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Analyzing Teacher Salaries Using the Post-Secondary Employment Outcomes Dataset

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Abstract

Studies relying upon household survey data have concluded that public school teachers receive substantially lower salaries than comparably-educated private sector workers. However, any given level of formal educational attainment found in household surveys can encompass a wide range of skills as valued in the labor market. We use a recently developed Census Bureau dataset, the Post-Secondary Employment Outcomes (PSEO), that allows us to analyze annual earnings up to 10 years following completion of a Bachelor's or Master's degree while controlling for both the educational institution attended and the field of study in which the degree was granted. We find that the teacher salary gap appears to be largely a function of higher salaries paid to holders of STEM degrees. Education degree holders receive median salaries that are not substantially different from those received by other non-STEM degree holders graduating from the same institutions.

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Introduction

Policymakers are concerned with the ability of public schools to attract and retain quality teachers. One issue that has been raised repeatedly over the last decade is whether teacher salaries are comparable to what teachers might receive in alternative occupations. Over the past several years public teachers in several states have successfully lobbied for higher salaries.

These efforts are buttressed by a series of studies that have concluded that there is a “teacher salary penalty” that is only partially offset by a shorter work year and more generous benefits. For instance, Allegretto and Mishel (2020) apply a Mincer (1970) style analysis to public school teacher salaries, concluding that public school teachers in 2019 received weekly salaries that are 19 percent below those paid to non-teachers with comparable levels of education and other earnings-related characteristics such as age, gender, marital status, and race.¹

However, educational attainment as measured in household surveys and applied in a standard wage regression is a broad bucket. The measures by which we assess formal educational attainment, such as highest degree attained or years of schooling, are sufficiently wide-ranging that variations in earnings are to be expected even among individuals with seemingly identical educational attainment. A Bachelor’s degree holder could include anyone from a lower-performing student who received a general studies degree at a community college to a star student who excelled in a STEM field at a highly-competitive university. Earnings in the workforce reflect the variation in the market value of skills of individuals with identical formal educational attainment as measured in household surveys. (See Carnevale, et al., 2013.) It is these earnings differences that drive recent efforts to encourage more college students-- in particular racial, ethnic and gender minorities-- to major in STEM fields. Thus, while earnings

¹ Allegretto and Mishel (2020) is the most recent of a series of studies that began with Allegretto, Corcoran and Mishel (2004), a book-length treatment of teacher pay issues.

are correlated with educational attainment over large groups of employees, it is less clear whether such analyses can establish that a given occupation is systematically underpaid relative to alternative occupations, as opposed to average salaries within a given occupation falling below the mean of a wide range of salaries paid to employees with the same level of formal educational attainment.

The difficulty in evaluating the appropriateness of occupational pay can be seen clearly when similar data and methods used in Allegretto and Mishel (2020) are applied to occupations other than public school teachers. We ran a series of Allegretto and Mishel-style wage regressions on each occupation identified in the Current Population Survey. Among the occupations with a total sample size of at least 100 between 2011 and 2019, about 49 percent (207 out of 423) had a wage differential greater in absolute value than the differential for public school teachers. As the selected occupations shown in Table 1 indicate, these differentials can be quite large, both in the positive and negative direction. Indeed, the most “overpaid” occupation is nurse anesthetists, a profession that performs roughly the same tasks as medical doctor anesthesiologists but receive salaries that are approximately 40 percent lower. Unless one is prepared to conclude that nurses are “overpaid” and telemarketers are “underpaid,” then the amount we can learn about teacher pay from this model is clearly limited.

It is more likely that the human capital model’s standard control variables, such as years of education and experience, are simply insufficient to account for important differences across occupations. Indeed, a theme in Table 1 appears to be that occupations that seemingly receive salary premia are those that demand higher skills relative to the formal educational attainment of job holders. For instance, registered nurses are found to receive a 27 percent salary premium over other workers with similar formal educational attainment. While registered nurses have

lower average levels of educational attainment than public school teachers – about one year shorter on average than public school teachers in the Current Population Survey – nursing is a STEM field where technical knowledge and precise attention to detail may literally be matters of life and death. Likewise, electricians, who purportedly receive a 20 percent wage premium, may not have high levels of formal educational attainment, but they conduct work that requires technical training and can be dangerous or destructive if done poorly. Hirsch and Schumacher (2015), using Occupation Information Network (O*NET) data, find that much of the seeming overpayment of nurses found using an Allegretto and Mishel-style analysis is resolved by O*NET data showing that “nursing jobs require relatively high levels of skill and have demanding working conditions.”

