Quantifying Institution stratification in higher education: Methods and Evidence

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2017 Summer School on Higher Education Research
"Higher Education and Social Inequality"
June 13th, 2017, St. Petersburg, Russia

Outline

- Quantitative or qualitative method?
- From theory to empirical work
- Recent development in economics literature

Quantitative or qualitative method?

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Before choosing method, one shall be able to:

  - To outline the qualitative and quantitative paradigms;
  - To illustrate the distinctiveness of each paradigm;
  - To illustrate issues of similarity between each paradigms;
  - To outline the ways in which qualitative and quantitative methods can be combined;
  - To apply this learning to individual research projects.

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- *Quantitative research is empirical research where the data are in the form of numbers.*

- *Qualitative research is empirical research where the data are not in the form of numbers. (Punch, 1998: 4)*

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Quantitative research: key characteristics
  - *CONTROL*: This is the most important element because it enables the scientist to identify the causes of his or her observations.
    - Experiments are conducted in an attempt to answer certain questions. They represent attempts to identify why something happens, what causes some event, or under what conditions an event does occur.
    - Control is necessary in order to provide unambiguous answers to such questions. To answer questions in education and social science we have to eliminate the simultaneous influence of many variables to isolate the cause of an effect

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Quantitative research: key characteristics
  - *OPERATIONAL DEFINITION*: This means that terms must be defined by the steps or operations used to measure them. Such a procedure is necessary to eliminate any confusion in meaning and communication.
    - Stating that *anxiety* refers to being tense or some other such term only adds to the confusion. However, stating that anxiety refers to a score over a criterion level on an anxiety scale enables others to realise what you mean by anxiety.
    - Stating an operational definition forces one to identify the empirical referents, or terms. In this manner, ambiguity is minimised.

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Quantitative research: key characteristics
  - *REPLICATION*: To be replicable, the data obtained in an experiment must be reliable; that is, the same result must be found if the study is repeated. If observations are not repeatable, our descriptions and explanations are thought to be unreliable.
  - *HYPOTHESIS TESTING*: The systematic creation of a hypothesis and subjecting it to an empirical test.

(Adapted from Burns, 2000: 6-7)

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Quantitative research: Strengths and limitations
- *STRENGTHS*
  - Precision - through quantitative and reliable measurement
  - Control - through sampling and design
  - Ability to produce causality statements, through the use of controlled experiments
  - Statistical techniques allow for sophisticated analyses
  - Replicable

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Quantitative research: Strengths and limitations
- *limitations*
  - Because of the complexity of human experience it is difficult to rule out or control all the variables
  - Quantification can become an end in itself.
  - Quantitative research often produces banal and trivial findings of little consequence due to the restriction on and the controlling of variables.
  - It is not totally objective because the researcher is subjectively involved in the very choice of a problem as worthy of investigation and in the interpretation of the results.

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Combine two methods

1. **Logic of triangulation**. The findings from one type of study can be checked against the findings deriving from the other type

2. **Qualitative research facilitates quantitative research**. Qualitative research may: help to provide background information on context and subjects; act as a source of hypotheses; aid scale construction.

3. **Quantitative research facilitates qualitative research**. Usually this means quantitative research helping with the choice of subjects for a qualitative investigation.

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Combine two methods

4. **Quantitative and qualitative research are combined in order to provide a general picture**. Quantitative research may be employed to plug the gaps in a qualitative study which arise because, for example the researcher cannot be in more than one place at any one time. Or if not all issues are amenable solely to a quantitative or a qualitative investigation.

5. **Structure and process**. Quantitative research is especially efficient at getting at the structural features of social life while qualitative studies are usually stronger on process aspects.

6. **Researchers' and subjects' perspectives**. Quantitative research is usually driven by the researcher's concerns, whereas qualitative research takes the subject's perspective.

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Combine two methods

7. **Problem of generality.** The addition of some quantitative evidence may help generalizability.

8. **Qualitative research may facilitate the interpretation of relationships between variables**. Quantitative research readily allows the researcher to establish relationships among variables, but is often weak when it comes to exploring the reasons for those relationships. A qualitative study can be used to explain the factors underlying the broad relationships.

9. **Relationship between macro and micro levels**. Employing both quantitative and qualitative research may provide a means of bridging the macro-micro gulf. Qualitative research can tap large-scale structural features of social life while qualitative research tends to address small-scale behavioral aspects.

10. **Stage in the research process**. Use at different stages of a longitudinal study.

11. **Hybrids**. Use of qualitative research is a quasi-experimental quantitative study.

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

- Which to choose? 6 factors to consider
  - **Research Questions:** What exactly are you trying to find out? Focus on the `exactly' as this can lead you either into the quantitative or qualitative direction.
  - **Are we interested in making standardized and systematic comparisons or do we really want to study this phenomenon or situation in detail?**
  - **The Literature:** How have other researchers dealt with this topic? To what extent do you wish to align your own research with standard approaches to the topic?

Qualitative and quantitative approaches

Christina Hughes (University of Warwick)

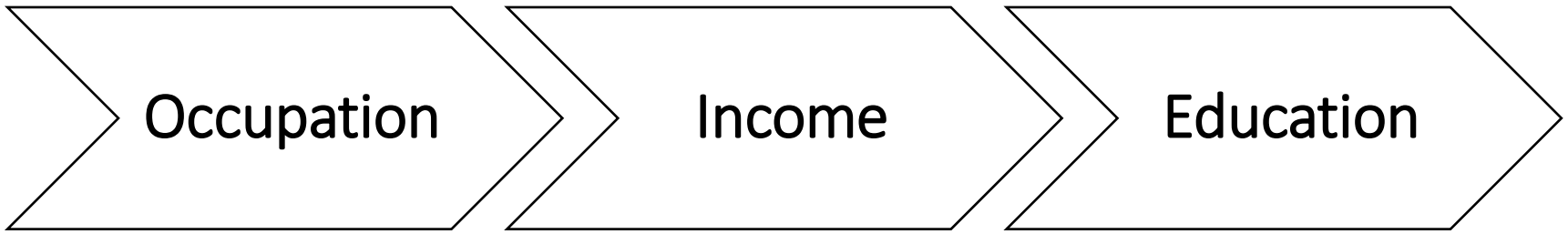
- Which to choose? 6 factors to consider
  - **Practical Considerations:** Issues of time, money, availability of samples and data, familiarity with the subject under study, access to situations, gaining co-operation.
  - **Knowledge payoff:** Will we learn more about this topic using quantitative or qualitative approaches? Which approach will produce more useful knowledge? Which will do more good?
  - **Style:** Some people prefer one to the other. This may involve paradigm and philosophical issues or different images about what a good piece of research looks like.

What have you used for your study and why?

From theory to empirical work in stratification research

From analysis of social stratification to institutional stratification

- Analysis of social stratification
  - Foundation of social stratification
    - **Social stratification** is a society's categorization of people into socioeconomic strata, based upon their occupation and income, wealth and social status, or derived power (social and political). As such, stratification is the relative social position of persons within a social group, category, geographic region, or social unit. (Wikipedia)

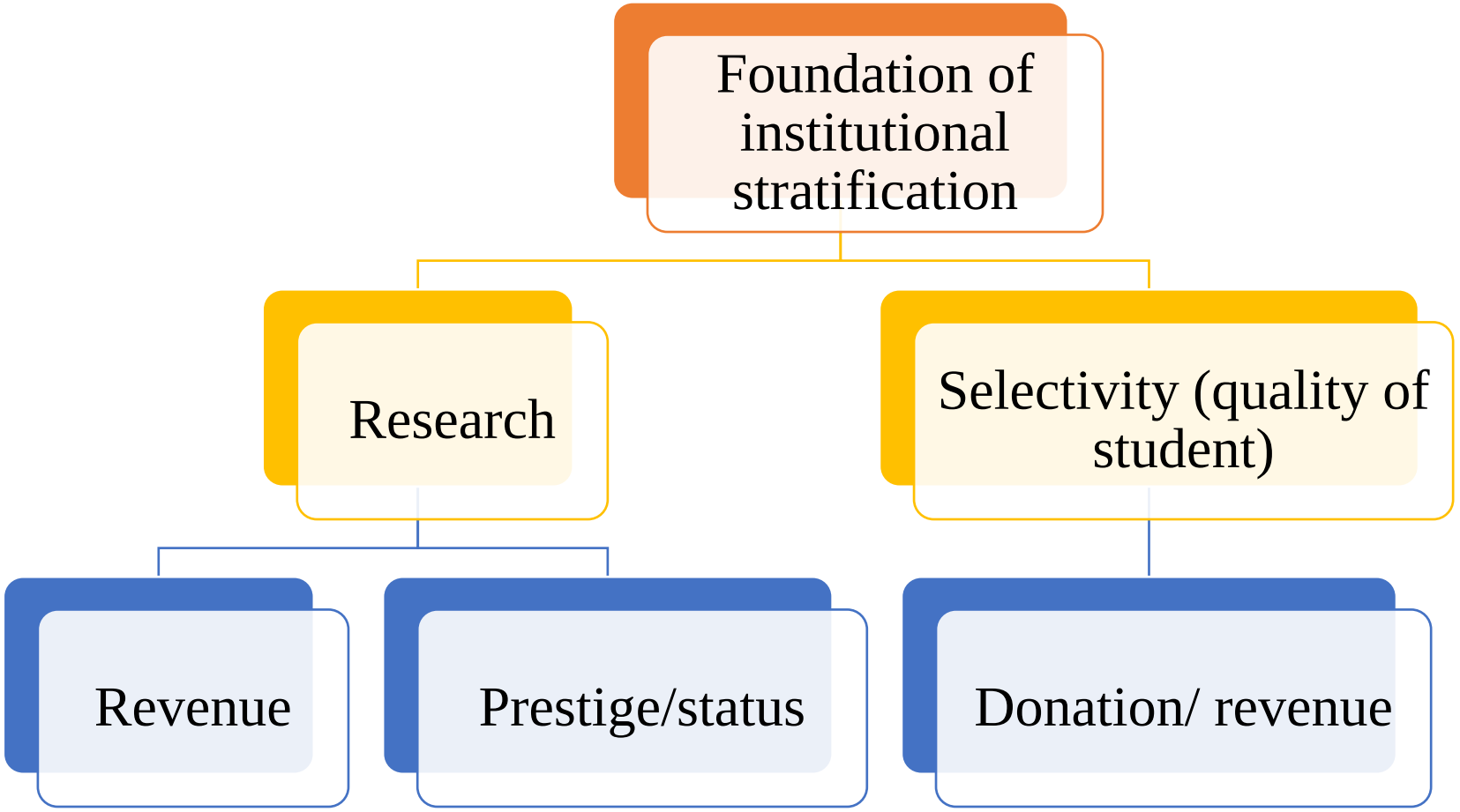


From analysis of social stratification to institutional stratification

- Analysis of social stratification
  - Indicators of social stratification (Haug 1977)
    - Economic capital
    - Human capital
    - Culture/social capital
    - Information capital
  - measurements for social stratification (based on income or expenditure)
    - Lorenz curve
    - Gini coefficient
    - Theil coefficient
    - Atkinson’s class of inequality measures

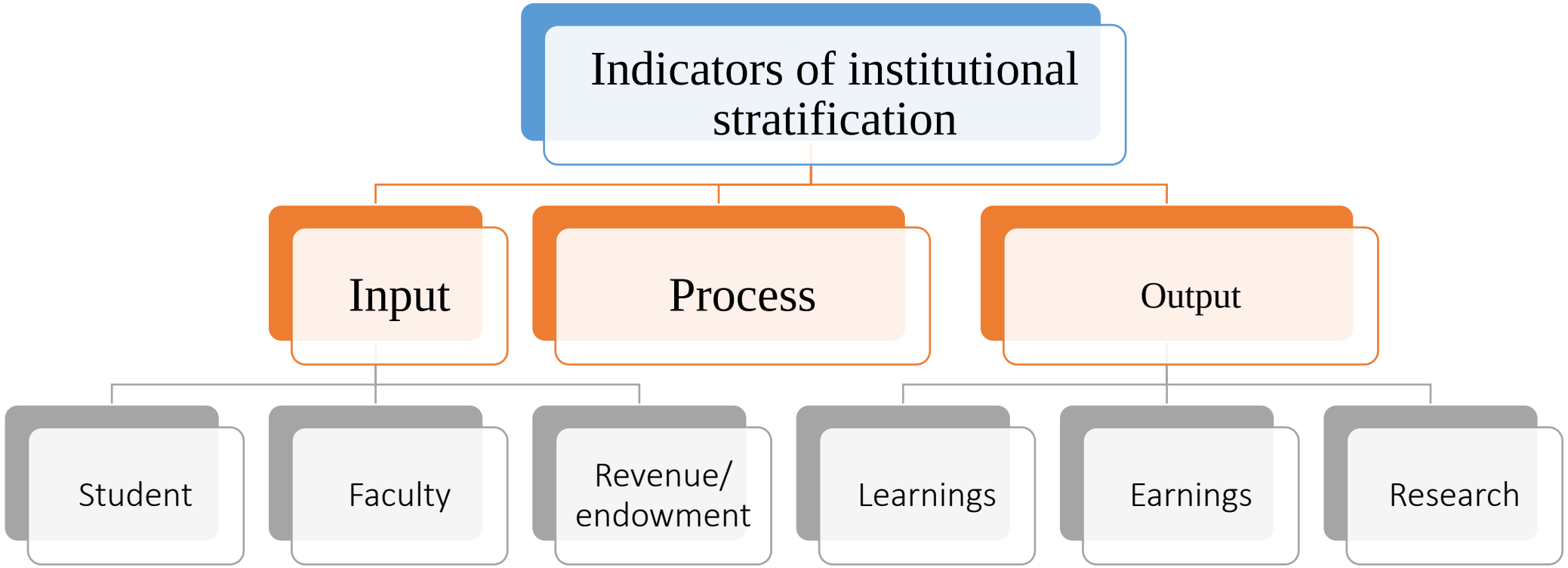
From analysis of social stratification to institutional stratification

