by gender. There exists a sizable literature documenting that males are more likely to overestimate their odds of success in a variety of economic outcomes, see for example Barber and Owens (2001) as well as Niederle and Vesterlund (2007).

Another important question left to future research is if exposure to the salary data impacts students' selection of major. Recent work suggests that responses to information often is asymmetric, bad news is less likely to lead to altered behavior than is good news as seen in Brunnermeier and Parker (2005), Kozegi (2006), and Eil and Rao (2011). This could be investigated by comparing students who learned they had been underestimating the median earnings for their major against students who had learned they were overestimating the median earnings for their major. If this information asymmetry holds, then the former group would be more likely to retain their major than the latter group would be to switch majors. Lastly, another extension of this research would be to survey students at different types of institutions to see if the results are robust to public versus private, liberal arts college versus university, and more selective versus less selective institutions.

In sum, this pilot research project has established that the in-class exercises exposing students to earnings by undergraduate major were quite well received by the students, helped motivate students, and drew valued linkages between the classroom concepts and real-world

outcomes directly relevant to their lives. The collected forecast error data reveals that for this student sample at a public regional university, many students make sizable errors when forecasting median salaries for their own major. These errors can have substantive future consequences for these students and support additional efforts to inform students about the likely earnings consequences associated with their selected college major.

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