In addition to Hirsch and Schumacher (2015), a number of other studies have considered the distinction between quantity of education as measured in household surveys and the quality of human capital that is rewarded in the labor market. Richwine and Biggs (2012) analyze teacher pay using data from the National Longitudinal Survey of Youth (NLSY), controlling for NLSY respondents’ scores on the Armed Forces Qualification Test rather than formal educational attainment. They find no significant teacher salary penalty on that basis.² Schanzenbach (2016) similarly analyzes public and private sector wages using the NLSY’s AFQT scores, finding that college educated state and local government employees have average AFQT scores about 0.24 standard deviations lower than college-educated employees in the private sector, which depending upon specifications partly or fully accounts for salary differences between the sectors. However, due to issues regarding the measurement of teachers’

² NLSY respondents take the AFQT test as part of their participation in the survey; the Richwine and Biggs (2012) analysis is not restricted to individuals who were members of the armed forces.

work hours, Schanzenbach's analysis focuses on non-teacher state and local government employees.

In this study we narrow the field of uncertainty by using a Census Bureau dataset that allows for analysis of earnings controlling for the college or university attended and the field of study in which the degree was received, both of which are likely to reflect earnings-related skills that are not captured in a simple measure of years of educational attainment. The U.S. Census Bureau's Post-Secondary Employment Outcomes (PSEO) dataset links data from universities and State Departments of Education to State Labor Market Information offices and the U.S. Census Bureau. The PSEO dataset includes data on over one million graduates of 243 colleges and universities in six states from the years 2001 through 2015. The states included in the PSEO dataset are Colorado, Michigan, New York, Pennsylvania, Texas, and Wisconsin. All colleges and universities included in the PSEO appear to be public and range from community and junior colleges to flagship state university campuses.

The PSEO data show annual earnings by institution and field of study one, five, and 10 years following the receipt of a Bachelor's or Master's degree. We analyze earnings one and five years following graduation only at the median, while for 10 years we provide additional detail by analyzing earnings at the 25th, 50th, and 75th percentiles. While the PSEO data are not without limitations, which are discussed in greater detail below, the data provide additional insights that were not previously available to researchers.

Before analyzing the PSEO data, a number of caveats are warranted. First, the PSEO figures are for salaries by educational institution and field of study, not by occupation. That is to say, in this analysis individuals who major in Education at the Bachelor's or Master's level are assumed to work as teachers, when in fact they could work in a variety of industries. For college

majors other than Education this would be a significant limitation. However, obtaining a degree in Education is a pathway to working as a teacher in a way that is not replicated in many other fields of study. For instance, in the PSEO data, 78 percent of Master's degree recipients in Education work in the field of Educational Services 10 years following graduation. A related problem is that some individuals who obtain degrees in non-Education fields are later employed in the Education Services sector. Again, however, most individuals employed in the Educational Services sector received degrees in Education. For instance, Master's degree holders in Education make up 61 percent of Educational Services employees holding Master's degrees. Moreover, only 6 percent of employees in the Educational Services sector who hold Master's degrees received their degrees in STEM fields, a fact that will become more pertinent in the data analysis section. In combination, a Bachelor's or Master's degree in Education appears to be a reasonable if imperfect proxy for working as a teacher.

Second, the salary figures in the PSEO cover all earnings in a year, not merely earnings from a main job such as teaching. Current Population Survey data show that 14 percent of teachers hold second jobs, versus 11 percent for non-teachers. More importantly in this context, earnings from non-primary jobs make up only two to three percent of public school teachers' total earnings. (Biggs and Richwine, 2019.) Thus, the salary figures found in the PSEO data should be overwhelmingly from the respondent's primary job.

