Everything you wanted to know about college major choice

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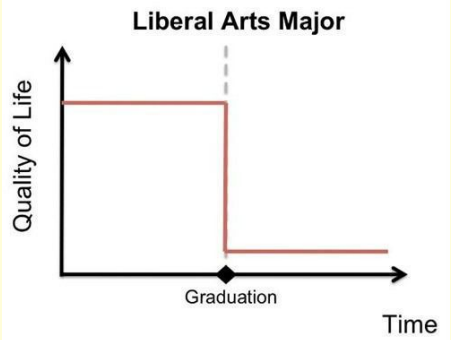
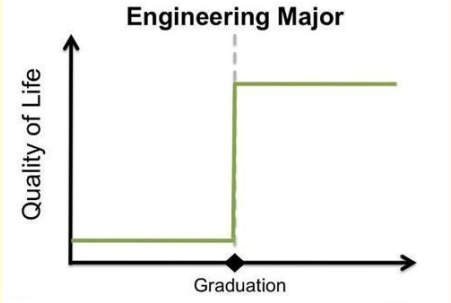
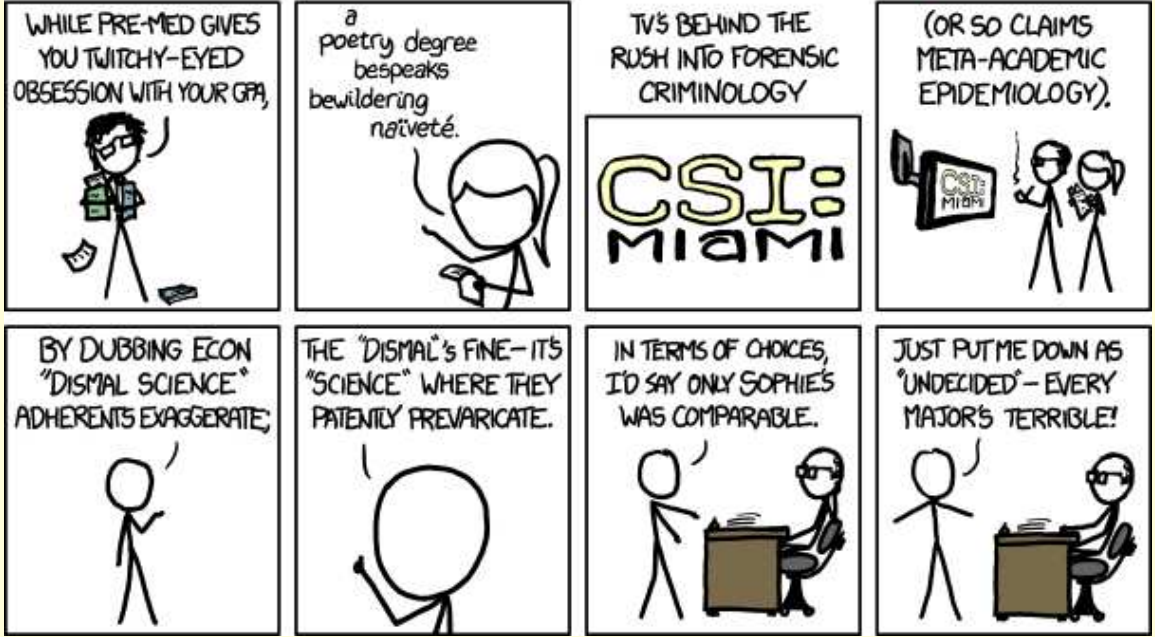

Liberal Arts Major
Quality of Life
Graduation
Time


Engineering Major
Quality of Life
Graduation



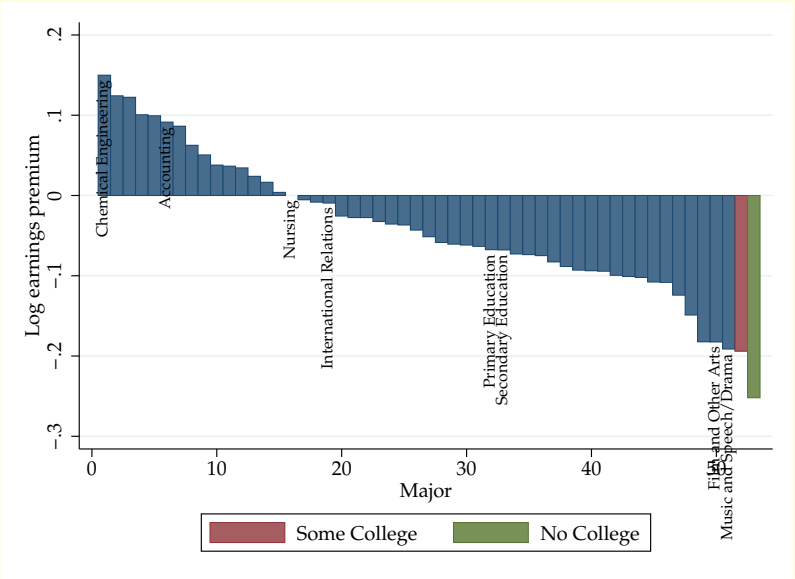
https://xkcd.com/1052/

Why do we care about college major?