- Foundation of institutional stratification



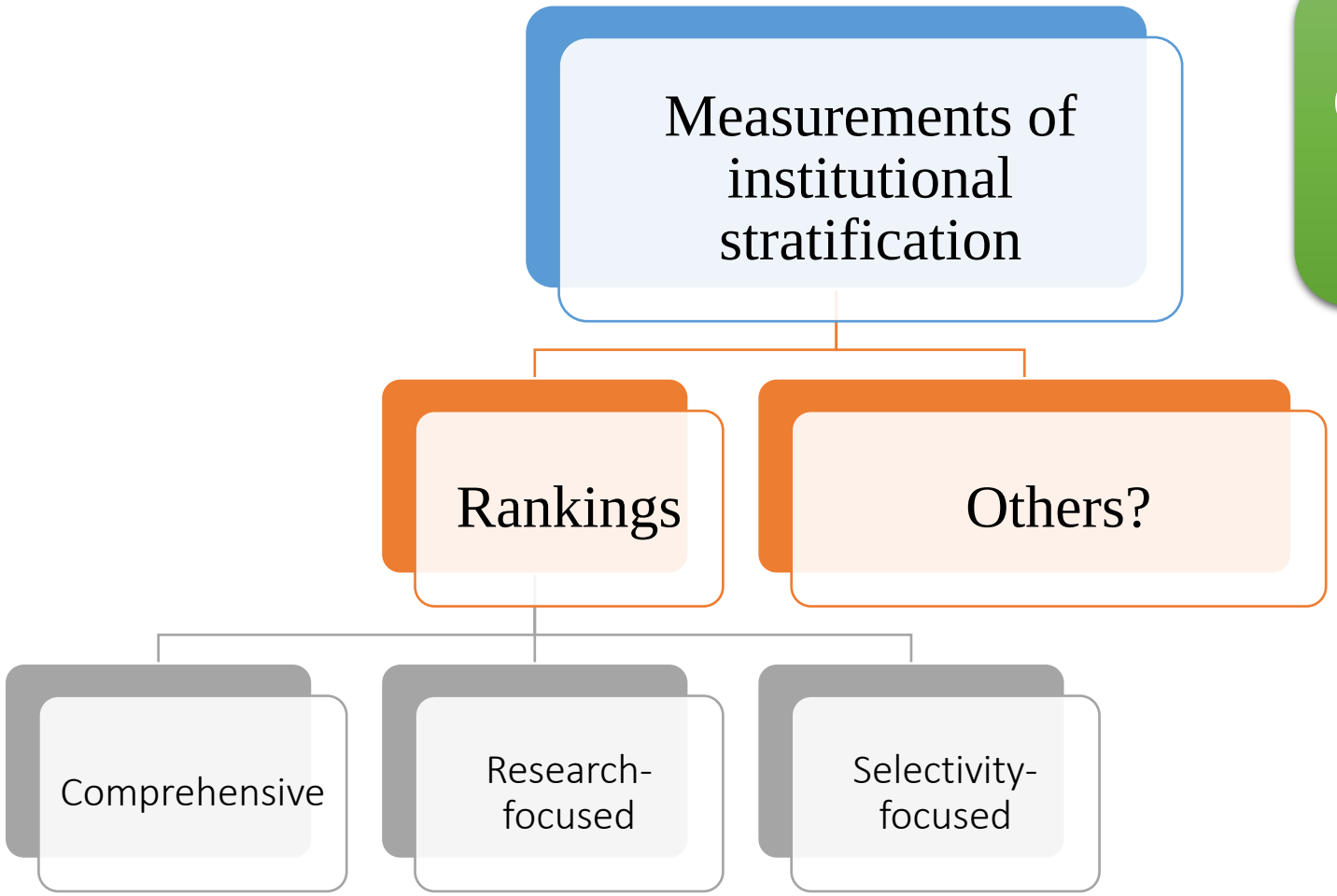
From analysis of social stratification to institutional stratification

- Indicators of institutional stratification



From analysis of social stratification to institutional stratification

- Measurements of institutional stratification



Question: what are other indicators?

Level of stratification between 2000 to 2008
(Taylor et al. 2016)

- Research questions
  - How do universities response to field-level changes? Whether the stratification increased between 2000 to 2008?
  - Will the additional competition for resources into the field of research universities heighten stratification (Slaughter and Cantwell 2012)?
- Empirical questions
  - Is there latent classes of public/private universities?
  - Are there mean group differences from the sample average? →measure of stratification
  - Are the latent classes stable over time?

Level of stratification between 2000 to 2008
(Taylor et al. 2016)

- Latent class analysis
  - Classifying public and private research universities using research capacity, instruction capacity and endowment (for private only)
  - Comparing group mean with population mean
  - From 2000 to 2008 data (mid-point of the NIH doubling, ended with the “Great Recession”)
    - Enrollment and financial characteristics: IPEDS
    - Research and development expenditure: NSF R&D “Survey of research and development expenditures at universities and colleges”
    - Council for the Advancement of Education: endowment data, “Voluntary support for education survey”
  - Separate analysis for public and private universities
  - Tracking time trend

Level of stratification between 2000 to 2008
(Taylor et al. 2016)

- Latent class analysis
  - Variables to identify latent categories of universities
    - Research capacity (Marginson 2006)
      - Doctoral degrees per 100 FTE
      - R&D expenditure per FTE funded by the US federal government, industry, state government, institution's own fund
    - Instructional capacity
      - faculty member per 100 FTE students
      - Net tuition and fees revenues per FTE
      - General subsidy per FTE (Winston 1999)
    - Endowment for private institutions

Level of stratification between 2000 to 2008
(Taylor et al. 2016)

- Hypothesis
  - Universities should be differentiated in terms of research capacity, instructional capacity and endowment
  - Research revenues generally, and federally-sponsored R&D specifically, are drivers of growing stratification
  - Elite universities should exceed sample average in federal-, industry-, state-supported R&D expenditures
  - The categories should be stable overtime

Latent class analysis with mean comparison

Table 4.1 Means of members of four latent classes of public universities (standard deviations in parentheses), 2000–2008

Variables	Sample average	"Middle class"	"Elite"	"Strivers"	"Poor relations"
Faculty members per 100 FTE students	6.438 (2.415)	6.574 (1.693)	9.498** (3.762)	8.095** (2.661)	4.876 (1.153)
Baccalaureate degrees per 100 FTE	14.522 (5.813)	14.076 (5.852)	17.138** (2.705)	15.221* (3.402)	14.192 (6.692)
Percent of applicants granted admission	71.0 % (15.218)	75.6 %** (12.7)	57.9 %** (19.5)	61.8 %** (12.8)	70.8 % (14.3)
Net tuition and fees revenues per FTE (in thousands)	$6.960 (2.565)	$6.468** (1.828)	$7.421** (1.564)	$12.594** (1.991)	$5.970** (1.741)
General subsidy per FTE (in thousands)	$8.389 (4.736)	$7.509** (3.381)	$17.507** (5.896)	$6.253** (3.429)	$7.536** (3.138)
Federally funded R&D per FTE (in thousands)	$4.798 (4.189)	$4.524** (2.009)	$13.257** (4.886)	$7.165** (0.691)	$1.943** (1.739)
Industry funded R&D per FTE (in thousands)	$0.489 (0.610)	$0.498 (0.528)	$1.181** (0.999)	$0.716** (0.691)	$0.201** (0.215)
Institution funded R&D per FTE (in thousands)	$2.096 (1.768)	$2.325** (1.360)	$4.342** (2.698)	$2.180 (1.568)	$1.057** (1.110)
State funded R&D per FTE (in thousands)	$0.779 (0.919)	$1.100** (1.111)	$0.948* (0.744)	$0.544** (0.503)	$0.333** (.418)
Doctoral degrees per 100 FTE	0.775 (0.517)	0.756 (0.434)	1.531** (0.519)	1.028** (0.456)	0.522** (0.383)
Total observations	1044	498	103	96	347

Results of "two-tailed" t-tests indicating whether class differs from sample mean depicted as **p<0.01, *p<0.05

Latent class analysis with mean comparison
(Taylor et al. 2016)

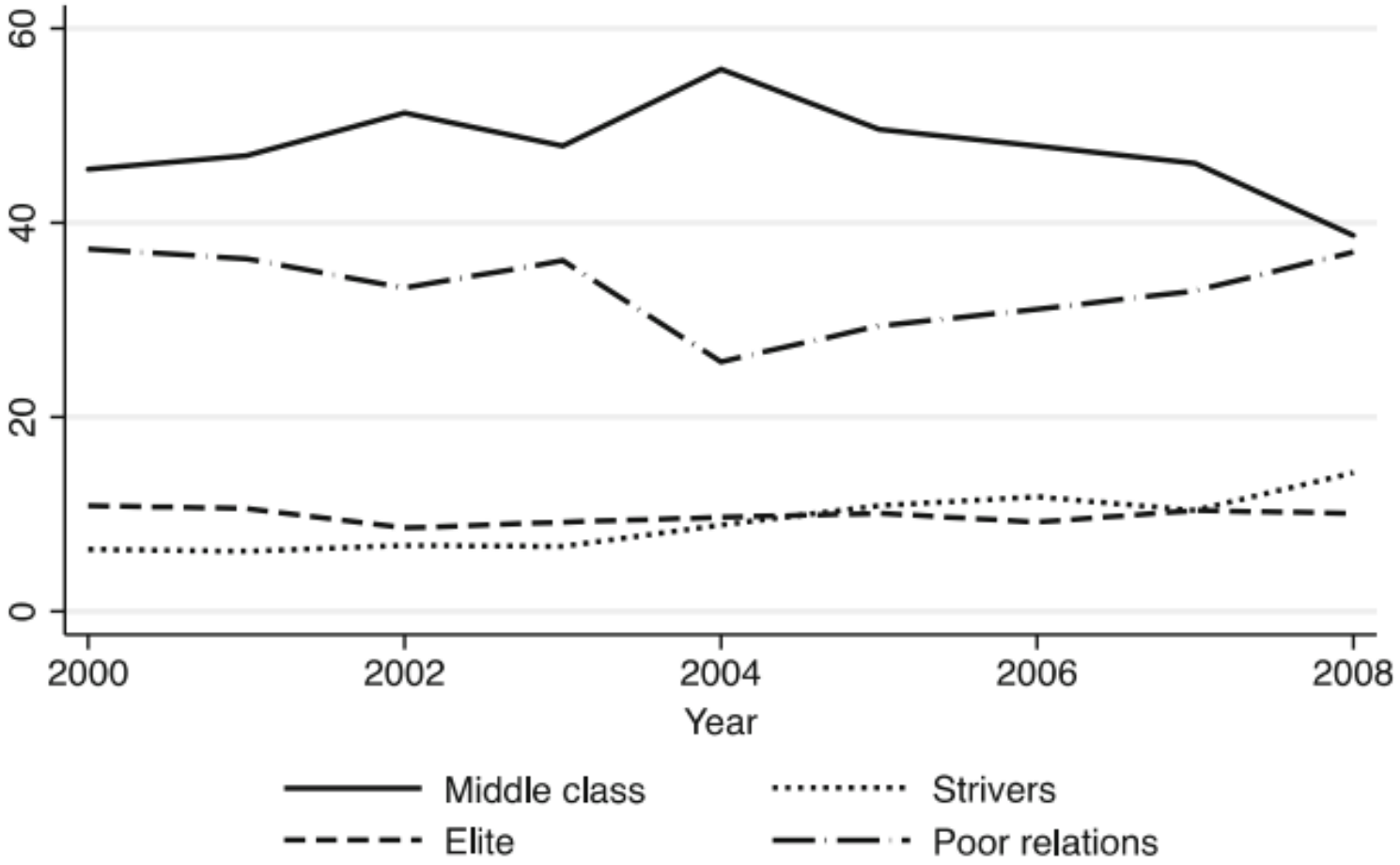


Fig. 4.1 Percent of public universities located in each of four latent classes over time,

Latent class analysis with mean comparison
(Taylor et al. 2016)

Table 4.2 Means of members of three latent classes of private universities (standard deviations in parentheses), 2000–2008

Variables	Sample average	"Elite"	"Tuition-focused"	"R&D super elite"	"Private money super elite"
Faculty members per 100 FTE students	12.371 (7.499)	16.492** (5.473)	7.590** (2.674)	24.377** (8.623)	24.619** (13.222)
Baccalaureate degrees per 100 FTE	14.042 (3.279)	13.617 (3.508)	14.772** (3.050)	10.376** (0.851)	12.172** (0.835)
Percent of applicants granted admission	42.1 % (22.5)	28.8 %** (16.5)	54.5 %** (20.1)	24.5 %** (7.6)	19.9 %** (4.8)
Net tuition and fees revenues per FTE (in thousands)	$20.868 (4.489)	$21.621 (4.971)	$20.477 (4.041)	$19.018 (6.372)	$20.992 (0.885)
General subsidy per FTE (in thousands)	$24.275 (25.406)	$40.403** (22.287)	$6.688** (4.516)	$83.795** (18.015)	$45.222** (6.091)
Federally funded R&D per FTE (in thousands)	$18.235 (23.332)	$23.818** (7.700)	$5.289** (3.581)	$113.409** (15.48)	$38.528** (9.077)
Industry funded R&D per FTE (in thousands)	$1.373 (2.210)	$1.384 (1.021)	$0.517** (0.527)	$3.020** (1.684)	$10.573** (1.895)
Institution funded R&D per FTE (in thousands)	$2.137 (2.377)	$3.602** (2.724)	$0.819** (0.840)	$5.222** (1.924)	$2.771 (2.060)
State funded R&D per FTE (in thousands)	$0.543 (0.820)	$0.814** (1.146)	$0.327** (0.415)	$0.737 (0.555)	$0.684 (0.704)
Doctoral degrees per 100 FTE	1.918 (1.373)	2.434** (0.930)	1.172** (0.519)	5.391** (2.682)	3.366** (1.798)
Endowment per 100 FTE (in millions)	$30.070 (40.031)	$56.447** (49.975)	$8.248** (7.456)	$48.157* (33.308)	$54.878** (27.615)
Total observations	427	161	230	18	18

Results of "two-tailed" t-tests indicating whether class differs from sample mean depicted as **p<0.01, *p<0.05

Latent class analysis with mean comparison
(Taylor et al. 2016)

