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Understanding the Cost Drivers for Instruction in Multiple Dimensions

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Delaware Cost Study Data & Research

“The National Study of Instructional Cost & Productivity”, conducted annually by the Higher Education Consortia at University of Delaware. Results reported here from a grant for public policy research by the Smith Richardson Foundation.

Two decade study, focused at the academic discipline level, of faculty instructional workload and costs, sponsored research and public service from over 700 four-year, public and private non-profit higher education institutions.

Research collaboration with the Education Policy Initiative Dr. Kevin Stange, University of Michigan and Dr. Steven Hemelt University of North Carolina- Chapel Hill
Motivation to Use Delaware Cost Study

- College prices ↑ 36% between 2008 and 2018 (College Board, 2018)
  - Student and parents now pay for >50% of costs (Desrochers & Hurlburt, 2016)
  - Concerns about access, persistence, indebtedness and value as an investment

- Improved understanding of cost differences by field, trends, and cost drivers is key tool for tempering future cost growth
- Better understating of costs → fuller picture of effects of policies such as financial aid, free college, and incentives to major in specific fields

**Example:** High cost of engineering majors makes increasing STEM much less welfare-enhancing than earnings differences would imply (Altonji & Zimmerman, 2017)
Impact on Public Opinion and Policy

Why it costs colleges far more to educate a physicist or teacher than an English major

Published Feb 13, 2019 1:24 p.m. ET

The costliest field is electrical engineering at $434 per credit hour, new research finds

The research looked at the cost to colleges of teaching different subjects and how various elements — such as professor salaries; or average class size — pull these costs up or down.

Students and parents know college is expensive, but even for those who closely study the bills it can be an uphill battle to find out why.

A recent working paper from professors at the University of Michigan, University of Delaware and University of North Carolina examined the different factors that can influence the cost of a college education. The research looked at the cost to colleges of teaching different subjects and how various elements — such as professor salaries; or average class size — pull these costs up or down.

What they found: There's a roughly $100 gap between the most excessive subject — electrical engineering at $434 — and the least expensive — math at $163 — in the cost for each credit a student earns. For comparison, English costs the college approximately $199 for each credit a student earns.

Our Study Sample

• Process of constructing weights honed our sample for future analyses
  – Identified outliers, missing data patterns
• We focus a subset of 20 disciplines in the study 2000-2015
  – Panel (2000-2015): 32,496 obs → 6,443 program, → 486 institutions
• Supplemented by IPEDS, OK Salary Survey, other sources
• Focus on 20 programs (CIP4 codes) using English (CIP 23.0101) as a reference for the other 19.
Questions and Analyses

1) What are the cost differences, direct instructional expenses (DIE) by field of study?
   • At point in time as well as trends over time

2) What drivers account for cost differences by field?
   • Decompose level and trend differences into 4 candidate drivers:
     (A) Personnel costs per FTE instructor
     (B) Non-personnel costs
     (C) Faculty workload
     (D) Class size

3) Simulate costs by substituting those for English as an index
Cost per Student Credit Hour Weighted to Control for Institutional Size & Governance

