Appendix to "College Majors and Earnings Growth"

Woosuk Choi Josh Kinsle Alexis Orellana Ronni Pavan

December 2025

A Additional Tables

Table A1: Majors Classification

Category from Deming and Noray (2020)	Majors
Engineering and CS	Communication Technologies (20), Computer and Information Sciences (21), Engineering (24), Engineering Technologies (25), Military Technologies (38), Nuclear, Industrial Radiology, and Biological Technologies (51),Electrical and Mechanic Repairs and Technologies (57), Precision Production and Industrial Arts (58), Transportation Sciences and Technologies (59)
Business	Business (62)
Life and Physical	Environment and Natural Resources (13), Biology and Life Sciences (36), Physical Sciences (50)
Social Science	Social Sciences (55)
Other	Agriculture(11), Architecture (14), Area, Ethnic, and Civilization Studies 15 Communications (19), Cosmetology Services and Culinary Arts (22), Education Administration and Teaching (23), Linguistics and Foreign Languages (26), Family and Consumer Sciences (29), Law (32), English Language, Literature, and Composition (33), Liberal Arts and Humanities (34), Library Science (35), Mathematics and Statistics (37), Interdisciplinary and Multi-Disciplinary (40), Physical Fitness, Parks, Recreation (41), Philosophy and Religious Studies (48), Theology and Religious Vocations (49), Psychology (52), Criminal Justice and Fire Protection (53), Public Affairs, Policy, and Social Work (54), Construction Services (56), Fine Arts (60), Medical and Health Sciences and Service (61), History (64)

Notes: This table shows the categorization of majors used by Deming and Noray (2020) and in most of this paper. Majors correspond to the variable DEGFIELD in the ACS 2009-2019 (https://usa.ipums.org/usa-action/variables/DEGFIELD#codes_section).

Table A2: ACS Log Earnings with Graduate Degree Profiles and Labor Supply Controls

		$\beta_{m,a}$			
Major m	Age a	(1)	Graduate degree profiles (2)	Labor supply controls (3)	Both (4)
Engineering & CS	29-30	-0.050	-0.059	-0.069	-0.068
		(0.059)	(0.060)	(0.058)	(0.059)
	39-40	-0.126	-0.131	-0.143	-0.141
		(0.071)	(0.069)	(0.065)	(0.063)
	49-50	-0.167	-0.168	-0.158	-0.152
		(0.075)	(0.072)	(0.069)	(0.067)
Business	29-30	-0.103	-0.106	-0.050	-0.053
		(0.054)	(0.053)	(0.045)	(0.044)
	39-40	-0.149	-0.134	-0.082	-0.071
		(0.062)	(0.061)	(0.051)	(0.049)
	49-50	-0.182	-0.164	-0.100	-0.086
		(0.068)	(0.067)	(0.055)	(0.054)
L&P Science	29-30	0.213	0.185	0.091	0.064
		(0.091)	(0.093)	(0.055)	(0.056)
	39-40	0.428	0.349	0.267	0.201
		(0.103)	(0.096)	(0.070)	(0.061)
	49-50	0.430	0.353	0.281	0.216
		(0.102)	(0.098)	(0.069)	(0.063)
Social Science	29-30	0.053	0.047	0.020	0.013
		(0.054)	(0.053)	(0.046)	(0.045)
	39-40	0.112	0.092	0.059	0.041
		(0.062)	(0.059)	(0.051)	(0.049)
	49-50	0.093	0.074	0.047	0.030
		(0.067)	(0.065)	(0.055)	(0.053)
	N	2,808,501	2,808,501	2,808,501	2,808,501
	R^2	0.197	0.203	0.470	0.475

Notes: This table presents estimates of Equation (**??**) using the ACS sample and various specifications. Column (1) is a repeat of the results from column (1) of Table **??**. Column (2) includes interactions between age group and advanced degree indicators. Column (3) includes indicators for each interval of weeks worked per year. Column (4) includes both. Observations are weighted using the ACS person weights. Standard errors are clustered at the major-by-age bin level. CS: Computer Science, L&P Science: Life and Physical Science.