Third, the salary differentials do not make any adjustment for teachers' shorter work year. Richwine and Biggs (2013), using the American Time Use Survey, conclude that teachers work at most about 83 percent as many annual hours as other white collar professionals, which is equivalent to a 10-month work year. Taylor (2008) and Milanowski (2008) also assume 10 months of work to make teacher salaries approximately comparable to those of full-year

employees. Failing to adjust for teachers' shorter work year would cause Education degree holders to appear underpaid even if their salaries per hour or day of work were comparable to other occupations. On the other hand, the PSEO data screen respondents in such a way that some part-time employees will remain in the sample. The PSEO drops individuals from the sample if either their earnings are below the amount paid to a full-time worker at the minimum wage or if they have two or more quarters without any earnings. Current Population Survey data for 2015-2019 show that roughly 90 percent of both public school teachers and other college graduate employees report working full-time rather than part-time. But within the PSEO data it is not possible to further break down employees by hours or weeks worked. For that reason, salaries by degree field are compared without any adjustment for the length of the work year, but the lack of such an adjustment may be borne in mind when interpreting the results.

Fourth, the figures presented look only at salaries and do not include fringe benefits such as health coverage, pensions and retiree health insurance. This omission is meaningful because fringe benefits differ significantly between the public and private sectors of the U.S. economy. Biggs (2019) uses National Income and Product Accounts data, finding that individuals employed in public education in 2017 received average benefits equal to 45 percent of their average salaries, while for private sector employees benefits averaged only 19 percent of salaries. To illustrate, a public school teacher earning the 2018-2019 school year average salary of \$62,304 would be eligible for annual benefits, including the present value of future pension benefits, equal to approximately \$28,037.³ For a private sector employee earning the same \$62,304 salary, annual benefits would be equal to approximately \$11,838, generating a

³ The 2018-2019 average public school teacher salary is drawn from National Education Association (2020).

difference of \$16,199 in total compensation. Thus, salary comparability is only one component of the larger teacher compensation question.⁴

Fifth, this paper analyzes whether individuals who studied Education at either the Bachelor's or Master's level receive salaries above or below those of individuals who attended the same college or university but majored in different fields of study. It does not analyze whether or how changing salaries for school teachers would alter the composition of the teaching workforce over time, which is a substantially more complex question. Those separate issues are discussed in work such as Ballou and Pogdursky (1995).

An Illustrative Example

Before moving to a generalized analysis of the data, we illustrate salaries by field of study using Master's degree graduates of the University of Colorado at Boulder.⁵ The PSEO database contains 6,865 individuals who received Master's degrees from the University of Colorado at Boulder, of whom 586 received degrees in Education. Of this latter group, 561 (94 percent) were employed in the field of Educational Services 10 years following graduation.⁶

Figure 1 shows median salaries 10 years following graduation from a Master's degree program at the University of Colorado at Boulder, broken down by field of study. Education degree holders are grouped on the far left, followed in rough order by humanities and liberal arts, then more quantitative or technical fields such as social sciences and business, and finally shifting toward STEM fields on the right.⁷

⁴ For discussion of teacher pensions in greater depth, see Biggs and Richwine (2013).

⁵ This university was chosen because it is the first to appear in the Census Bureau's PSEO online data visualizer.

⁶ The remaining 6 percent were employed in a variety of industries, including Other Services, Retail Trade, Health Care and Social Assistance, and others.

⁷ While some Master's in Business Administration degrees are considered to be STEM degrees, to date most are not, and so we group Business degrees separately from STEM fields.

Individuals who graduated from the University of Colorado at Boulder with an MA in Education had median earnings 10 years following receipt of their degree equal to \$59,796. This salary exceeds in varying degrees those of Master's degree holders in philosophy, English, foreign languages, visual and performing arts, psychology, multi- and interdisciplinary programs, and health professions; but falls short of salaries paid to MA graduates in social sciences, business, and STEM fields, with shortfalls being largest relative to business degree holders and graduates in mathematics, computer sciences, and engineering. These are roughly the relationships one would expect if Education is grouped with other liberal arts and non-STEM fields of study.

Analysis of PSEO data

We now move to a more formal analysis incorporating the full PSEO dataset. The unit of analysis is median or percentile earnings by field of study and by educational institution. For the main analysis we begin by regressing the natural log of earnings measured one, five, and 10 years following receipt of a Bachelor's or Master's degree on controls for the college or university attended, the field of study for which the Master's degree was granted, and a dummy variable for whether the degree granted was in a STEM field. For one and five years following receipt of degree, we analyze only median earnings, while at 10 years following graduation we analyze earnings at the 25th, 50th, and 75th percentiles.