Direct Instructional Expenditure per Student Credit Hour

Survey year

- Unweighted
- SCH weighted
- IPW weighted
- IPW*SCH weighted
Our Study Focus

<table>
<thead>
<tr>
<th>Code</th>
<th>Discipline</th>
<th>Code</th>
<th>Discipline</th>
</tr>
</thead>
<tbody>
<tr>
<td>0901</td>
<td>Communication/Media Studies</td>
<td>4008</td>
<td>Physics</td>
</tr>
<tr>
<td>1101</td>
<td>Computer/Info sciences</td>
<td>4201</td>
<td>Psychology, General</td>
</tr>
<tr>
<td>1301</td>
<td>Education</td>
<td>4506</td>
<td>Economics</td>
</tr>
<tr>
<td>1410</td>
<td>Electrical Engineering</td>
<td>4510</td>
<td>Political Science and Government</td>
</tr>
<tr>
<td>1419</td>
<td>Mechanical Engineering</td>
<td>4511</td>
<td>Sociology</td>
</tr>
<tr>
<td>2301</td>
<td>English</td>
<td>5007</td>
<td>Fine and Studio Arts</td>
</tr>
<tr>
<td>2601</td>
<td>Biology</td>
<td>5138</td>
<td>Nursing</td>
</tr>
<tr>
<td>2701</td>
<td>Mathematics</td>
<td>5202</td>
<td>Business</td>
</tr>
<tr>
<td>3801</td>
<td>Philosophy</td>
<td>5203</td>
<td>Accounting and Related Services</td>
</tr>
<tr>
<td>4005</td>
<td>Chemistry</td>
<td>5401</td>
<td>History</td>
</tr>
</tbody>
</table>

- Selected largely based on size, coverage, policy relevance
Avg. number of degrees produced each year during 2012 to 2015

Average of Number of Degrees by Type for each Cip4. Color shows details about Degree Type. The marks are labeled by average of Number of Degrees by Type. The view is filtered on Degree Type and Cip4. The Degree Type filter has multiple members selected. The Cip4 filter has multiple members selected.
High Demand Disciplines Have the Highest Percentage of Online Teaching: Nursing, Education and Business Administration
Snapshot 2013 - 2015: Cost Differences by Field

- Electrical Engineering: +0.74%
- Nursing: +0.63%
- Mechanical Engineering: +0.60%
- Education: +0.31%
- Fine/Studio Arts: +0.26%
- Computer/Info Sciences: +0.23%
- Accounting: +0.21%
- Physics: +0.20%
- Chemistry: +0.16%
- Biology: +0.11%
- English: +0.07%
- Poli Sci/Government: -0.02%
- Economics: -0.05%
- History: -0.09%
- Comm/Media Studies: -0.11%
- Psychology: -0.18%
- Sociology: -0.18%
- Philosophy: -0.22%
- Mathematics: -0.25%
Average instructional cost
By field, per credit hour

- Electrical Engineering: $434
- Nursing: $375
- Mechanical Engineering: $372
- Education: $291
- Physics: $281
- Computer/Info Sciences: $274
- Fine/Studio Arts: $273
- Biz Admin/Mgmt/Operations: $263
- Accounting: $261
- Chemistry: $248
- Biology: $221
- Economics: $218
- Poli Sci/Government: $215
- English: $199
- History: $186
- Comm/Media Studies: $185
- Philosophy: $181
- Psychology: $176
- Sociology: $172
- Mathematics: $163

Source: The National Bureau of Economic Research
Similar Stories Emerge

1: Actual difference; 2: Equate other exp; 3: Equate salary; 4: Equate workload; 5: Equate class size
Trends in Faculty Mix

Weighted by SCH*IPW
Cost per student credit hour summarizes four basic cost drivers related to instruction.
Workload based on fall semester teaching activity excluding lab sections

Educating mechanical engineers costs twice as much as teaching philosophers
Philosophy instructors have relatively low salaries and teach lots of students

<table>
<thead>
<tr>
<th></th>
<th>Philosophy</th>
<th>Mechanical Engineering</th>
<th>Economics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average workload of instructors</td>
<td>3.1 sections</td>
<td>2.9 sections</td>
<td>2.9 sections</td>
</tr>
</tbody>
</table>
Class size is the ratio of fall semester student credit hours divided by three per class section.

<table>
<thead>
<tr>
<th>Students per section</th>
<th>Philosophy</th>
<th>Mechanical Engineering</th>
<th>Economics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>89</td>
<td>79</td>
<td>112</td>
</tr>
</tbody>
</table>

*Educating mechanical engineers costs twice as much as teaching philosophers.*

Philosophy instructors have relatively low salaries and teach lots of students.
Salaries are expressed in 2015 dollars using CPI-U
Other than personnel expenses in support of instruction generally range between 3% and 10% of the total direct instructional expenditures.
Privately Governed Research Institutions Have Largest Differences in High Demand Disciplines

Percentage Different from English by Carnegie and Governance
Publicly Governed Comprehensive Institutions Have Largest Differences in High Demand Disciplines

Percentage in Cost For English for Comprehensive Institutions
How does the cost driver analysis differ for undergraduate focused institutions?