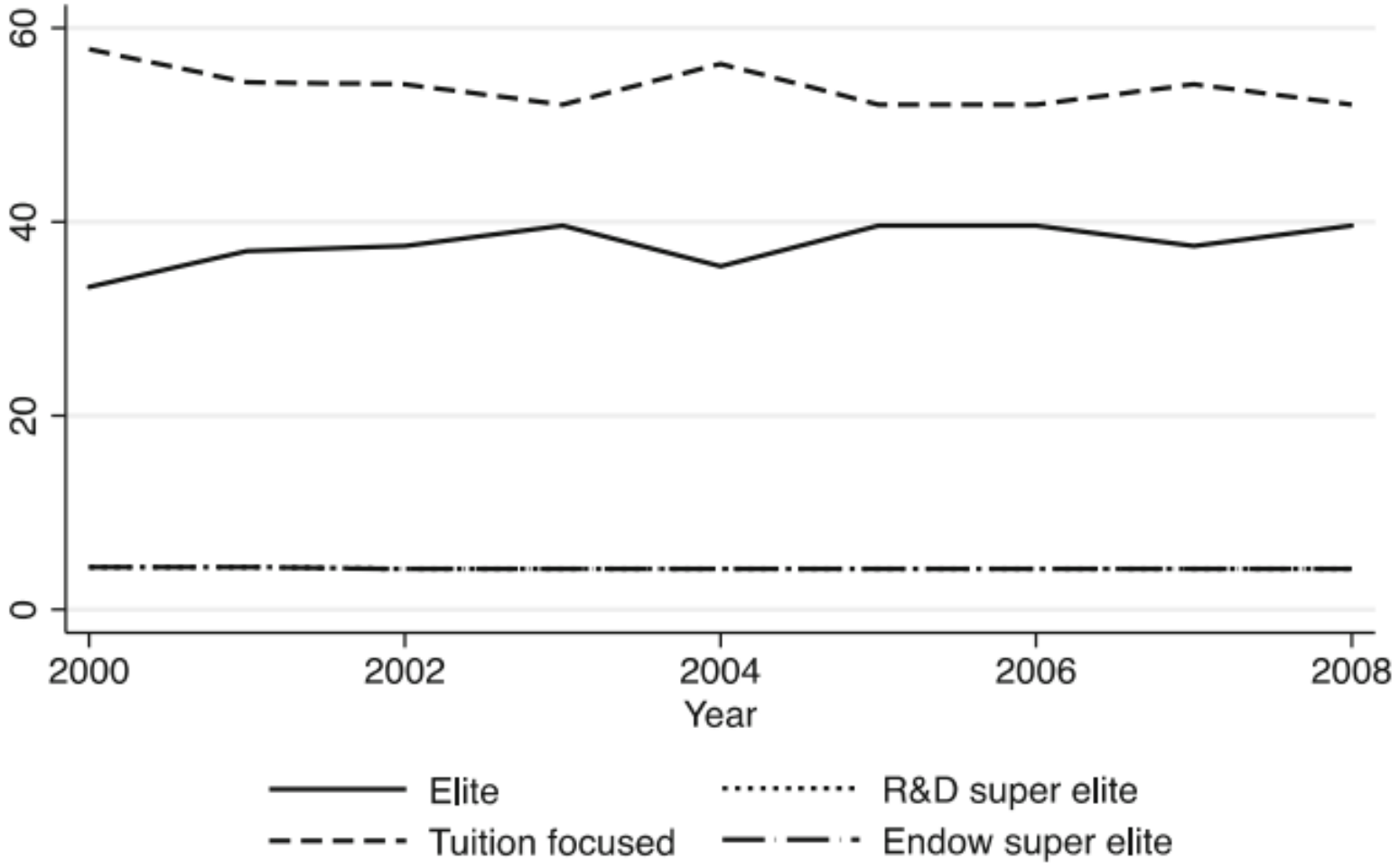


Fig. 4.2 Percent of private universities located in each of four latent classes over time, 2000–2008

Level of stratification between 2000 to 2008
(Taylor et al. 2016)

- Questions about this research
  - What is the foundation of stratification? In what dimensions are universities stratified?
  - How do you measure the effect of external R&D support?
  - Results of latent classes analysis are sensitive to the choice of variable
  - How do you illustrate group differences?

Bias towards research expenditure
(Leslie et al. 2012)

- Research questions
  - Do research universities prioritize expenditure for research?
  - Where do research expenditure come from?
- Empirical questions
  - What is the link between funding sources and university activities?
  - What is the relationships between revenues and expenditures of research universities?

Bias towards research expenditure
(Leslie et al. 2012)

- Economics perspective
  - University as multi-product firms that produce instruction, research and other outputs (Cohn et al. 1990)
  - Resource theory of costs (Bowen 1980) suggests universities try to maximize excellence, prestige and quality
  - University's cost increases overtime (Baumal 1993)
  - Universities prioritize research expenditures to maximize prestige and reputation (Ehrenberg 2007)

Bias towards research expenditure
(Leslie et al. 2012)

- Institutional theory and neo-institutional theory
  - Tierney (1997): universities are likely to behave in a manner consistent with their tripartite mission of teaching, research and service, and that expenditures would proceed according to that sequence (institutional theory)
  - Neo-institutional theory perceive research universities as an organizational field. Isomorphism leads universities all pursue research as prestige generating activities

Bias towards research expenditure
(Cantwell et al. 2013)

- Slaughter and Rhoades (2004): academic capitalism identifies the mechanisms by which institutional and organizational structures link universities with state, corporations, and interstitial organizations
- Changing environment and upward transfer
  - State support for higher education in US decline in 1980s and 1990s
  - Federal grant for R&D increases overtime, resource dependent universities become more reliant on competitive research grants and contracts from pubic sources and industry (Slaughter and Leslie, 1997)
  - The upper strata universities receive the largest share of federal R&D funding→ hiring additional faculty or contingent labor →getting addition research grants → inter-institutional stratification increases

Bias towards research expenditure
(Leslie et al. 2012)

- Hypothesis
  - External grants and contracts money support research expenditure
  - Cross-subsidization for research from general revenue or tuition
  - The allocation of revenues across expenditure categories will change overtime, towards redistribution towards research expenditure (expenditure bias)

Bias towards research expenditure
(Leslie et al. 2012)

- Two-way fixed effect model
  - IPEDS data from 1984/85 to 2007/08
    - Finance, enrollment, and institutional characteristics
    - FTE, institutional revenues by source and expenditures by function
  - Revenue and expenditure type data
  - 96 research extensive institutions as of 2007/08
  - Per FTE in dollars

Bias towards research expenditure
(Leslie et al. 2012)

- Empirical model
  - Each categories of institutional expenditure of institution i in year t as a function of different revenue categories

$$E_{it} = \alpha_o + \alpha_i R_{it} + u_{it} \qquad (1)$$

  - Adding fixed effect for institution and for year

$$E_{it} = \alpha_0 + \alpha_1 R_{it} + \gamma_i + \eta_t + u_i \qquad (2)$$

  - To capture the trend

$$E_{it} = \alpha_0 + (\alpha_1 + \alpha_2 \times year) R_{it} + \gamma_i + \eta_t + u_i \qquad (3)$$

Fixed effect model --public
(Leslie et al. 2012)

Table 1 Estimates of institutional revenues on expenditures at public research I institutions (per FTE in $)

	(1) Instruction	(2) Research	(3) Public services	(4) Academic support	(5) Student services	(6) Institutional support	(7) Scholarships
Tuition	0.456***	0.051**	−0.197***	0.087***	0.080***	0.100***	0.111***
	(0.020)	(0.019)	(0.020)	(0.011)	(0.005)	(0.010)	(0.011)
Appropriations	0.322***	0.108***	0.103***	0.092***	0.036***	0.090***	0.016*
	(0.012)	(0.011)	(0.012)	(0.006)	(0.003)	(0.006)	(0.006)
Grants and contracts	0.288***	0.500***	0.042***	0.098***	0.026***	0.042***	0.026***
	(0.012)	(0.011)	(0.012)	(0.007)	(0.003)	(0.006)	(0.007)
Gifts	0.388***	0.555***	0.196***	0.160***	0.065***	0.132***	−0.014
	(0.028)	(0.026)	(0.028)	(0.015)	(0.006)	(0.014)	(0.015)
Sales	0.014*	0.017**	0.060***	−0.010**	−0.010***	0.003	−0.001
	(0.006)	(0.005)	(0.006)	(0.003)	(0.001)	(0.003)	(0.003)
Other	−0.008	0.065***	0.172***	−0.008	−0.005	−0.011	0.024***
	(0.012)	(0.011)	(0.012)	(0.007)	(0.003)	(0.006)	(0.007)
Observations	1511	1511	1511	1511	1511	1511	1511
R^2	0.798	0.846	0.382	0.540	0.559	0.470	0.524

Standard errors in parentheses

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Fixed effect model --private

(Leslie et al. 2012)

Table 2 Estimates of institutional revenues on expenditures at private research I institutions (per FTE in $)

	(1) Instruction	(2) Research	(3) Public services	(4) Academic support	(5) Student services	(6) Institutional support	(7) Scholarships
Tuition	0.474***	−0.031	−0.018	0.086*	−0.012	0.052	0.304***
	(0.059)	(0.037)	(0.030)	(0.039)	(0.021)	(0.028)	(0.013)
Grants and contracts	0.391***	0.786***	0.015	0.079***	0.032***	0.177***	−0.016**
	(0.023)	(0.015)	(0.012)	(0.015)	(0.008)	(0.011)	(0.005)
Gifts	0.118***	0.098***	0.023	0.087***	0.040***	0.116***	0.001
	(0.024)	(0.015)	(0.012)	(0.016)	(0.008)	(0.011)	(0.005)
Sales	0.023*	0.021***	−0.005	0.022***	−0.006	0.003	−0.006**
	(0.009)	(0.006)	(0.005)	(0.006)	(0.003)	(0.004)	(0.002)
Other	−0.011	0.029***	0.000	−0.010*	−0.002	−0.005	−0.002
	(0.006)	(0.004)	(0.003)	(0.004)	(0.002)	(0.003)	(0.001)
Observations	791	791	791	791	791	791	791
R^2	0.770	0.913	0.026	0.359	0.385	0.690	0.900

Standard errors in parentheses

* $p < 0.05$; ** $p < 0.01$, *** $p < 0.001$

Fixed effect model –public with year interaction term
(Leslie et al. 2012)

Table 3 Estimates of institutional revenues on expenditures at public research I institutions over years (per FTE in $)

	(1) Instruction	(2) Research	(3) Public services	(4) Academic support	(5) Student services	(6) Institutional support	(7) Scholarship
Tuition	0.346***	0.017	−0.022	0.133***	0.046***	0.075***	0.350***
	(0.041)	(0.038)	(0.042)	(0.023)	(0.009)	(0.020)	(0.022)
×Year	0.007***	0.001	−0.010***	−0.003**	0.002***	0.001	−0.013***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
Appropriations	0.312***	0.191***	0.138***	0.100***	0.033***	0.083***	−0.014
	(0.014)	(0.013)	(0.015)	(0.008)	(0.003)	(0.007)	(0.008)
×Year	0.003**	−0.008***	−0.004***	0.000	0.001*	0.001*	0.001**
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Grants and Contracts	0.171***	0.492***	0.067*	0.060***	0.018*	0.059***	0.061***
	(0.031)	(0.029)	(0.032)	(0.017)	(0.007)	(0.015)	(0.016)
×Year	0.005***	0.000	−0.001	0.001	0.000	−0.001*	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Gifts	0.276***	0.293***	0.301***	−0.024	−0.024	0.119***	0.008
	(0.067)	(0.062)	(0.069)	(0.037)	(0.015)	(0.033)	(0.035)
×Year	0.005	0.015***	−0.005	0.013***	0.005***	0.002	0.001
	(0.004)	(0.004)	(0.004)	(0.002)	(0.001)	(0.002)	(0.002)
Sales	0.107***	−0.006	0.015	−0.028***	0.011***	−0.033***	0.001
	(0.010)	(0.010)	(0.011)	(0.006)	(0.002)	(0.005)	(0.006)
×Year	−0.005***	0.002***	0.002***	0.001**	−0.001***	0.002***	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other	−0.289***	0.211***	0.055	−0.005	0.005	0.061*	0.059*
	(0.053)	(0.050)	(0.055)	(0.030)	(0.012)	(0.027)	(0.028)
×Year	0.015***	−0.007**	0.005	−0.000	−0.000	−0.004**	−0.002
	(0.003)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	1511	1511	1511	1511	1511	1511	1511
R^2	0.818	0.862	0.411	0.570	0.604	0.501	0.603

Fixed effect model –private with year interaction term
(Leslie et al. 2012)

Table 4 Estimates of institutional revenues on expenditures at private research I institutions over years (per FTE in $)

	(1) Instruction	(2) Research	(3) Public services	(4) Academic support	(5) Student services	(6) Institutional support	(7) Scholarships
Tuition	1.192***	0.054	−0.097	−0.285***	0.103*	0.052	0.419***
	(0.113)	(0.072)	(0.060)	(0.079)	(0.044)	(0.057)	(0.026)
×Year	−0.043***	0.007	0.001	0.031***	−0.008**	0.003	−0.009***
	(0.007)	(0.005)	(0.004)	(0.005)	(0.003)	(0.004)	(0.002)
Grants and Contracts	0.323***	0.626***	0.149***	0.009	0.060***	0.187***	−0.004
	(0.040)	(0.026)	(0.021)	(0.028)	(0.016)	(0.020)	(0.009)
×Year	0.001	0.006***	−0.007***	0.004**	−0.002**	−0.001	−0.000
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Gifts	−0.071	−0.042	−0.058	0.087	−0.038	−0.040	−0.010
	(0.071)	(0.045)	(0.038)	(0.050)	(0.028)	(0.036)	(0.016)
×Year	0.008*	0.007**	0.006**	0.000	0.004**	0.009***	0.000
	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)
Sales	−0.124***	0.025	−0.005	0.040**	−0.005	0.008	−0.006
	(0.021)	(0.013)	(0.011)	(0.015)	(0.008)	(0.011)	(0.005)
×Year	0.007***	0.000	0.000	−0.001	−0.000	−0.000	−0.000
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Other	−0.236***	−0.121***	−0.086***	0.099***	−0.056***	0.060**	0.054***
	(0.039)	(0.025)	(0.021)	(0.028)	(0.015)	(0.020)	(0.009)
×Year	0.017***	0.012***	0.006***	−0.008***	0.004***	−0.005**	−0.004***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
Observations	791	791	791	791	791	791	791
R^2	0.811	0.930	0.111	0.413	0.412	0.704	0.909

Bias towards research expenditure
(Leslie et al. 2012)

- Questions about this research
  - How to measure expenditure bias?
  - Autonomy of institution in terms of expenditure decision?
  - How do expenditures translate into stratification?

Intra-institutional stratification and organization segmentation and global status (Cantwell et al. 2013)

- Research questions
  - Whether markers of inter-institutional stratification and organizational segmentation predicts global status among US research universities?
  - If so, global ranking normalizes the inter-institutional stratification and organizational segmentation of national system

Academic capitalism brings organization segmentation
(Cantwell et al. 2013)

- Academic capitalism indicates new forms of organization that segment universities

Intra-institutional stratification and organization segmentation and global status (Cantwell et al. 2013)

- Hypothesis
  - Intra-institutional stratification predicts ARWU ranking
    - Net tuition
    - R&D expenditures from federal, industry, institution
    - Number of full time faculty/proportion of faculty who are employed as full time
  - Organizational segmentation predicts ARWU ranking
    - Proportion of doctorates awarded in S&E fields
    - Presence of medical school
    - Part-time faculty
    - Postdoc researchers

Intra-institutional stratification and organization segmentation and global status (Cantwell et al. 2013)

- Tobit model for ARWU ranking
  - With lagged input
  - 68 US research universities from 2003 to 2008
  - Data source
    - ARWU raw aggregate scores
    - Delta project: university enrollment, finance, institutional characteristics
    - NSF WebCASPAR： number of postdoc, R&D expenditure, S&E doctorates
  - Tobit model with panel data

Panel Tobit model—inter-institutional stratification
(Cantwell et al. 2013)

Table 2 Tobit analyses of ARWU scores for US research universities, 2004–2009 (independent variables measured 2003–2008)

	(1)	(2)
Logged revenues from tuition and fees	−0.334	1.859
	(3.188)	(3.355)
Logged R&D expenditures funded by federal government	9.003**	11.16**
	(2.148)	(1.957)
Logged R&D expenditures funded by industry	0.975	1.287*
	(0.678)	(0.555)
Logged R&D expenditures funded by institution	−0.255	−0.214
	(0.132)	(0.129)
Private control	14.94**	20.35**
	(5.531)	(6.797)

Panel Tobit Model—organization segmentation
(Cantwell et al. 2013)

Table 2 Tobit analyses of ARWU scores for US research universities, 2004–2009 (independent variables measured 2003–2008)

	(1)	(2)
Logged count of Ph.D.s conferred in S&E fields	10.79**	
	(1.865)	
Proportion of Ph.D.s conferred in S&E fields		14.78**
		(5.515)
Logged count of full-time faculty members	−0.582	
	(1.188)	
Logged count of part-time faculty members	0.952	
	(0.545)	
Proportion of faculty who are full-time		−4.447
		(4.475)
Logged count of postdocs	−0.658	−0.890
	(1.072)	(0.986)

Intra-institutional stratification and organization segmentation and global status (Cantwell et al. 2013)

- Problems about this study?
  - How do you measure intra-institutional stratification and/or organizational segmentation?
  - Direction of causality?
  - Correlation between intra-institutional stratification and/or organizational segmentation?