Establishing a dummy variable for STEM fields appears reasonable for two reasons. First, Hanushek et al. (2015) find that the U.S. labor market pays a particularly high wage premium to individuals with greater quantitative abilities. While STEM fields are not the only ones that demand strong mathematical skills, they are a commonly-used proxy for such fields of study. Second, while the PSEO dataset contains no information on the quantitative skills of

particular fields of study, individuals intending to study Education either at the undergraduate or postgraduate level do tend to have substantially lower mathematics scores on standardized tests than those intending to major in STEM fields. Among students taking the Scholastic Aptitude Test, individuals intending to major in STEM fields had weighted average mathematics scores of 580; students intending to major in non-STEM fields excluding Education had average math SAT scores of 515; and students intending to major in Education had average math scores of 503.⁸ (College Board, 2020.) While students can and do change majors while in college, these figures seem to indicate a substantial difference in quantitative skills between STEM and non-STEM students. Patterns are similar for the Graduate Record Exam (GRE), which is a prerequisite for most postgraduate study. In 2019, GRE test takers intending to pursue graduate work in a STEM field had an average quantitative reasoning score of 155, on a scale running from 130 to 170. This placed the average prospective STEM student at approximately the 59th percentile of individual test takers. (Educational Testing Service, 2020.) The average test taker intending to pursue a graduate degree in Education fields had a GRE quantitative reasoning score of 147, at approximately the 27th percentile of individual scores. The average non-STEM, non-Education test taker had a GRE quantitative reasoning score of 150, at the 39th percentile of individual test takers. Thus, a simple STEM dummy variable may understate the extent to which holders of undergraduate or postgraduate Education degrees have quantitative skills below holders of degrees in other fields.

In the PSEO data, STEM fields are designated via the Department of Homeland Security's STEM Designated Degree Program list, which relies upon the Department of

⁸ On the SAT verbal exam, the respective average scores were 568 for prospective STEM majors; 527 for non-STEM, non-Education majors; and 519 for students intending to major in Education.

Education's Classification of Instructional Program (CIP) taxonomy system.⁹ In the Designated Degree Program, a degree field is automatically classified as STEM if it is in the broad field of engineering, biological sciences, mathematics, or physical sciences. In addition, related fields are included at DHS's discretion or if the field uses engineering, mathematics, computer science, or natural sciences, including physical, biological and agricultural sciences. We include as STEM the fields of computer and information sciences and support services, engineering technologies/technicians, and military technologies.

Earnings are measured at the 50th percentile (median) for the first, fifth, and 10th years following graduation. The results are shown in Table 2. For the 10th year following graduation, Table 2 provides additional detail via figures at the 25th and 75th percentiles for each degree field.

One year following receipt of a Bachelor's degree, degree holders in Education receive salaries that are statistically indistinguishable from other non-STEM degree holders. Individuals receiving STEM degrees received salaries one year following graduation that are approximately 25 percent higher than those received by non-STEM, non-Education degree holders. The substantial STEM degree salary advantage continues through the fifth and tenth years following graduation. Five years following receipt of a Bachelor's degree, the median Education degree holder receives a salary that is approximately 10 percent higher than those of other non-STEM degree holders. Ten years following receipt of a Bachelor's degree, the median Education degree holder receives a salary that is not significantly different from those received by other non-STEM degree holders graduating from the same educational institutions. At the 25th percentile of the salary distribution, Education degree holders receive salaries that are eight percent higher than those of non-STEM degree holders, but at the 75th percentile Education degree holders receive

⁹ STEM fields are designated via the Department of Homeland Security's STEM Designated Degree Program list, which is available at <https://www.ice.gov/sites/default/files/documents/Document/2016/stem-list.pdf>.

salaries that are 11 percent lower than those of other non-STEM degree holders. These latter figures may reflect wage compression that is often exhibited in public sector employment, where lower-skill public sector positions receive higher salaries relative to lower-skill jobs in the private sector.

Analyzing salaries for Bachelor's degree holders has both advantages and disadvantages. The key advantage is that most people receive Bachelor's degrees relatively soon after graduating from high school, so that degree holders will tend to be of reasonably similar ages. Master's degrees, by contrast, are often obtained long after receipt of a Bachelor's degree, and so this implicit control for age is weakened. On the other hand, the PSEO data on salaries for Bachelor's degree holders does not control for receipt of a subsequent Master's degree or other qualification, which is disproportionately likely among public school teachers where salary schedules provide additional pay for teachers with advanced degrees. As a result, the results shown in Table 2, particularly for five and ten years following graduation, may compare salaries for non-teachers who hold only a Bachelor's degree to those of teachers who subsequently obtained a Master's degree or other postgraduate qualification.