- According to Altonji, Arcidiacono, and Maurel (2016):
- Education is no longer unidimensional
- $\Rightarrow$ returns to *type* of schooling $>$ returns to *amount* of schooling
- Huge differences in labor market outcomes across majors

Earnings

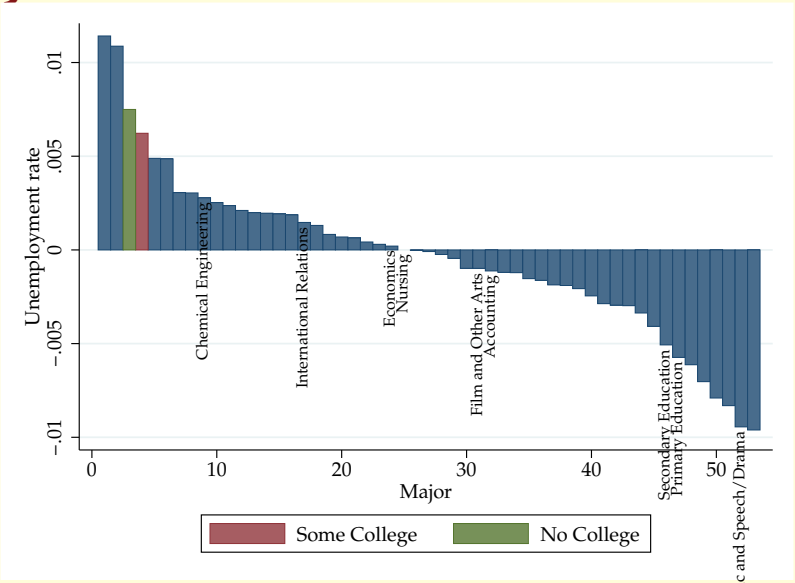
▸ Data details



Earnings (cont'd)

Rank	Major	Earnings (relative to nursing)
1	Chem Engineering	0.150
2	Elec Engineering	0.124
3	Economics	0.122
4	Mech Engineering	0.101
5	Finance	0.099
⋮	⋮	⋮
49	Philosophy and Religion	-0.182
50	Film and Other Arts	-0.182
51	Music and Speech/Drama	-0.191
52	Some college	-0.194
53	No college	-0.252

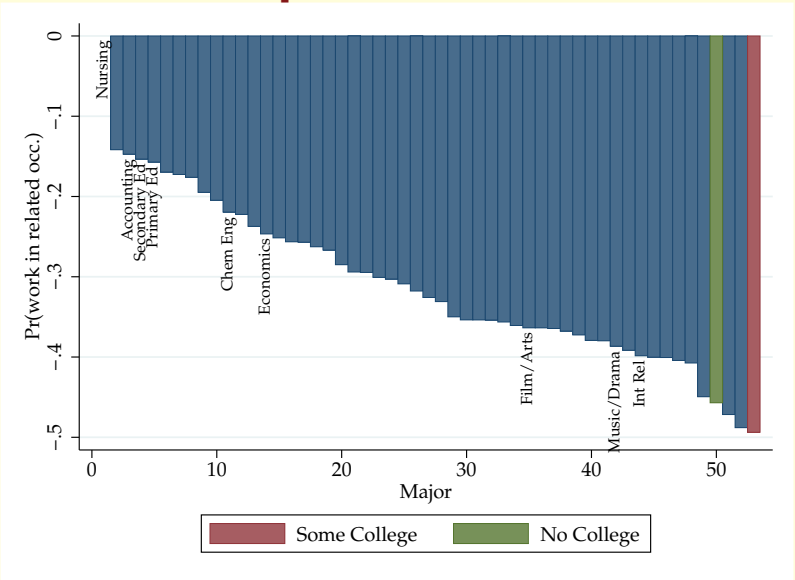
Unemployment



Unemployment (cont'd)