Recent development in economics literature

Research on higher education stratification

- Higher education literature focuses on:
  - Input-oriented
    - Stratification in input rather than output of institution, such as revenue, student enrollment, faculty characteristics, expenditures, ranking score
  - Research focus
    - Stratification research focuses on research extensive universities
    - Mainly about U.S. institutions
  - Theory first
    - Stratification research generates testable hypotheses from existing theories, such as sociology theory, organizational theory, or economics theory

Research on higher education stratification

- Higher education literature focuses on:
  - Global ranking
    - Stratification research use global ranking both as indicator for and result of inter-institutional stratification
  - Methodology
    - Quantitative and qualitative and mixed method
    - Government collected data (voluntary reporting), survey data
    - Cross-sectional and longitudinal data
    - Various empirical approach, depending on topics

Research on higher education productivity

- Economics literature on higher education recently focuses on
  - higher education institution's productivity, or the output of colleges and universities
    - Response to accountability movement
    - productivity becomes the base to compare institution performance difference and institution stratification
  - Coverage
    - The research is not limited to research universities, but cover all types of tertiary institutions, including non-selective universities and community colleges
  - Data
    - Most research use administrative data from education sector and other parts of government such as labor, social security and etc.

Research on higher education productivity

- Economics literature on higher education recently focuses on
  - Multiple output
    - The institution output includes graduate's earnings, standardized exit exam scores, transfer rate, baccalaureate graduation rate, GPA, persistence rate and etc.
  - Methodological advancement
    - Controlling for student self-selection into various institutions, and institution's selection of students
    - Controlling for characteristics of student body, such as SES composition, gender, average college freshmen standardized test score, average high school standardized test score and etc.

Research on higher education productivity

- Economics literature on higher education recently focuses on
  - Theory-free approach
    - Not interested in theory, simple inter-institution comparison
  - How does this research relate to institution stratification?
    - Using the results to inform the discussion of stratification, extending the analysis from input to output of higher education
    - understanding how to measure stratification in larger scale, with administrative data

Scott E. Carrell, Michal Kurlaender, 2016. Estimating the productivity of community colleges in paving the road to four-year college success

Carrell and Kurlaender (2016)

Abstract

- Multiple missions
  - The distinct mission and open-access nature of community colleges and the diverse goals of the students they serve make it difficult to assess differences in quality across community college campuses.
- Institutional difference in terms of transfer rate and graduation rate
  - In this paper, we investigate institutional differences in both the extensive and intensive margin of the transfer function across California's 108 community college campuses. Importantly, due to the richness of our dataset, we are able to adjust our estimates for a host of observed student differences, including scores on 11th grade math and English standardized tests.
- Stratification within community colleges
  - Results show there is significant variation in community college quality for both the probability of transfer as well as outcomes measuring how well students perform after transferring. Additionally, we examine whether any observable characteristics of the community college are significantly correlated with transfer productivity.

- **Carrell and Kurlaender (2016)**
  - Research background
    - Determinants of transfer success: individual level
      - individual characteristics: SES, high school preparation, gender and race （Gross and Goldhaber 2009; Dougherty and Kienzl, 2006; Adelman, 2006; Lee and Frank, 1990; Dougherty, 1987, 1994; Whitaker and Pascarella 1994; Grubb 1991)
      - Motivation for transfer (Horn, 2009; Bradburn and Hurst 2001)
      - demands for remedial education (Bettinger and Long 2009)
      - college attendance pattern (Doyle 2009; Roksa and Calcagno 2010)

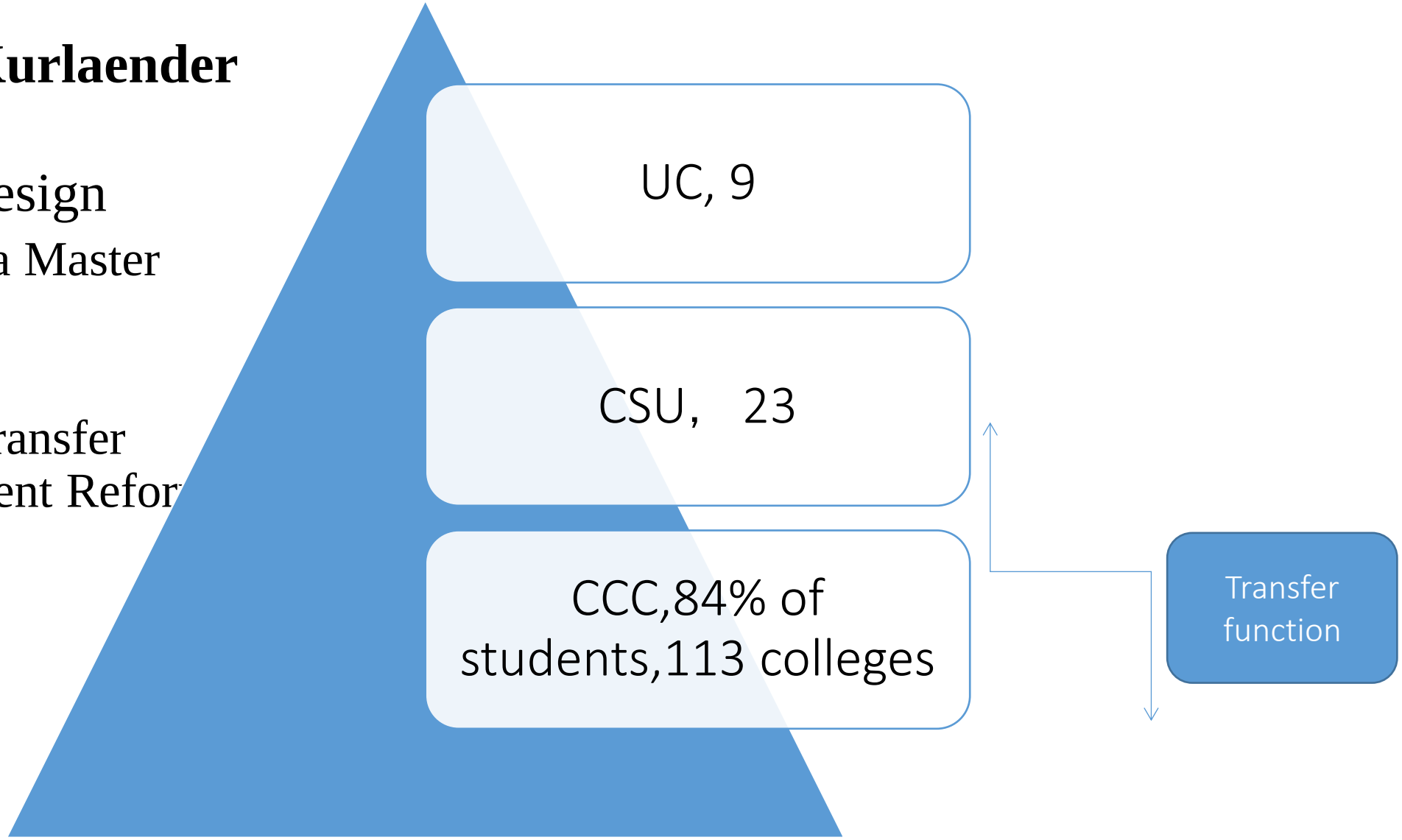
Carrell and Kurlaender (2016)

Research background

- Earlier studies find universities differ in terms of transfer success rate
  - After adjusting for differences in student inputs, our lower bound estimates show that going from the 10th to 90th percentile of campus quality is associated with a 3.32 (34.3 percent) increase in student transfer units earned, a 0.07 (9.6 percent) increase in the probability of persisting to year two at the community college, a 0.09 (40.7 percent) increase in the probability of transferring to a our-year college, and a 0.08 (27.1 percent) increase in the probability of completion of a two-year degree (Kurlaender, Carrell, and Jackson 2016)

- Some studies find no significant effect of institution quality
  - Clotfelter and colleagues (2013) explored variation in success measures across North Carolina's 58 community colleges, and find that conditional on student differences, colleges were largely indistinguishable from one another in degree receipt or transfer coursework, save for the differences between the very top and very bottom performing colleges (Clotfelter, Ladd, Muschkin, and Vigdor 2013).

- **Carrell and Kurlaender (2016)**
  - Research design
    - California Master Plan
    - Student Transfer Achievement Refor Act



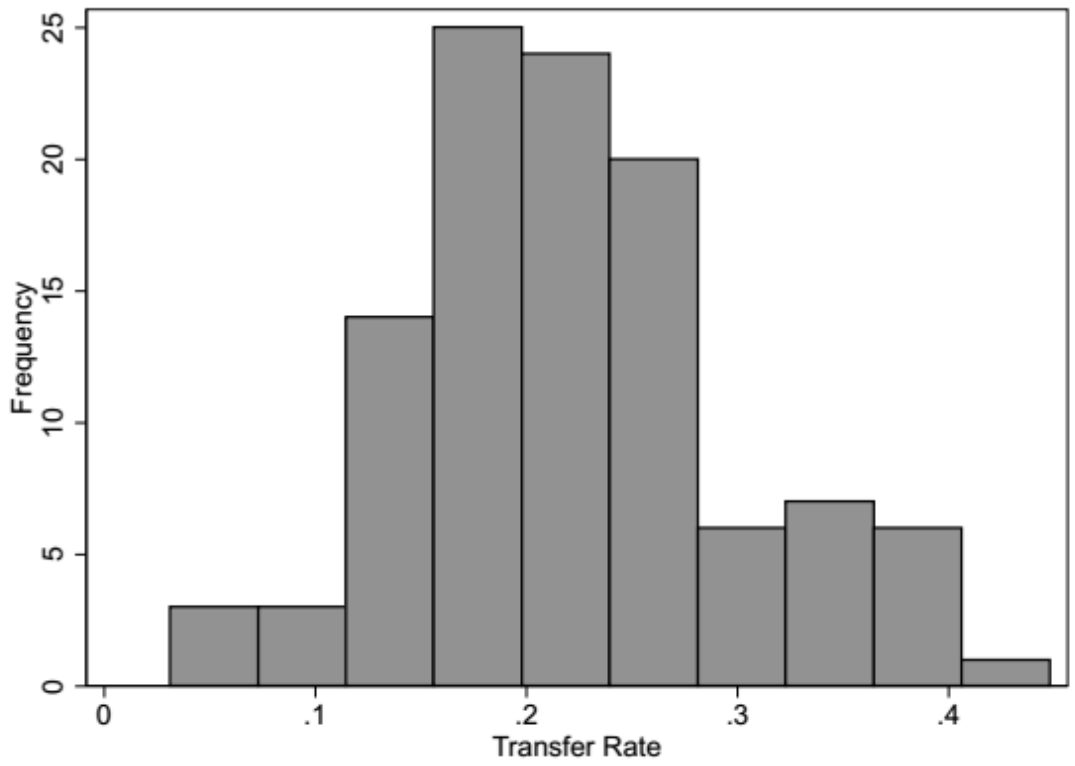
- **Carrell and Kurlaender (2016)**
  - Research design
    - Data
      - California Community College Chancellor’s Office,
      - the California State University Chancellor’s Office,
      - and the California Department of Education

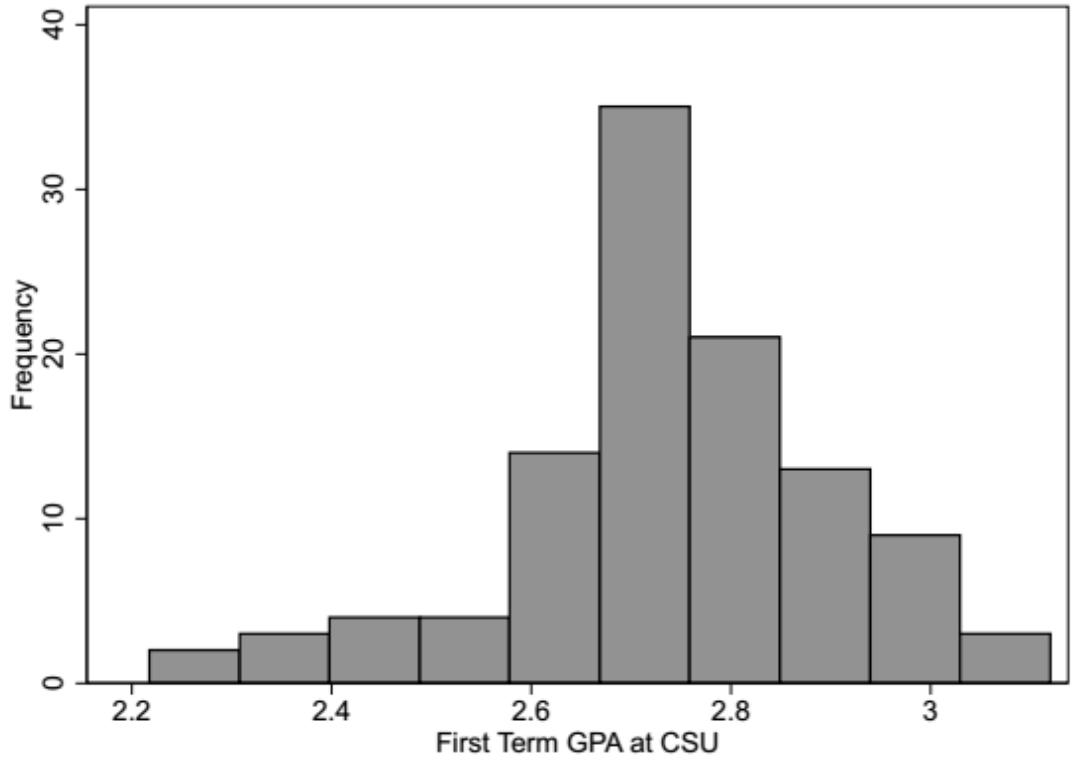
- **Carrell and Kurlaender (2016)**
  - Research design
    - Data process
      - Extensive Margin
        - We linked all transcript and completion data for four first time freshmen fall-semester cohorts (2004-2008) age 17-19, enrolled at a California community college with the census of California 11th grade students with standardized test score data
        - We restrict the sample for our study to first time freshman at the community college, of traditional age.
        - This sample contains 389,187 students across 108 California community college campuses.
      - Intensive margin
        - we linked transcript level records of four cohorts (2005-2008) of California State University students who had we linked transcript level records of four cohorts (2005-2008) of California State University students who had