Table 3 repeats Table 2's analysis, except for Master's degree holders rather than Bachelor's degree holders. One, five, and 10 years following receipt of a Master's degree in Education, degree holders receive median salaries that are statistically indistinguishable from those of other non-STEM Master's degree holders who graduate from the same college or university. Ten years following graduation the 25th percentile of Education Master's degree holders also receive no statistically significant salary premium or penalty, but at the 75th percentile are subject to a statistically significant salary penalty of about 13 percent.

As above with Bachelor's degrees, analysis of Master's degree holders has both pros and cons. Unlike the Bachelor's degree analysis, comparison of salaries for Master's degree prevents the inadvertent comparison of non-Education degree holders with only Bachelor's degrees to Education degree holders who subsequently go on to earn Master's degrees. Thus, the figures in Table 3 largely compare employees who hold the same final educational credentials. On the other hand, the age of Masters degree holders is likely to exhibit more variation than that of Bachelor's degree holders, thus weakening the implicit control for age and experience in the Bachelor's degree analysis. The comparison of Master's degree holders' salaries also implicitly assumes that all non-STEM Master's degrees do or should confer the same earnings advantage in the years following graduation. The control for receipt of a STEM degree eliminates direct comparisons of Master's degrees in Education to those in, for instance, engineering or physics. But Education Master's degree holders are still compared directly to individuals holding Masters of Business Administration degrees and Master's degrees in law, where high earnings may be the norm.

Discussion and Conclusions

In everyday life, individuals well understand that the college or university they attend and the field of study they choose to pursue will affect their future earnings potential. It likewise is commonly understood that STEM fields provide the quantitative skills that are in particular demand in the U.S. economy. Thus, no one finds it surprising that liberal arts majors receive lower average salaries than engineers. However, most datasets used to assess teacher compensation lack information on the colleges employees attended and the degree fields they specialized in. As a result, analyses of such data implicitly assume that all holders of Bachelor's

or Master's degrees have the same sets of skills and characteristics, and that any variation from the mean implies either "over" or "under" payment.

The Census Bureau's Post-Secondary Employment Outcomes dataset makes it possible to control both for the educational institution attended and the field of study in which the individual received a Bachelor's or Master's degree, narrowing the range of uncertainty found in a conventional model in which education-based human capital is assumed to depend solely on years of formal educational attainment. Controlling for differences in institution attended and degree fields pursued, at both the Bachelor's and Master's levels STEM degree holders receive salaries 10 years following graduation that are roughly one-fifth higher than those of non-STEM degree holders. Individuals who received Bachelor's or Master's degrees in Education have median earnings following graduation that are roughly in line with earnings of other holders of non-STEM degrees. Thus, the teacher salary penalty found in other studies appears to be at least partly accounted for by the more general salary differences between STEM degree holders and individuals who received degrees in non-STEM fields of study. That is to say, Education is a non-STEM field of study and individuals who receive Bachelor's or Master's degrees in Education appear to receive salaries similar to what other non-STEM graduates are paid.

Figures and Tables

Figure 1.