Rank	Major	Unemp. Rate (rel. nursing)
1	Computer Programming	0.011
2	Public Admin and Law	0.011
3	No college	0.007
4	Some college	0.006
5	Physics	0.005
⋮	⋮	⋮
49	Journalism	-0.007
50	Agriculture and Agr. Sci	-0.008
51	Family and Consumer Sci	-0.008
52	Music & Speech/Drama	-0.009
53	Leisure Studies	-0.010

Work in a related occupation



Related occupation employment (cont'd)

Rank	Major	Rel. Occ. Emp. Rate (rel. nursing)
1	Nursing	0.000
2	Civil Engineering	-0.142
3	Accounting	-0.147
4	Secondary Educ.	-0.153
5	Primary Educ.	-0.157
⋮	⋮	⋮
49	Agriculture and Agr. Sci	-0.449
50	No college	-0.457
51	General Science	-0.472
52	Environmental Studies	-0.488
53	Some college	-0.494

Aggregate economic output

- STEM majors are thought to produce more innovation than others
- If US doesn't produce enough STEM majors, economic growth may suffer due to decreased innovation

What can explain these large differences?

1. True treatment effect (✓ human capital vs. signaling)
    - i.e. anyone randomly assigned to be an engineering major will earn more than if they hadn't
2. Unobserved ability bias
    - engineering majors would have earned just as much if they were drama majors
3. Comparative advantage (✓ Roy model)
    - drama majors would have earned *even less* if they were engineering majors, because they lack appropriate skills

Explanations (cont'd)

4. Preferences
   - Compensating differentials: high-paying majors worse in other aspects
     - More difficult coursework during college (see xkcd.com/863/)
     - More unpleasant jobs / higher unemp. risk after college
     - **Even if ability is same across majors, this could generate earnings differences**
   - parental approval
     - parents may not help pay for college if certain majors are chosen

Explanations (cont'd)

5. Occupation after college
   - Choice of major may limit later occupational choices
   - Majors with higher earnings may indicate greater access to occupations with higher earnings
6. Information
   - students are misinformed about major-specific outcomes

Difficulties in uncovering causal effects

- Need to know the counterfactual outcomes for each person/group
    - i.e. what would my earnings have been if I had chosen business instead of humanities?
- Counterfactual complicated by link between occupation and major
    - i.e. what occupation would I be working in if I had chosen business instead of humanities?
- Different students place different weight on study effort during college, wages & jobs after college, etc.
    - So even if we knew the causal effect on earnings and occupation, we may not know the student's taste for other job attributes

Overcoming selection biases

Ways that have been used to uncover the labor market return to majors:

1. Assume unconfoundedness (James et al., 1989; Altonji, 1993; Webber, 2014, many others)
    - OLS regression of log earnings on major dummies + other controls
    - Various attempts to account for cognitive/non-cognitive abilities, selection bias, college quality

Overcoming selection biases (Cont'd)

2. Model preferences (Arcidiacono, 2004; Beffy, Fougère, and Maurel, 2012; Kinsler and Pavan, 2015)

   - Use students' choices to back out how much they prefer good grades vs. high earnings, etc.

   - Can say how much of wage premium is selection vs. actual returns

Overcoming selection biases (Cont'd)

3. Elicit beliefs from students (Arcidiacono, Hotz, and Kang, 2012; Arcidiacono et al., 2014; Wiswall and Zafar, 2015, many others)

   - Ask students how likely they would choose a given major under various counterfactual scenarios

   - Able to uncover preference intensity for each major

4. Fuzzy RD (non-US settings; see Hastings, Neilson, and Zimmerman, 2013; Kirkeboen, Leuven, and Mogstad, 2016)

   - Leverage random variation in major choice induced by test score cutoffs

   - Can uncover LATE associated with particular major

Data on wage returns to major

- Most accessible source: American Community Survey (2009–)
- New source: **`College Scorecard`** (released Nov 20, 2019)
- Caveats: These are both observational data
- Other studies have experimental data (Arcidiacono, Hotz, and Kang, 2012)
- or quasi-experimental data (Kirkeboen, Leuven, and Mogstad, 2016)

Evidence on wage returns to major

- There is a causal effect of major choice on earnings (Kirkeboen, Leuven, and Mogstad, 2016)
- Casual effect is smaller than raw premium (due to unobserved ability bias)
- Large variance in earnings even within major (Webber, 2014)
  - see also: `http://www.hamiltonproject.org/charts/career_earnings_by_col`

College major vs. college quality

- Returns to college major appear to trump returns to college quality (James et al., 1989; Kirkeboen, Leuven, and Mogstad, 2016)
    - but not necessarily in Chile (Hastings, Neilson, and Zimmerman, 2013)