- **Carrell and Kurlaender (2016)**
  - Research design
    - Deal with student's self-selection issue
      - Control variables
        - 11^{th} grade math and English standardized test scores
        - academic challenge for 11^{th} grade math
        - gender, race and parental income
        - selectivity of high school (API index)
        - Student goal for attending community college
        - college-level characteristics: 11^{th} grade average English and math score, race, gender, parental income, API, goals

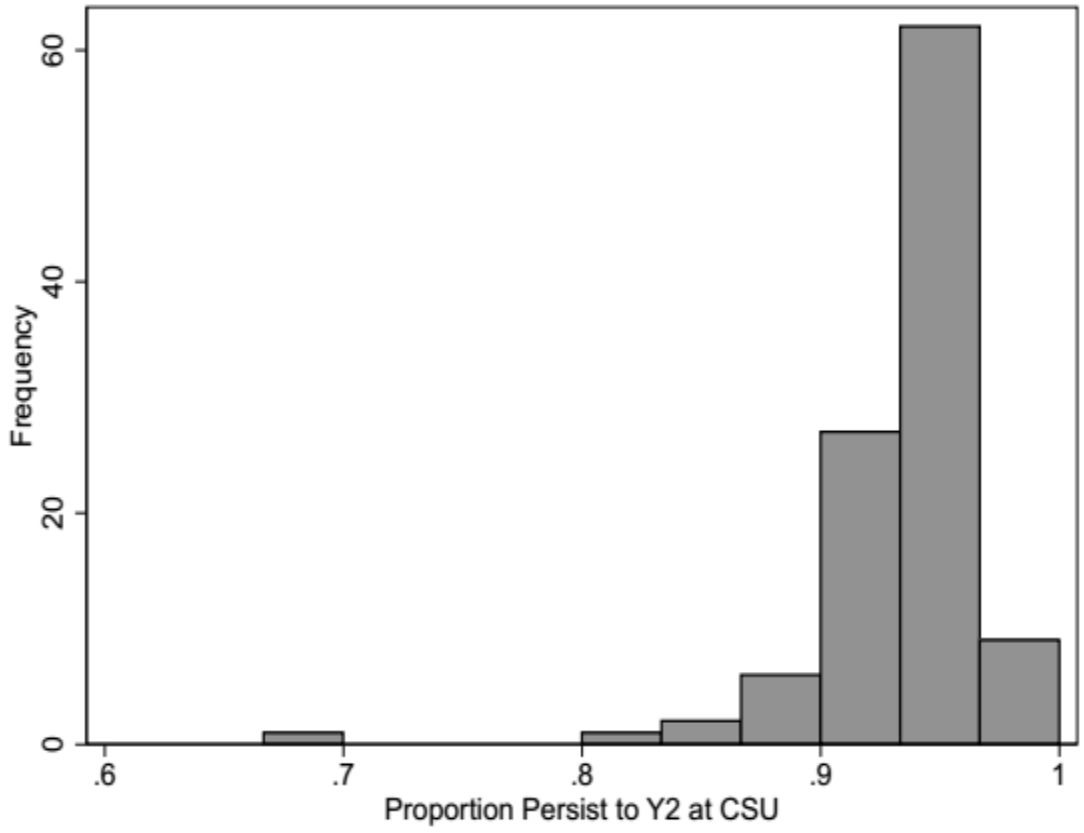
- **Carrell and Kurlaender (2016)**
  - Empirical findings
    - large difference in institutional transfer rate and GPA after transfer

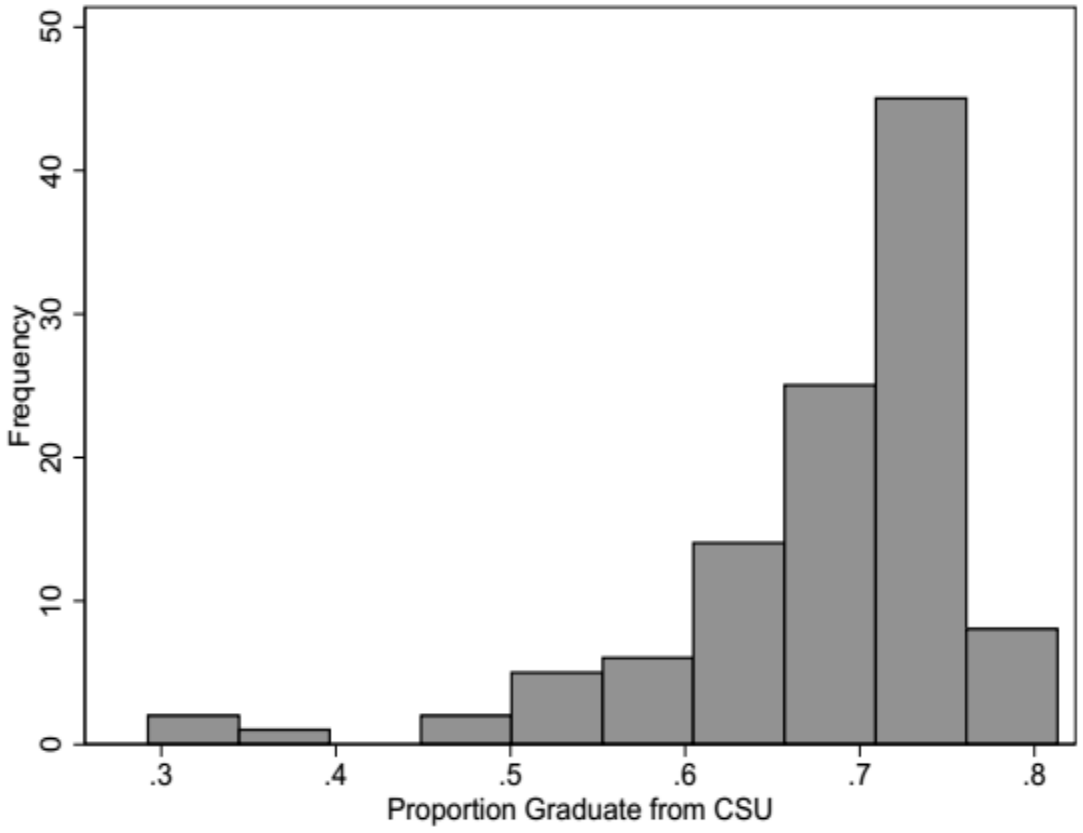
Figure 1. Distribution of Outcomes by Community College





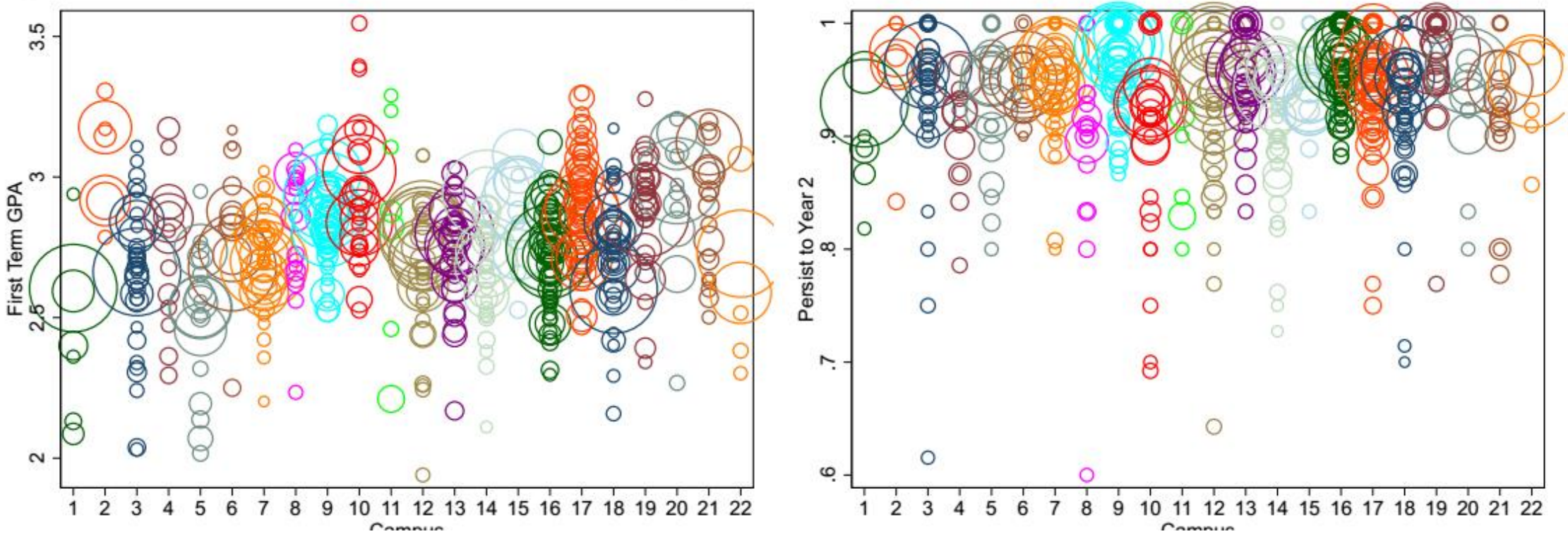
- **Carrell and Kurlaender (2016)**
  - large difference in institutional persistence rate and graduation rate



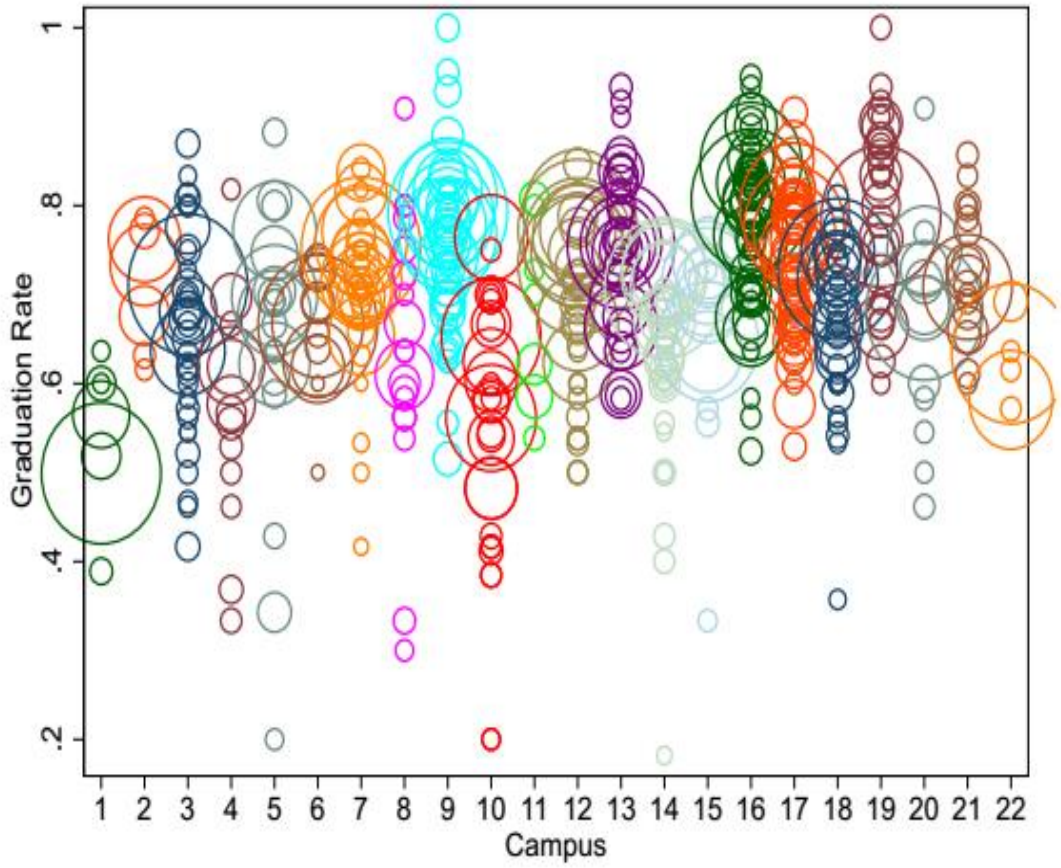


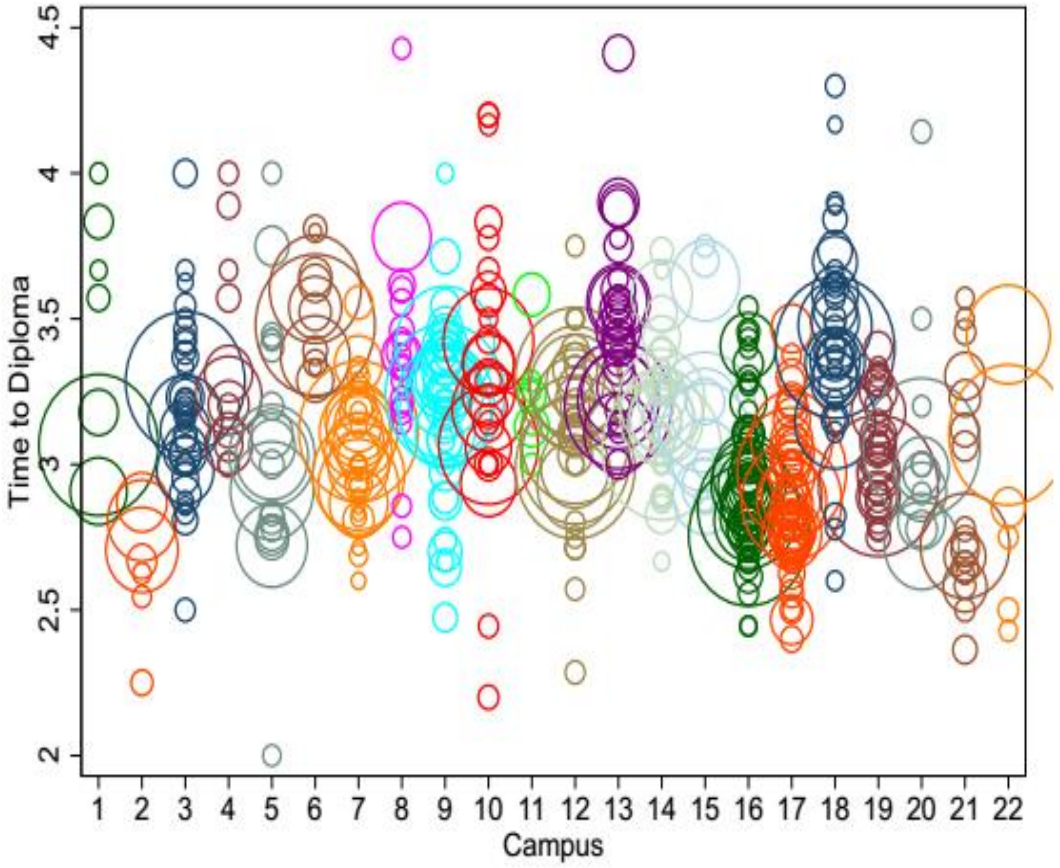
- **Carrell and Kurlaender (2016)**
  - Each community college perform differently in each CSU