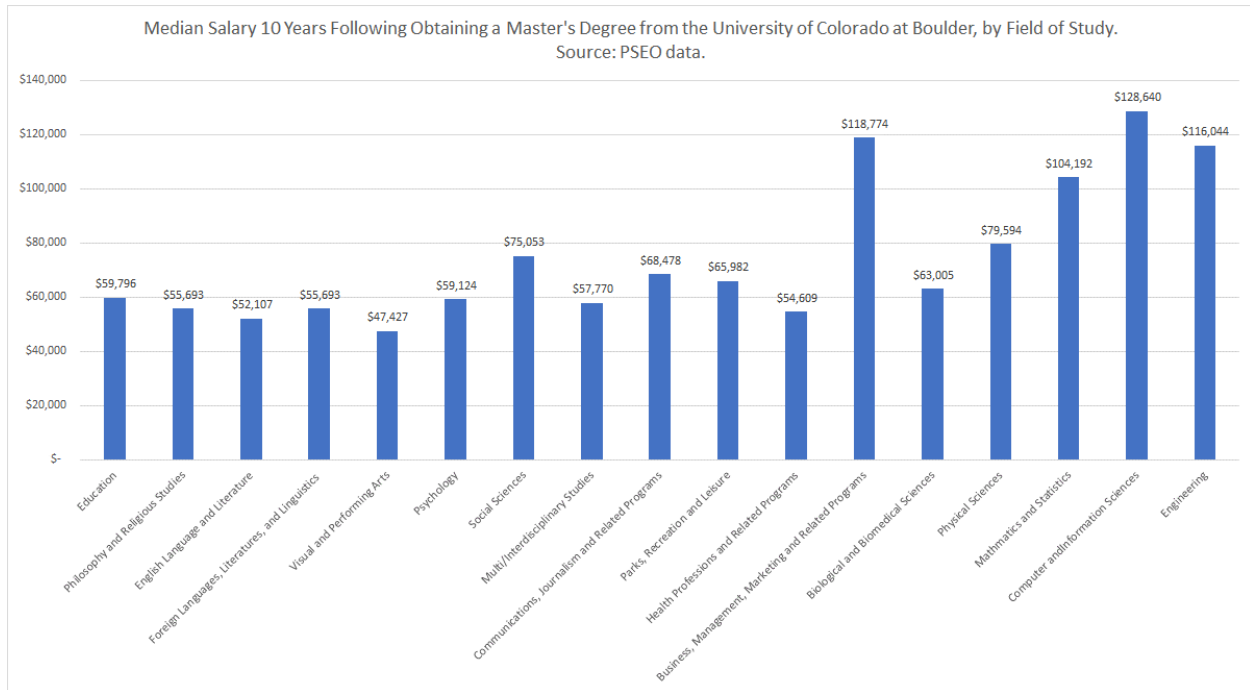


Table 1. Weekly salary premium or penalty for selected occupations.

Occupation	Salary Differential
Nurse anesthetists	77%
Air traffic controllers	66%
Pilots	39%
Nurse practitioners	40%
Aerospace engineers	36%
Physician assistants	36%
Dental hygienists	31%
Registered nurses	29%
Computer programmers	25%
Aircraft mechanics	25%
Firefighters	24%
Electrician	20%
Police	21%
Chemists and materials scientists	12%
Massage therapists	-9%
Travel agents	-13%
Public school teacher	-14%
Chefs	-17%
Photographers	-16%
Non-farm animal caretakers	-22%
Athletes, coaches, umpires	-20%
Musician	-18%
Veterinary assistants	-20%
Baker	-26%
Telemarketers	-25%

Source: Authors' calculations from 2015-2019 Current Population Survey Outgoing Rotation Group data.

Table 2. Bachelor's Degree Holders

	1 year - 50th percentile	5 years - 50th percentile	10 years - 50th percentile	10 years - 25th percentile	10 years - 75th percentile
Education degree	0.0203 (0.0346)	0.0967*** (0.0247)	0.00547 (0.0248)	0.0774*** (0.0262)	-0.113*** (0.0259)
STEM degree	0.226*** (0.0275)	0.260*** (0.0196)	0.310*** (0.0197)	0.339*** (0.0208)	0.300*** (0.0206)
Constant	10.25*** (0.0960)	10.53*** (0.0686)	10.64*** (0.0676)	10.31*** (0.0715)	10.93*** (0.0706)
Observations	2,214	2,238	2,309	2,309	2,309
R-squared	0.646	0.705	0.773	0.722	0.815
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.					

Table 3. Master's Degree Holders

	1 year - 50th percentile	5 years - 50th percentile	10 years - 50th percentile	10 years - 25th percentile	10 years - 75th percentile
Education degree	0.140 (0.0883)	0.0313 (0.0706)	-0.0439 (0.0689)	0.0305 (0.0738)	-0.142** (0.0701)
STEM degree	0.246*** (0.0883)	0.291*** (0.0706)	0.337*** (0.0689)	0.348*** (0.0738)	0.331*** (0.0701)
Constant	10.66*** (0.136)	10.81*** (0.108)	10.92*** (0.106)	10.68*** (0.113)	11.23*** (0.108)
Observations	592	596	624	624	624
R-squared	0.639	0.770	0.823	0.761	0.868
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.					

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