Evidence on comparative advantage

- Students appear to sort into majors based on comparative advantage
  - true for academic ability (Arcidiacono, Hotz, and Kang, 2012; Arcidiacono et al., 2016; Kirkeboen, Leuven, and Mogstad, 2016)
  - also true for occupation ability (Kinsler and Pavan, 2015)

Evidence on preferences

- Students choose major in part due to lower study effort during college (Arcidiacono et al., 2016; Ahn et al., 2017)

- Students care about future wages when choosing major (Arcidiacono, 2004; Beffy, Fougère, and Maurel, 2012; Wiswall and Zafar, 2015)

- But care more about non-wage attributes of the major (Wiswall and Zafar, 2015)

- Preferences for occupation & future job also matter a lot, and are heterogeneous (Arcidiacono et al., 2014; Wiswall and Zafar, Forthcoming)

Evidence on Information frictions

- Students are misinformed about earnings across majors in the population (Wiswall and Zafar, 2015)

- Students would switch their major if they knew with certainty what their ability is (Arcidiacono, Hotz, and Kang, 2012; Arcidiacono et al., 2016)

Evidence on exposure effects

- Timing of courses can matter a lot (Patterson, Pope, and Feudo, 2019)
  - Students at West Point randomly assigned to certain classes
  - Courses assigned during major-declaration period have massive effects
  - Students are over 2x more likely to choose corresponding major

Take-home message

When choosing a major, students should try to check the most boxes:

- ☐ Do I know the future career path of students graduating in this field?
- ☐ Can I get good grades in this field?
- ☐ Do I like studying this field?
- ☐ Can I make a decent living at jobs in this field?
- ☐ Would I like working in jobs related to this field?
- ☐ Is this field my comparative advantage?

The role of universities on major choice

> *[Our] purpose is to encourage undergraduates to follow their intellectual passions and study what they love, with confidence in the fulfilling lives that lie ahead and the knowledge that* ***in no way will their choice of major limit the career choices they may wish to make in the future****.*
>
> —Major Choices vol. II, Princeton University *(emphasis mine)*

- Universities may want to steer students to certain majors:
  - To match the number of faculty in each field
  - To match the costs of instruction in each field (Altonji and Zimmerman, 2017)
- Not a lot of research on this topic

Main findings (Altonji and Zimmerman, 2017)

- Large differences in costs of producing majors (engineering is expensive, business is cheap)
- Also large differences in costs of producing, net of labor market returns of graduates
- Universities don't appear to make spending changes in response to per-credit production costs, or in response to earnings

Admissions policies

- Affirmative action policies at the university level can change the composition of student preparedness and hence the composition of STEM majors (Arcidiacono, Aucejo, and Spenner, 2012; Arcidiacono, Aucejo, and Hotz, 2016)

- Less prepared minority students at Berkeley/UCLA would have higher science graduation rates had they attended UC Santa Cruz/Riverside (Arcidiacono, Aucejo, and Hotz, 2016)

Women in STEM

- Women don't choose STEM because they have different pre-college skill composition (Aucejo and James, 2017; Speer, 2017)
    - Men show more STEM skills in early high school (Speer, 2017); Women more verbal skills (Aucejo and James, 2017)
- HS course curriculum and gender gap in college enrollment (Card and Payne, 2017)
    - Consistent with comparative advantage: the men who go to college are STEM-ready, whereas only some of the women who go to college are STEM-ready.
- Some evidence that harsher grading in STEM fields may contribute to gap because women prefer good grades (Ahn et al., 2017)

Minorities in STEM

- Affirmative action can have large effects (Arcidiacono, Aucejo, and Spenner, 2012; Arcidiacono, Aucejo, and Hotz, 2016)

- Same-race professors (Price, 2010) or graduate students (Griffith, 2010) can improve STEM retention among minorities

Data details I

- 22-55 yr olds, HS grad or above, 2009-2015 American Community Survey ($N \approx 6$ million)
- Each bar is one of 51 majors, or “some college” or “no college”
- Right-hand side variables:
  - major dummies (incl. no college & some college as “majors”)
  - calendar year dummies
  - advanced degree dummy

Data details II

- calendar year, gender, foreign born, marital status, race/ethnicity dummies
- cubic in age

- industry, occupation, residence state dummies

- Restrict to annual earnings between $20k-$600k

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References I

Ahn, Thomas, Peter Arcidiacono, Amy Hopson, and James Thomas. 2017. "Equilibrium Grade Inflation with Implications for Female Interest in STEM Majors." Working paper, Duke University.