Figure 2. Distribution of Outcomes by Community College and CSU



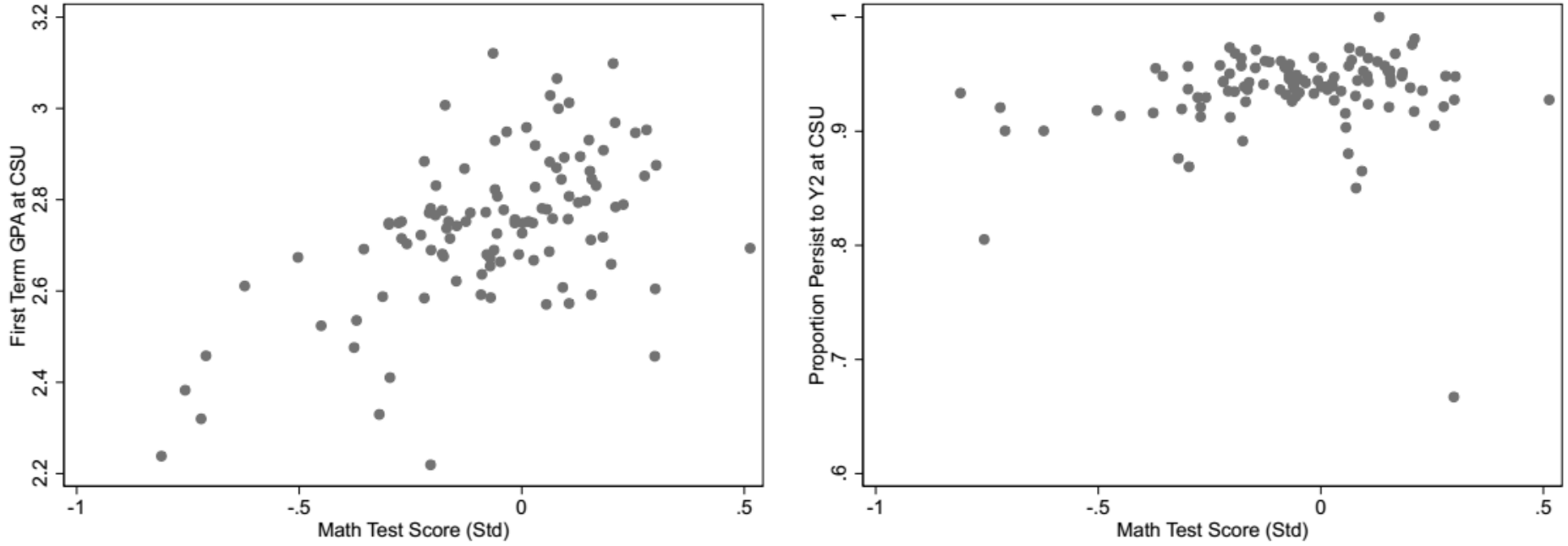
- **Carrell and Kurlaender (2016)**
  - Each community college perform differently in each CSU





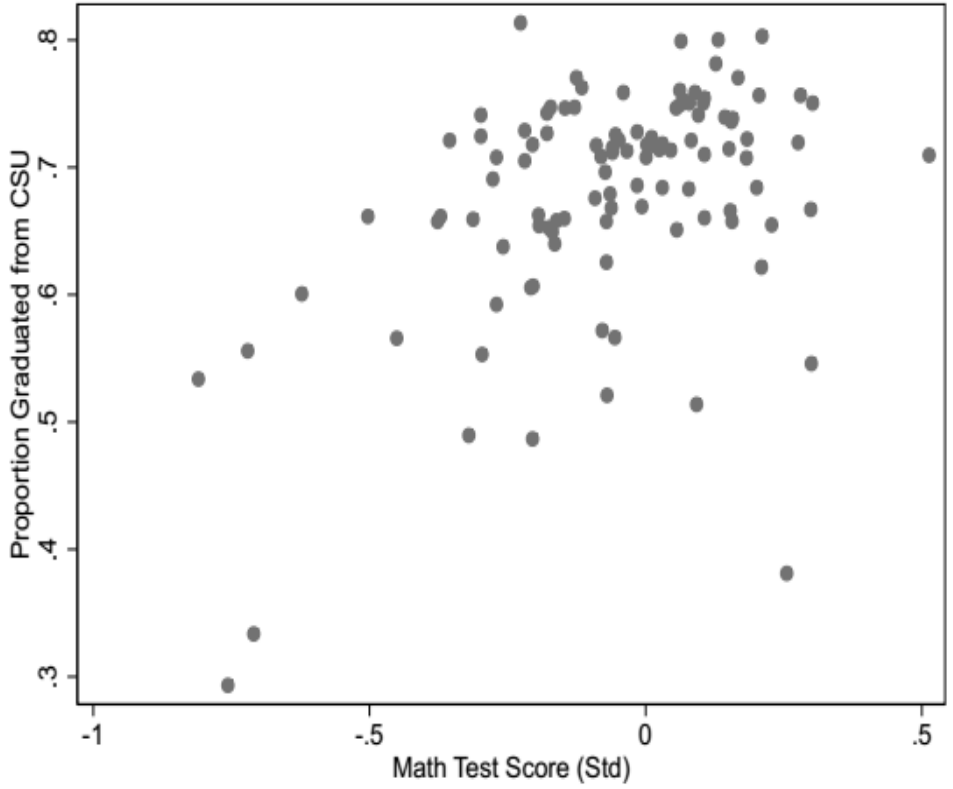
- **Carrell and Kurlaender (2016)**
  - Positive association between 11th grade score and first-year GPA at CSU and persistence to 2nd year in CSU

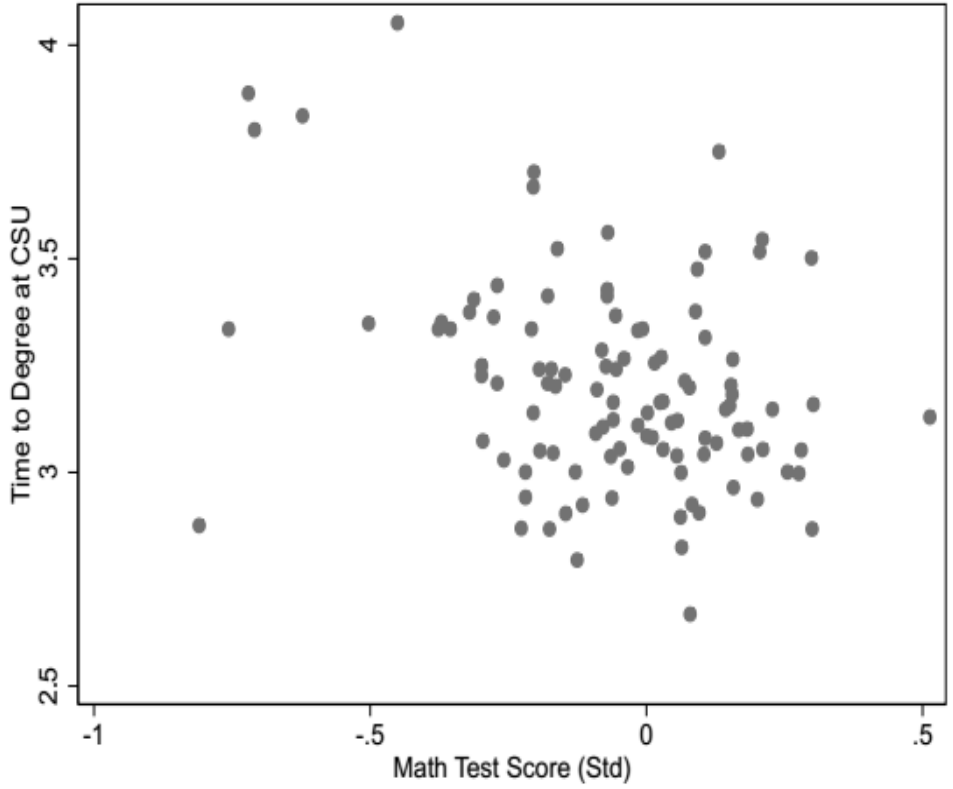
Figure 3. Scatterplot of Average CSU Outcomes against Students'11th Grade Math Test Scores



Carrell and Kurlaender (2016)

- Positive association between 11th grade score and proportion graduation from CSU and time to degree at CSU





☐ **Regression analysis:** extensive margin (transfer rate)

start by estimating the following linear random effects model as in Kurlaender, Carrell, and Jackson (2016):

$$Y_{iscty} = \beta_0 + \beta_1 x_i + \beta_2 \bar{x}_{cy} + \beta_3 w_s + \lambda_t + \phi_y + \zeta_c + \varepsilon_{iscty} \qquad (1)$$

where Y_{iscty} is our outcome variables of interest (transfer to any four-year institutions, transfer to a CSU, or transfer to a UC) for individual *i*, from high school *s*, who is a first-time freshman enrolled at community college *c*, in term *t* in year *y*; x_i is a vector of individual-level characteristics (race/ethnicity, gender, parental education, and eleventh grade math and English language arts test scores), $\bar{x}_{cy}$ are community college by cohort means of x_i, and w_s is a measure of the quality of the high school attended (California's API score)[9] for each individual; and ε_{iscty} is the individual-level error term.

☐ **Regression analysis:** extensive margin (transfer rate)

$$Y_{iscty} = \beta_0 + \beta_1 x_i + \beta_2 \bar{x}_{cy} + \beta_3 w_s + \lambda_t + \phi_y + \zeta_c + \varepsilon_{iscty} \qquad (1)$$

The main parameter of interest is the community college random effect, ζ_c.[10] We estimate $\widehat{\zeta_c}$ using an empirical Bayes shrinkage estimator to adjust for reliability. The empirical Bayes estimates are best linear unbiased predictors (BLUPs) of each community college's value added, which takes into account the variance (signal to noise) and the number of observations (students) at each college campus. Estimates of ζ_c with a higher variance and a fewer number of observations are shrunk towards zero (Rabe-Hesketh and Skrondal 2008).

☐**Regression:** intensive margin(GPA, persistence, graduation)

$$Y_{isctyu} = \beta_0 + \beta_1 x_i + \beta_2 \bar{x}_{cy} + \beta_3 w_s + \lambda_t + \phi_y + \zeta_c + \sigma_u + \varepsilon_{isctyu} \qquad (2)$$

where Y_{isctyu} are the post-transfer outcome variables of interest (first term GPA, persistence, graduation, and time to degree) for individual i, from high school s, who is a first-time freshman enrolled at community college c, in term t in year y at CSU campus u. All other variables in the model are the same as in equation (2) and σ_u are CSU campus fixed effects. Importantly, the CSU fixed effects controls for all unobserved (fixed)

☐ Carrell and Kurlaender (2016)

Table 5. College Random Effects Regressed on Observable Characteristics

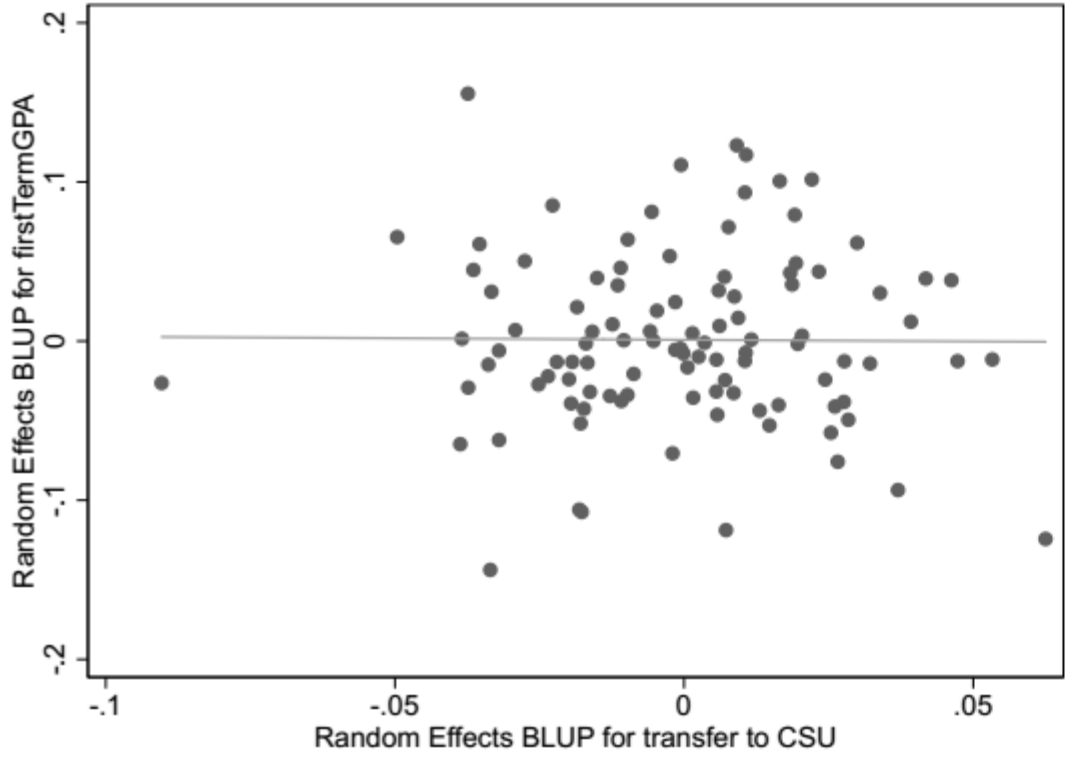
Specification	(1)	(2)	(3)	(4)	(5)	(6)	(6)
Variable	Transfer Ever	Transfer to CSU	First Term GPA	Persist to Year Two	Graduate with BA	TTD <=2 Years	TTD <=3 Years
Tenured to Adjunct Faculty Ratio	-0.707	0.749	2.237	0.068	0.359	0.359	0.640
	(1.066)	(0.721)	(1.494)	(0.147)	(0.524)	(0.602)	(0.452)
Female to Male Faculty Ratio	-0.553	0.106	3.806	0.373	0.618	1.563	0.935
	(2.049)	(1.386)	(2.872)	(0.283)	(1.006)	(1.157)	(0.869)
Faculty to Student Ratio	-0.024	-0.014	0.030	0.002	-0.005	0.006	-0.008
	(0.019)	(0.013)	(0.027)	(0.003)	(0.009)	(0.011)	(0.008)
Support Staff to Student Ratio	0.289	0.066	0.067	-0.014	-0.013	-0.109	0.063
	(0.184)	(0.125)	(0.258)	(0.025)	(0.091)	(0.104)	(0.078)
Average Faculty Years of Experience at the College	-0.354	-0.089	-0.637	0.066	-0.180	-0.145	-0.106
	(0.519)	(0.351)	(0.727)	(0.072)	(0.255)	(0.293)	(0.220)
Distance to the nearest CSU (miles)	0.011	-0.014	0.023	0.000	-0.018**	0.006	0.007
	(0.018)	(0.012)	(0.025)	(0.002)	(0.009)	(0.010)	(0.008)
Student Population (1,000's)	0.158*	0.028	0.404***	0.024**	0.082**	0.066	0.053
	(0.080)	(0.054)	(0.113)	(0.011)	(0.040)	(0.045)	(0.034)
Fraction Vocational Education Degrees/Certificates	-0.089***	-0.023	-0.042	0.009**	-0.006	-0.003	-0.018
	(0.030)	(0.020)	(0.042)	(0.004)	(0.015)	(0.017)	(0.013)
# of Community Colleges	102	102	102	102	102	102	102
R-squared	0.164	0.058	0.162	0.155	0.164	0.06	0.096