Instructional Cost Percentage Different from English
Sorted by Carnegie Baccalaureate Groups

Nursing  Physics  Chemistry  Education  Fine/Arts  Biology  Computer/Info Science  English  Poli Sci/Gov  Intl Affairs  Economics  History  Mathematics  Accounting  Philosophy  Sociology  Comp Media/Sciences  Psychology

Private bacc  Public Bacc
Seven disciplines have costs above English for both publicly and privately governed institutions

Instructional Cost Percentage Different from English
Sorted by Carnegie Baccalaureate Groups

- Nursing
- Physics
- Education
- Fine/Studio Arts
- Biology
- Computer/Info Sciences
- Chemistry

Private bacc  Public Bacc
Five disciplines show higher costs than English in publicly controlled institutions with the opposite in privately controlled
Five disciplines are less expensive than English for both privately and publicly governed institutions

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Private bacc</th>
<th>Public Bacc</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>-16</td>
<td>-17</td>
</tr>
<tr>
<td>Mathematics</td>
<td>-20</td>
<td>-22</td>
</tr>
<tr>
<td>Philosophy</td>
<td>-30</td>
<td>-5</td>
</tr>
<tr>
<td>Sociology</td>
<td>-30</td>
<td>-28</td>
</tr>
<tr>
<td>Psychology</td>
<td>-36</td>
<td>-17</td>
</tr>
</tbody>
</table>
Identify cost differences with respect to English then examine how the four cost drivers contribute to the total

1) USE ENGLISH AS AN INDEX BY FIRST COMPUTING THE COST PER STUDENT CREDIT HOUR IN ENGLISH AS A PERCENTAGE OF THE AVERAGE FOR ENGLISH IN THE SAME CARNEGIE AND GOVERNANCE GROUP.

2) COMPUTE A SIMILAR INDEXED PERCENT FOR A SPECIFIC DEPARTMENT OTHER THAN ENGLISH USING THE COST PER STUDENT CREDIT HOUR WITH THE AVERAGE FOR THE SAME DEPARTMENT TYPE AND CARNEGIE AND GOVERNANCE GROUP.

3) COMPUTE THE DIFFERENCE USING THE INDEXED PERCENTAGES FOR A THE DEPARTMENT AND ENGLISH.
Case Study: English is equal (within 1%) in cost to the average for small BAS, privately governed institutions. Art is 161% more expensive than the average department at other small privately governed institutions. The four cost drivers will reveal why.
Our case study art department pays salaries and benefits that are 14% higher than the Carnegie & governance group average.
The art department spends 5% more on instructional materials and other non-personnel items than similar departments.
The art department teaches almost 30% fewer class sections than art departments in the same Carnegie and governance group; this is approximately one fewer class per FTE instructional faculty member.
The art department teaches a small percent more student credit hours per faculty than the group.
Use the web portal to benchmark with three-year averages.

**Carnegie Classification**: Baccalaureate Colleges - Arts & Science Focus

**Program**: Art

**CIP Code**: 50.0701 (Art/Art Studies, General)

**Results Display Options**
- **Average Type**: Carnegie
- **Program Type**: Private
- **Show 3 Year Averages**
Table 3 standard cost study teaching ratio comparisons in the web portal provide complementary information

Three year averages in the web portal or peer group reporting provide context and comparisons