Altonji, Joseph G. 1993. "The Demand for and Return to Education When Education Outcomes are Uncertain." *Journal of Labor Economics* 11 (1, Part 1):48–83.

Altonji, Joseph G., Peter Arcidiacono, and Arnaud Maurel. 2016. "The Analysis of Field Choice in College and Graduate School: Determinants and Wage Effects." Amsterdam: Elsevier, 305–396.

Altonji, Joseph G. and Seth D. Zimmerman. 2017. "The Costs of and Net Returns to College Major." Working paper, Yale University.

Arcidiacono, Peter. 2004. "Ability Sorting and the Returns to College Major." *Journal of Econometrics* 121:343–375.

References II

Arcidiacono, Peter, Esteban Aucejo, Arnaud Maurel, and Tyler Ransom. 2016. "College Attrition and the Dynamics of Information Revelation." Working Paper 22325, National Bureau of Economic Research.

Arcidiacono, Peter, Esteban M. Aucejo, and V. Joseph Hotz. 2016. "University Differences in the Graduation of Minorities in STEM Fields: Evidence from California." *American Economic Review* 106 (3):525–62.

Arcidiacono, Peter, Esteban M. Aucejo, and Ken Spenner. 2012. "What Happens after Enrollment? An Analysis of the Time Path of Racial Differences in GPA and Major Choice." *IZA Journal of Labor Economics* 1 (1):5.

Arcidiacono, Peter, V. Joseph Hotz, and Songman Kang. 2012. "Modeling College Major Choices Using Elicited Measures of Expectations and Counterfactuals." *Journal of Econometrics* 166 (1):3–16.

References III

Arcidiacono, Peter, V. Joseph Hotz, Arnaud Maurel, and Teresa Romano. 2014. "Recovering Ex Ante Returns and Preferences for Occupations using Subjective Expectations Data." Working Paper 20626, National Bureau of Economic Research.

Aucejo, Esteban M. and Jonathan James. 2017. "The Path to College Education: Are Verbal Skills More Important than Math Skills?" Working paper, Arizona State University and Cal Poly SLO.

Beffy, Magali, Denis Fougère, and Arnaud Maurel. 2012. "Choosing the Field of Study in Postsecondary Education: Do Expected Earnings Matter?" *The Review of Economics and Statistics* 94 (1):334–347.

Card, David and A. Abigail Payne. 2017. "High School Choices and the Gender Gap in STEM." Working Paper 23769, National Bureau of Economic Research.

References IV

Griffith, Amanda L. 2010. "Persistence of Women and Minorities in STEM Field Majors: Is It the School that Matters?" *Economics of Education Review* 29 (6):911–922.

Hastings, Justine S., Christopher A. Neilson, and Seth D. Zimmerman. 2013. "Are Some Degrees Worth More than Others? Evidence from College Admission Cutoffs in Chile." Working Paper 19241, National Bureau of Economic Research.

James, Estelle, Nabeel Alsalam, Joseph C. Conaty, and Duc-Le To. 1989. "College Quality and Future Earnings: Where Should You Send Your Child to College?" *American Economic Review* 79 (2):247–252.

Kinsler, Josh and Ronni Pavan. 2015. "The Specificity of General Human Capital: Evidence from College Major Choice." *Journal of Labor Economics* 33 (4):933–972.

References V

Kirkeboen, Lars J., Edwin Leuven, and Magne Mogstad. 2016. "Field of Study, Earnings, and Self-Selection." *The Quarterly Journal of Economics* 131 (3):1057–1111.

Patterson, Richard, Nolan G. Pope, and Aaron Feudo. 2019. "Timing Is Everything: Evidence from College Major Decisions." Discussion Paper 12069, IZA.

Price, Joshua. 2010. "The Effect of Instructor Race and Gender on Student Persistence in STEM Fields." *Economics of Education Review* 29 (6):901–910.

Speer, Jamin D. 2017. "The Gender Gap in College Major: Revisiting the Role of Pre-college Factors." *Labour Economics* 44:69–88.

Webber, Douglas A. 2014. "The Lifetime Earnings Premia of Different Majors: Correcting for Selection Based on Cognitive, Noncognitive, and Unobserved Factors." *Labour Economics* 28:14–23.

References VI

Wiswall, Matthew and Basit Zafar. 2015. "Determinants of College Major Choice: Identification using an Information Experiment." *Review of Economic Studies* 82 (2):791–824.

———. Forthcoming. "Preference for the Workplace, Investment in Human Capital, and Gender." *The Quarterly Journal of Economics* .