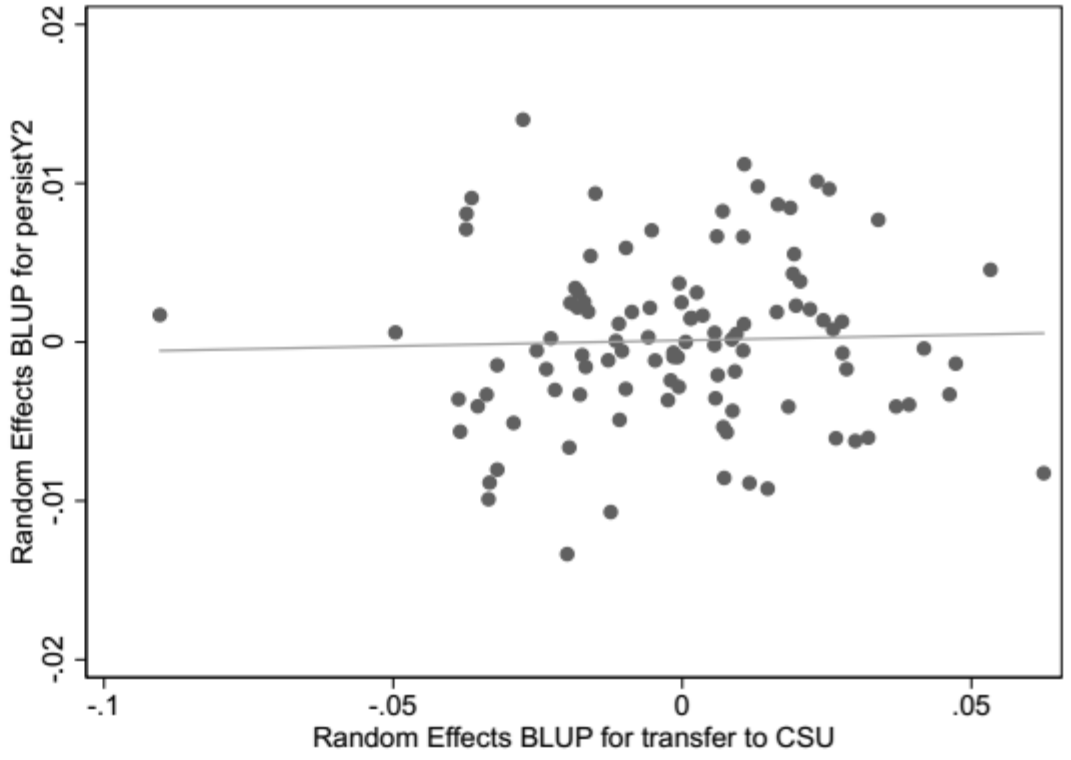
Notes: Each column represents a separate regression where the indicated community college random effects are regressed on observable characteristics of the community college. Random effects estimates were divided by 100 prior to running the regressions. ***, **, and * represents .01, .05, and .10 levels

Carrell and Kurlaender (2016)

- Positive correlation between transfer rate and first-term GPA and persistence to year 2

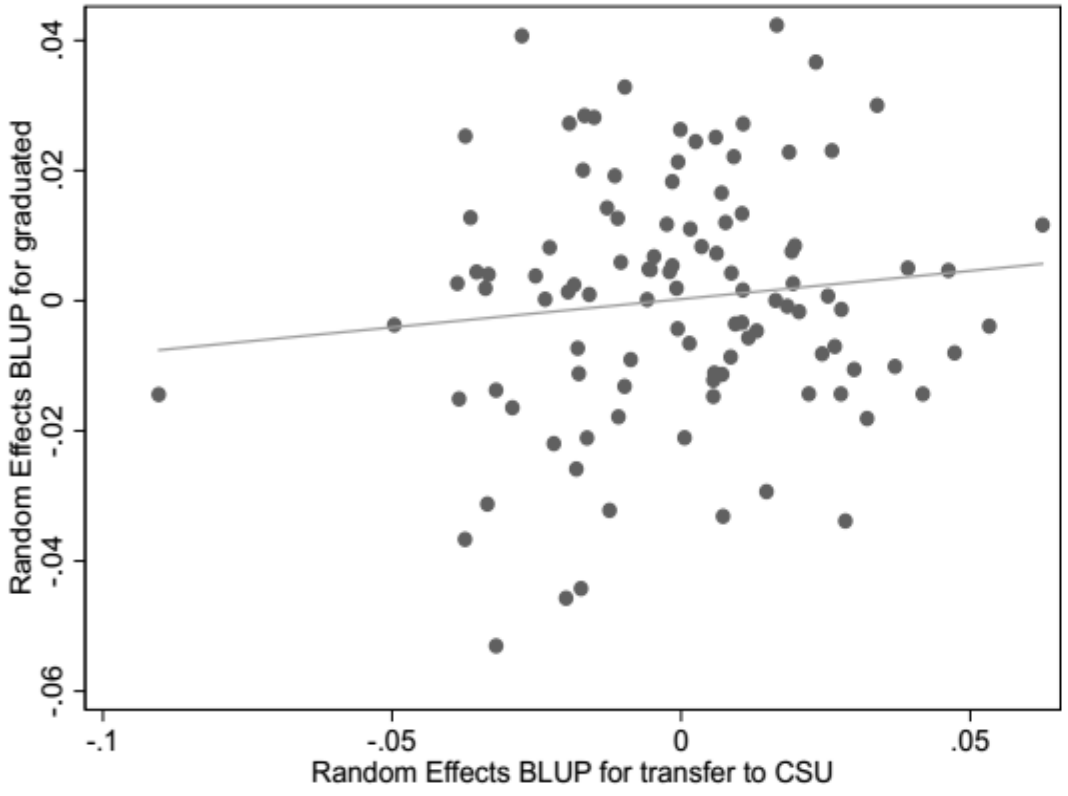
Figure 5. Intensive Transfer Margin versus Extensive Transfer Margin

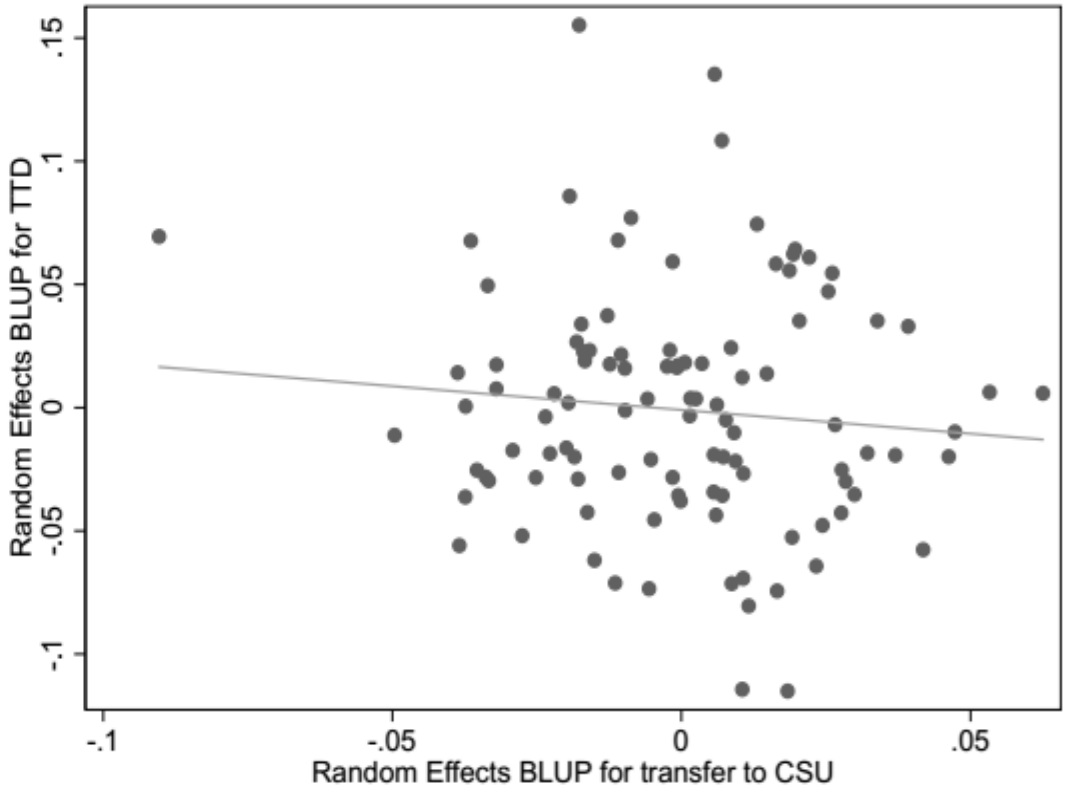




Carrell and Kurlaender (2016)

- Positive correlation between transfer rate and graduate rate and time to degree





- **Carrell and Kurlaender (2016)**
  - How can the results from this study inform our understanding of inter-institutional stratification?
  - Is the institutional difference in productivity in educational attainment more important than research output?

- Riehl, E. D. (2016). Learning and earning: an approximation to college value added in two dimensions. Social Science Electronic Publishing.

- Riehl **(2016)**
  - Abstract
    - Measuring higher education productivity in terms of learnings and earnings
      - This paper explores the implications of measuring college productivity in two different dimensions: earning and learning.
    - Data integration
      - We compute system-wide measures using administrative data from the country of Colombia that link social security records to students' performance on a national college graduation exam. In each case we can control for individuals' college entrance exam scores in an approach akin to teacher value added models.

- Riehl **(2016)**
  - Abstract
    - We present three main findings:
      - Colleges' earning and learning productivities are far from perfectly correlated, with private institutions receiving relatively higher rankings under earning measures than under learning measures;
      - Earnings measures are significantly more correlated with student socioeconomic status than learning measures;
      - In terms of rankings, earning measures tend to favor colleges with engineering and business majors, while colleges offering programs in the arts and sciences fare better under learning measures.

- Riehl **(2016)**
  - Research question
    - This is the first study to simultaneously analyze system-wide measures of the earnings and learning productivity of colleges.
  - Method
    - Our detailed administrative records provide the earnings of nearly all graduates in the country upon labor market entry. With these data we can control for a measure of ability—performance on a national standardized admission exam—and for characteristics related to students' socioeconomic backgrounds.
    - Further, the Colombian setting allows us to propose and implement measures of college productivity in the learning dimension, as all graduates are required to take a national college
      exit exam.
    - In measuring learning performance we can similarly control for individual characteristics and pre-college ability. In particular, some components of the college exit exam are also assessed in the entrance exam, enabling us to implement an approach akin to those commonly used in the teacher value added literature.
    - In short, our earning and learning measures may not fully isolate college value added, but they have advantages relative to measures previously used in the context of measuring college productivity

- Riehl **(2016)**
  - Research background
    - Access to higher education in Columbia

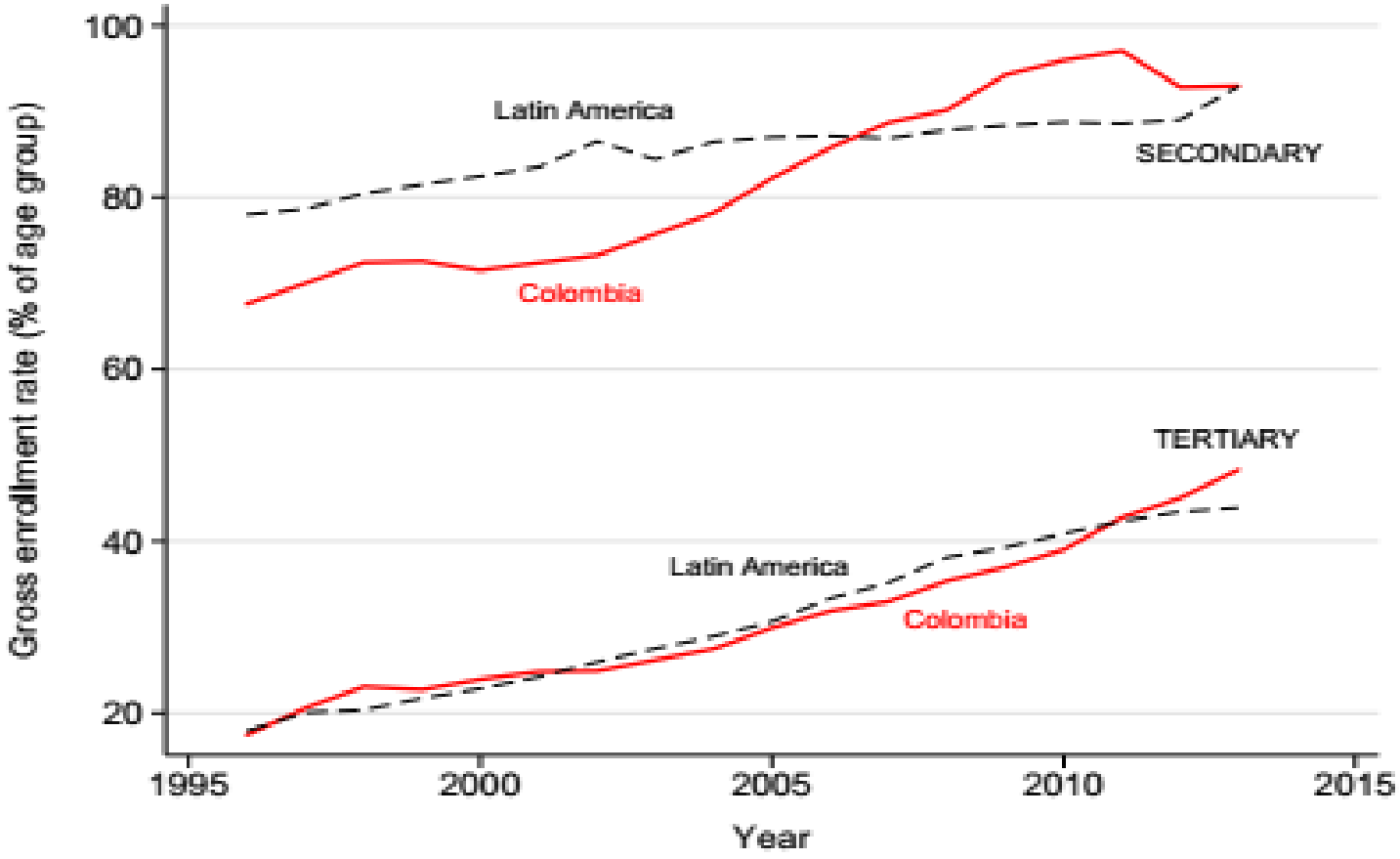


FIGURE 1. Enrollment trends in Colombia and Latin America

- Riehl **(2016)**
  - higher education system in Columbia
    - public and private universities

TABLE 1. Colombian higher education market structure

	Institutions			Enrollment		
	Public	Private	Total	Public	Private	Total
Universities	47	142	189	495,855	799,673	1,295,528
	0.17	0.53	0.70	0.25	0.40	0.65
Technical schools	15	65	80	524,007	163,886	687,893
	0.06	0.24	0.30	0.27	0.08	0.35
Total	62	207	269	659,142	601,744	1,983,421
	0.23	0.77	1.00	0.52	0.48	1.00

- Riehl **(2016)**
  - Data sources

(1) The Colombian Institute for Educational Evaluation, which administers the college entrance and exit exams, provided records for both tests. This includes scores for all high school seniors who took the entrance exam between 1998 and 2012, as well as college exit exam scores for all exam takers in 2004–2011.