Table A3: Cohort-by-Major and Year-by-Major Fixed Effects Estimates

	Engineering & CS (1)	Business (2)	Life & Physical Science (3)	Social Science (4)
Panel A: Cohort-by-Major estimates (Base: Up to 1960)				
1961-1963	0.022	-0.010	0.011	0.033
	(0.010)	(0.009)	(0.015)	(0.018)
1964-1966	0.011	-0.014	0.016	0.028
	(0.010)	(0.009)	(0.015)	(0.017)
1967-1969	0.003	-0.009	-0.010	0.042
	(0.012)	(0.009)	(0.016)	(0.016)
1970-1972	0.018	-0.001	-0.010	0.044
	(0.013)	(0.010)	(0.016)	(0.017)
1973-1975	0.045	0.005	0.027	0.061
	(0.013)	(0.010)	(0.016)	(0.018)
1976-1978	0.032	0.006	0.024	0.048
	(0.014)	(0.011)	(0.017)	(0.019)
1979-1981	0.016	-0.013	-0.003	0.016
	(0.014)	(0.012)	(0.018)	(0.019)
1982-1984	0.048	-0.005	-0.005	0.034
	(0.015)	(0.013)	(0.019)	(0.019)
1985-1987	0.045	-0.010	-0.033	0.007
	(0.016)	(0.014)	(0.021)	(0.020)
1988-1990	0.073	-0.006	-0.044	0.025
	(0.019)	(0.014)	(0.023)	(0.022)
1991 and after	0.134	0.040	-0.051	0.062
	(0.031)	(0.015)	(0.025)	(0.022)
Panel B: Year-by-Major estimates (Base: Up to 1995)				
1996-1998	0.040	0.025	-0.032	0.033
	(0.011)	(0.008)	(0.009)	(0.009)
1999-2001	0.088	0.037	-0.019	0.067
	(0.015)	(0.011)	(0.013)	(0.013)
2002-2004	0.030	0.020	-0.015	0.047
	(0.010)	(0.008)	(0.012)	(0.009)
2005-2007	0.036	0.027	-0.026	0.048
	(0.012)	(0.009)	(0.012)	(0.010)
2008-2010	0.038	0.011	-0.024	0.031
	(0.014)	(0.009)	(0.014)	(0.010)
2011-2013	0.066	0.022	-0.023	0.027
	(0.014)	(0.010)	(0.015)	(0.011)
2014-2016	0.070	0.024	-0.035	0.029
	(0.015)	(0.010)	(0.014)	(0.011)
2017-2019	0.074	0.027	-0.040	0.035
	(0.014)	(0.010)	(0.015)	(0.011)

Notes: Panel A presents estimates of Equation (**??**) using the LEHD sample with cohort-by-major effects. The specification is identical to that of column (4) of Table **??**. Panel B presents estimates of Equation (**??**) using the LEHD sample and year-by-major effects. The specification is identical to that of column (5) of Table **??**. Observations are weighted using the ACS person weights. Standard errors are clustered at the major-by-age bin level and at the individual level. CS: Computer Science.

Table A4: Share of Detailed Majors by Birth Cohort

Field of degree	Born $\leq$ 1970	Born $>$ 1970
Engineering and Computer Science		
Computer Science	11.90	19.02
Electrical Engineering	19.11	13.03
Mechanical Engineering	14.53	11.88
Computer and Information Systems Managers	3.18	6.90
Civil Engineering	8.94	6.83
General Engineering	9.85	6.48
Computer Engineering	1.75	6.15
Chemical Engineering	5.56	4.43
Business		
Business Management	33.87	28.57
General Business	22.76	17.70
Accounting	20.48	16.63
Marketing	8.58	12.61
Finance	7.09	11.79
Hospitality Management	1.14	2.83
Management Information Systems and Statistics	1.27	2.42
Human Resources and Personnel Management	2.05	2.22
Life and Physical Sciences		
Biology	34.94	41.30
Chemistry	17.96	10.48
Multi-disciplinary or General Science	9.71	7.69
Biochemical Sciences	2.84	5.47
Physics	8.00	5.21
Environmental Science	1.92	5.08
Physiology	1.33	2.96
Geology and Earth Science	5.05	2.75
Social Sciences		
Political Science and Government	30.12	31.45
Economics	28.3	25.03
Sociology	23.29	20.91
Anthropology and Archeology	4.82	7.20
International Relations	2.36	4.75
Geography	3.77	3.91
General Social Science	5.23	3.04
Criminology	1.43	3.04
Other		
Psychology	6.88	10.32
Nursing	7.67	6.95
English Language and Literature	6.29	5.73
Elementary Education	9.87	5.62
Communications	2.63	5.36
General Education	9.13	4.56
Criminal Justice and Fire Protection	2.04	4.27
History	4.48	3.88

Notes: Shares of the eight most common detailed majors for each one of the five categories as defined in Deming and Noray (2020), based on ACS data from 2009 and 2019.