### Table 3: Student Credit Hours and Organized Class Sections per FTE Instructional Faculty

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Total FTE Faculty</th>
<th>Instructional Faculty</th>
<th>UG Lower Div OC</th>
<th>UG Upper Div OC</th>
<th>Undergrad Indv. Instruct</th>
<th>Total Undergrad SCH And 3 Year Avg. by Carnegie Class</th>
<th>Grad OC</th>
<th>Graduate Indv. Instruct.</th>
<th>Total Graduate SCH And 3 Year Avg. by Carnegie Class</th>
<th>Total Student Credit Hours And 3 Year Avg. by Carnegie Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
<td></td>
<td>FTE</td>
<td>% of Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular Faculty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Table 3]

More information can be found in the web portal or peer group reporting.
Class sections comparisons with a three year average

<table>
<thead>
<tr>
<th>Lab/Dsc/Rec Sections</th>
<th>Other Section Types</th>
<th>TotalAnd3 YearAvg.byCarnegieClass</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UG Lower Div</td>
<td>UG Upper Div</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1.44</td>
</tr>
</tbody>
</table>

The number of class section for tenure / tenure track FTE is 0.74 sections smaller than the three year average.
Table 4 Cost ratio three year averages in web portal show the aggregated difference in cost per student credit hour

<table>
<thead>
<tr>
<th>Description</th>
<th>Control</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total FTE Faculty</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>2. Total Instructional Faculty</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>3. Tenured/tenure eligible faculty as % of total Instructional faculty</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>4. FTE students taught</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>5. Direct instructional expenditure per SCH</td>
<td>$569</td>
<td>$347</td>
</tr>
<tr>
<td>6. Direct instructional expenditure per FTE student</td>
<td>$17075</td>
<td>$10408</td>
</tr>
<tr>
<td>7. Personnel cost as percent of direct instructional expenditure</td>
<td>87%</td>
<td>94%</td>
</tr>
<tr>
<td>8. Research expenditure per FTE tenured/tenure-track faculty</td>
<td>$0</td>
<td>0</td>
</tr>
<tr>
<td>9. Public service expenditure per FTE tenured/tenure-track faculty</td>
<td>$26516</td>
<td>0</td>
</tr>
<tr>
<td>10. Research &amp; public service expenditure per FTE tenured/tenure-track faculty</td>
<td>$26516</td>
<td>0</td>
</tr>
</tbody>
</table>

* Tables 1, 2, and 3 and items 1-4 of Table 4 are based on the Fall semester data. Items 5, 10 depend on the academic/fiscal year data being supplied.*
At UD and nationally, ‘Math costs less to teach than English’

MATH IS OVER 20 % CHEAPER TO TEACH THAN ENGLISH

- 2015
- 2016
- 2017

0% -25%
-20% -20%
-15% -15%
-10% -10%
-5% -5%
0% 0%
UD Math $/SCH Higher than Carnegie corresponds to DEA # lower than 1.0

UD English $/SCH Higher than Carnegie corresponds to DEA # lower than 1.0

Math Dept Cost and DEA summary 2015 - 2017

English Dept Cost and DEA summary 2015 - 2017
UD Math Department Externally Sponsored Research and Public Service Funding
Higher than Carnegie and Doctoral Average

MATH DEPARTMENT SPONSORED RESEARCH

- Math $ Research & Public Service / T-TT vs Carnegie avg
- Math $ Research & Public Service / T-TT vs Hi Deg Proportion

UD English Department Externally Sponsored Research and Public Service Funding
Higher in 2015 than Doctoral Average

ENGLISH DEPARTMENT SPONSORED RESEARCH

- English $ Research & Public Service / T-TT vs Carnegie avg
- English $ Research & Public Service / T-TT vs Hi Deg Proportion
Teaching in Problem Centered Approach Decreases DFW Rate 5% from 2011 baseline
Deployment of Post-Doctoral Faculty
Teaching an Increasing Proportion of Students while Decreasing the DFW Rate

Impact of Post-Docs in E110 2014 through 2017

- Proportion of E110 taught by Post-docs
- DFW rate
- Difference DFW rate from Dept