Table A5: Detailed Classification of College Majors

Category	Majors
Applied Science	Precision Production and Industrial Arts, Environmental Studies, Multidisciplinary or General Science, Architecture, Agriculture or Agricultural Science, Earth and Other Physical Science
Business and Economics	Economics, Finance, Miscellaneous Business and Medical Support, Accounting, Marketing, Business Management and Administration
Computer Science	Computer and Information Technology, Computer Programming
Education	Secondary Education, Library Science and Education
Engineering	All Other Engineering, Mechanical Engineering, Electrical Engineering, Civil Engineering, Chemical Engineering, Engineering Technology
Humanities	Commercial Art and Design, Foreign Language, Music and Speech/Drama, Communications, Letters: Literature, Writing, Other, Art History and Fine Arts, Philosophy and Religion, Journalism, Film and Other Arts, History
Medical Services	Medical Technology, Public Health, Nursing, Other Medical/Health Services
Natural Science	Mathematics, Physics, Chemistry, Biological Sciences
Services	Fitness and Nutrition, Leisure Studies and Basic Skills, Protective Services, Social Work and Human Resources
Social Science	Family and Consumer Science, Psychology, Other Social Sciences, Area, Ethnic, and Civil Studies, Political Science, International Relations, Public Administration and Law

Notes: This table shows the categorization of majors used in section **??**. Majors included in each cell correspond to the classification used by Altonji et al. (2016).

B Linking ACS and LEHD Data

The LEHD infrastructure contains different files with information about workers and the firms where they are observed. In this paper, we employ the Employment History Files (EHF). For each state included in the LEHD 2022 snapshot, the state-specific EHF contains quarterly employment and earnings records for all individuals that appear in the UI records during the corresponding period linked to an employer. Each individual in the LEHD is represented by a unique identifier called PIK (Protected Identification Key). Similarly, each individual in the ACS is represented by a combination of household (CMID) and individual (PNUM) identifiers. We employ the BOC PIK Crosswalk American Community Survey, provided by the Census Bureau, to link the datasets. We exclude cases where an individual in the ACS is linked to more than one PIK identifier.

After linking our sample of college graduates interviewed in the ACS, we construct a panel with one observation per person per year. We construct annual earnings as the sum of quarterly earnings across quarters, jobs, and states during the corresponding year. Table 1 shows that, on average, we observe 18.3 observations per individual.

C NSCG

The NSCG (National Survey of College Graduates) is a biennial survey conducted by the National Center for Science and Engineering Statistics, which is part of the National Science Foundation. The 1993 and 2003 NSCG use a stratified random sampling method to select individuals who reported having a bachelor's degree or higher in the 1990 and 2000 Decennial Census Long Form, were younger than 76 years old, and resided in the United States. Since 2010, the NSCG has employed a rotating panel design, which means that the survey includes both returning sample cases from the previous NSCG survey and new sample cases from the American Community Survey (ACS). The NSCG 2010 mostly consists of new samples from the 2009 ACS, and the 2013 NSCG includes a subsample of the 2010 NSCG and the 2011 ACS. The NSCG 2015, 2017, and 2019 follow the same survey design. In our analysis, we rely on the NSCG waves from 1993, 2003, and 2010-2019 as they are representative of all college graduates in the United States under 76 years old. [1]

The NSCG is primarily a cross-sectional survey that covers a longer time period than the ACS.[2] This reduces the reliance on cross-cohort comparisons when estimating age-earnings profiles since cohorts of young workers in 1993 will also be represented as older workers in 2019. It is important to point out that while the NSCG starts in 1993, only 36% of the data is from post ACS years (after 2009). So while the NSCG is representative within wave, it is not representative of all cohorts working between 1993 and 2019. Yet it still provides a supplement to the analysis using the LEHD, since young workers are overrepresented in our sample of workers in the early years of the LEHD.

Table C1 provides some basic information about the individuals in the NSCG data. In

[1] The NSCG data is available at the NCSES webpage (https://nsf.gov/statistics/srvygrads/#tabs-2). We augment the 1993 NSCG using a version from the Inter-university Consortium for Political and Social Research (ICPSR). The ICPSR version provides information about work hours and weeks from the 1990 census. We exclude the NSCG waves focused only on science and engineering graduates.

[2] The NSCG has a panel component, as it surveys a subset of interviewees up to four times. In the 1990s and 2000s, it only followed individuals whose field of degree or occupation was related to science and engineering in their first survey. Starting in 2010, there is sample overlap, with some cases included in the 2010 NSCG also appearing in survey waves through 2017, in the 2013 NSCG also appearing in waves through 2019, and so on. This longitudinal structure is available within a restricted environment.

terms of age, gender, and race, the NSCG sample looks similar to the ACS. The distribution of majors also matches the ACS, with engineering and computer science majors accounting for roughly 13% of the sample and business majors accounting for around 20% of the sample.

In Table C2, we display estimates of Equation 1 using the NSCG. Throughout the analysis we include only individuals aged 25-50 since relatively few individuals under 25 are surveyed. In column (1) we estimate a version of Equation 1 excluding cohort-by-major effects, year-by-major effects, and worker fixed effects. This specification matches the one used for the ACS displayed in column (1) of Table 2. Similar to the ACS results, technical and business majors experience slower earnings growth over the life cycle relative to other majors, though the effects are somewhat muted. In columns (2), we include dummies for working week intervals and the interaction between dummies of age groups and graduate degrees. In columns (3) and (4) we allow the returns to majors to vary by cohorts and years, respectively. Similar to our analysis based on the LEHD, once we allow the returns to major to vary by cohort, earnings grow faster over the life cycle for technical and business majors relative to humanities. The inclusion of major-by-year effects does not yield significant differences relative to the model without them, again similar to what we find in the LEHD.

The broad takeaway is that the age-earnings profile estimates based on the NSCG are quite similar to the estimates based on the LEHD. This is despite the fact that we are unable to include worker fixed effects. The key is to have a long enough panel of repeated cross-sections to credibly identify changes in the returns to major by cohort. Once these features are taken into account, there is little evidence that wage growth is slower for engineering, computer science, and business majors.

Table C1: Summary Statistics, NSCG 1993-2019

	ACS	LEHD	NSCG
% Male	46.9	46.8	48.8
% White	78.8	74.8	72.7
% Engineering & CS	13.1	13.5	13.2
% Business	20.9	20.5	20.7
% Life & Physical Science	8.7	8.7	8.8
% Social Science	7.6	7.5	9.1
% Others	49.7	49.8	48.2
Total Persons	2,808,501	2,398,000	385,499

Notes: The first two columns repeat summary statistics of the ACS and the LEHD sample in Table **??**. The NSCG 1993-2019 is extracted from the National Center for Science and Engineering Statistics. The NSCG 1993 is further augmented by a version from the Inter-university Consortium for Political and Social Research. The sample includes all respondents aged 25-50 with at least a bachelor's degree who report a valid major. CS: Computer Science.

Table C2: Log Earnings Estimates, NSCG

		$\beta_{m,a}$			
Major, m	Age, a	NSCG (1)	Graduate degree and labor supply controls (2)	Cohort-by-major FE (3)	Year-by-major FE (4)
Engineering & CS	29-30	0.007	0.015	0.047	0.031
		(0.091)	(0.094)	(0.106)	(0.093)
	39-40	-0.124	-0.113	0.026	-0.096
		(0.091)	(0.089)	(0.102)	(0.089)
	49-50	-0.069	-0.060	0.092	-0.047
		(0.097)	(0.094)	(0.110)	(0.095)
Business	29-30	-0.001	0.009	-0.008	0.018
		(0.078)	(0.078)	(0.087)	(0.078)
	39-40	-0.058	-0.026	0.059	-0.013
		(0.074)	(0.071)	(0.083)	(0.071)
	49-50	-0.059	-0.040	0.034	-0.032
		(0.085)	(0.080)	(0.094)	(0.081)
L&P Science	29-30	0.111	0.133	0.157	0.142
		(0.091)	(0.091)	(0.097)	(0.091)
	39-40	0.249	0.214	0.255	0.231
		(0.086)	(0.085)	(0.093)	(0.085)
	49-50	0.305	0.268	0.336	0.280
		(0.100)	(0.095)	(0.105)	(0.096)
Social Science	29-30	0.027	0.039	0.062	0.047
		(0.079)	(0.077)	(0.079)	(0.077)
	39-40	0.015	-0.007	0.080	0.006
		(0.074)	(0.071)	(0.076)	(0.071)
	49-50	0.048	0.022	0.077	0.034
		(0.085)	(0.078)	(0.084)	(0.078)
	N	385,499	385,499	385,499	385,499
	R^2	0.185	0.233	0.235	0.233

Notes: This table presents estimates of Equation 1 using various samples and specifications. The baseline sample is all four-year college graduates between 25-50 years old in the 1993-2019 National Survey of College Graduates. Column (1) presents estimates from a specification identical to Deming and Noray (2020) using the NSCG sample. Column (2) includes working weeks and interaction between age group and advanced degree indicators. Column (3)-(4) include cohort-by-major fixed effects and year-by-major fixed effects respectively in addition to column (2). All regressions include major dummies, sex-by-age indicators, age and year fixed effects, race, and an indicator of birth in US. Observations are weighted using the NSCG sample weights.Standard errors are clustered at the major-by-age bin level. CS: Computer Science, L&P Science: Life and Physical Science.

References

Altonji, J., L. Kahn, and J. Speer (2016). Cashier or consultant? entry labor market conditions, field of study, and career success. *Journal of Labor Economics 34*(S1), S361–S401.

Deming, D. J. and K. Noray (2020). Earnings dynamics, changing job skills, and stem careers. *The Quarterly Journal of Economics 135*(4), 1965–2005.