(2) The Ministry of Education provided enrollment and graduation records for students entering college between 1998 and 2012. These include each individual's college, program of study, and enrollment and graduation dates. These data cover roughly 90 percent of all college enrollees; the Ministry omits a number of smaller colleges due to poor and inconsistent reporting.

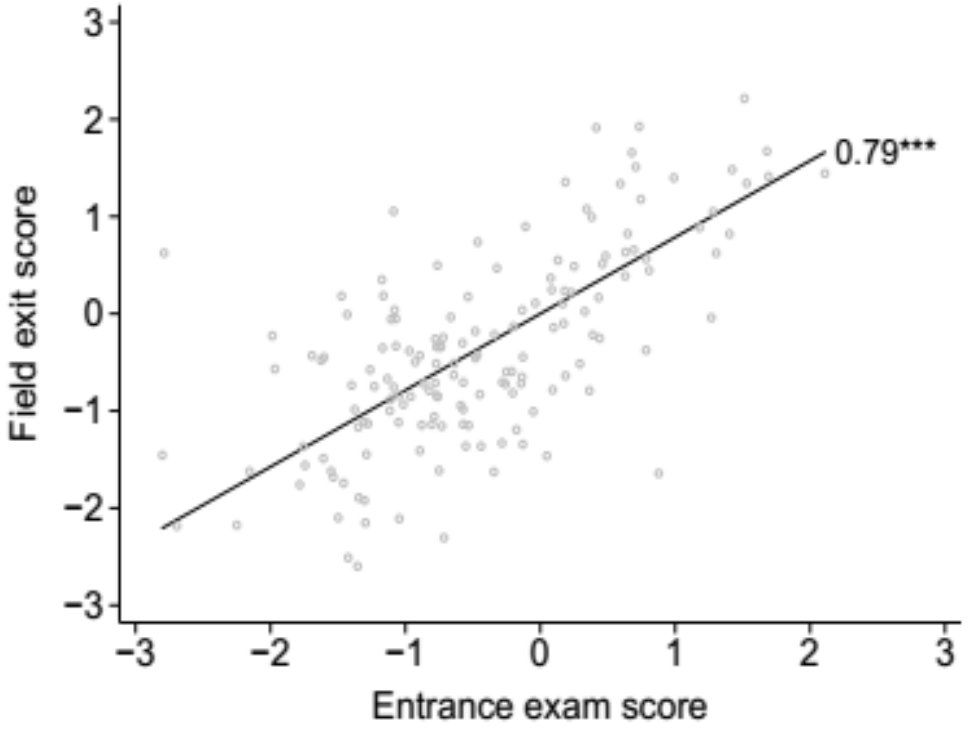
(3) The Ministry of Social Protection provided monthly earnings records for formal sector workers during 2008–2012. These come from data on contributions to pension and health insurance funds.

- Riehl **(2016)**
  - Six types of universities

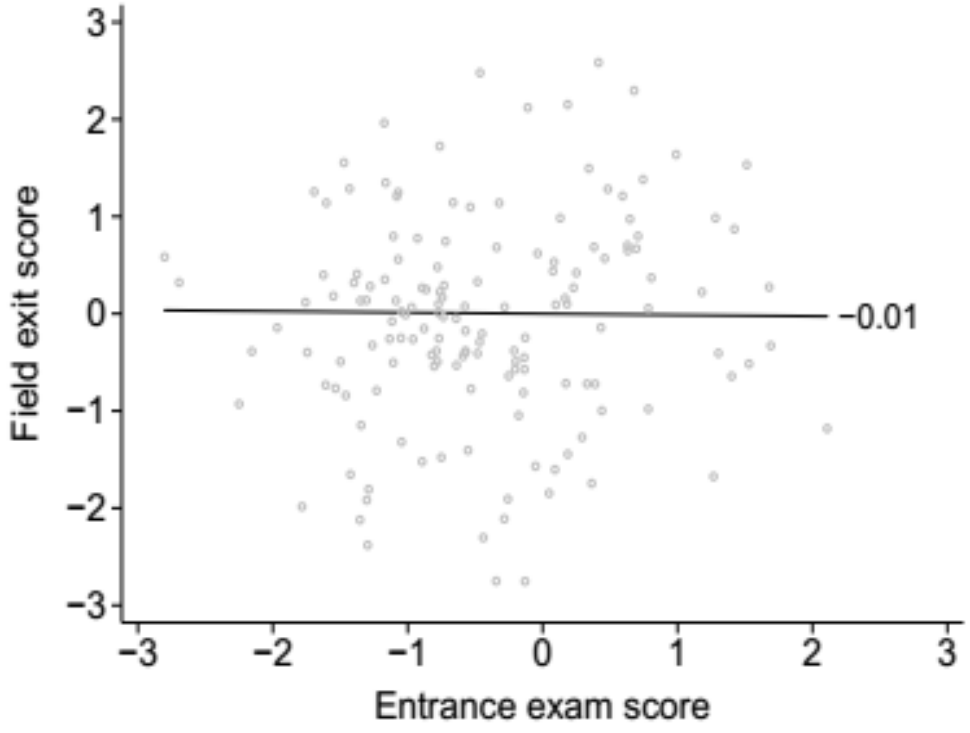
College type	No. of colleges	No. of grads	Admit rate	Annual tuition	Mother went to college	Entrance exam pctile
Public (most selective)	12	15,642	0.20	$369	0.42	0.82
Public (medium selective)	24	13,228	0.55	$509	0.29	0.67
Public (least selective)	12	6,063	0.87	$535	0.23	0.59
Top private	8	9,653	0.64	$2,584	0.90	0.90
Other private (high cost)	51	19,229	0.82	$1,696	0.59	0.72
Other private (low cost)	50	17,489	0.86	$1,079	0.31	0.63
Total	157	81,304	0.65	$1,134	0.46	0.72

- Riehl **(2016)**
  - Measurements
    - Earnings
      - Our earnings variable is log average daily formal labor market earnings, which we calculate by dividing base monthly earnings for pension contributions by the number of employment days in each month and averaging across the year
    - Learning outcomes
      - Our learning variables are based on students' scores on the college exit exam. During the exam years we analyze (2009–2011), this test included a field-specific component related to a student's major (e.g., economics or mechanical engineering) as well as several components taken by all students. We focus on three of these: i) the field-specific score, ii) a reading common component score, and iii) an English common component score.

- Riehl **(2016)**
  - Correlation between entrance exam score and field exit score

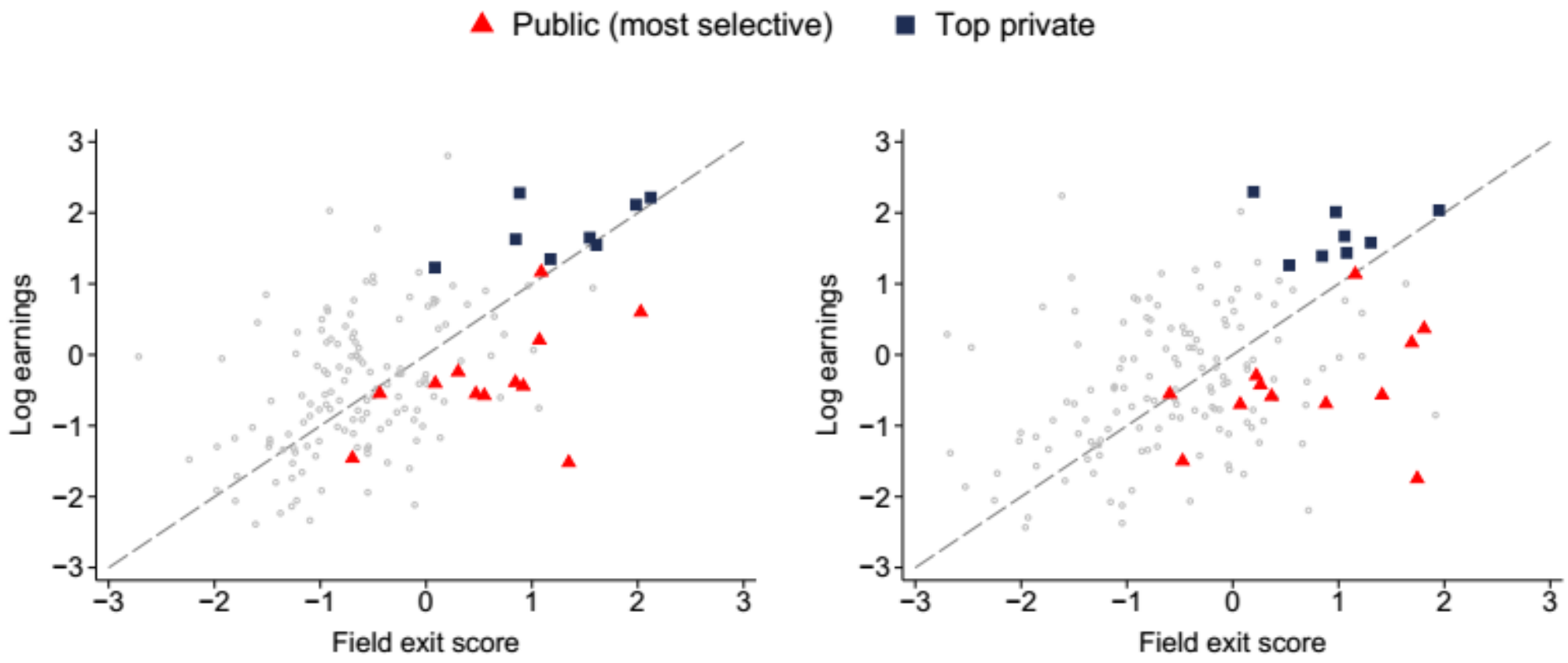


Panel C. Exam + SES residuals



Panel D. College-level residuals

- Riehl **(2016)**
  - Correlation between field exit scores and log earnings



Panel A. Raw scores

Panel B. Entrance exam residuals

- Riehl **(2016)**
  - Correlation between SES and earnings/field exit exam score

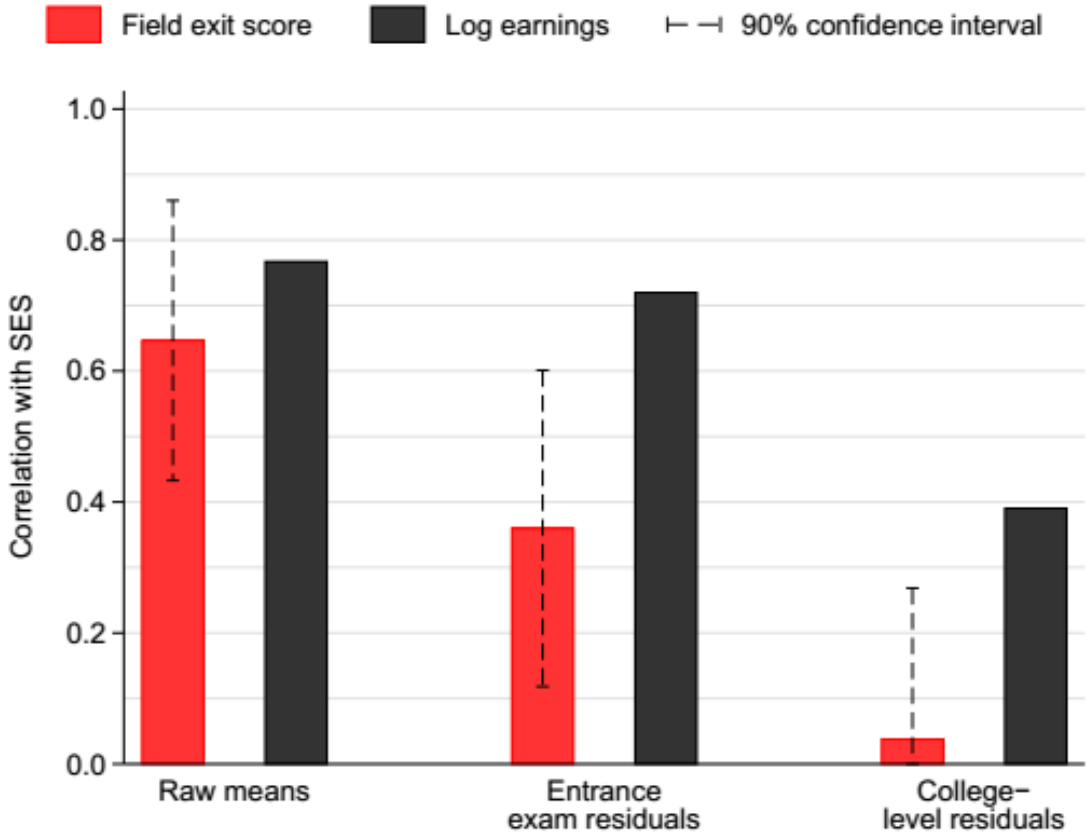


FIGURE 4. Correlations with SES

- Riehl **(2016)**
  - Major ranking by earnings and learning

TABLE 9. Average institution/major rank by major area

Major area	Prop. of grads	Panel A. Entrance exam residuals: Field exit score	Panel A. Entrance exam residuals: Log earnings	Panel B. College/major level residuals: Field exit score	Panel B. College/major level residuals: Log earnings
Business/economics	0.35	0.50	0.53	0.53	0.59
Engineering	0.29	0.51	0.60	0.45	0.59
Law	0.14	0.48	0.81	0.43	0.75
Social sciences	0.14	0.55	0.41	0.51	0.33
Health	0.07	0.52	0.66	0.54	0.68
Education	0.06	0.55	0.27	0.57	0.36
Fine arts	0.05	0.50	0.46	0.41	0.27
Agronomy	0.02	0.52	0.35	0.47	0.37
Natural sciences	0.02	0.75	0.62	0.55	0.50

- Riehl **(2016)**
  - Major ranking by earnings and learning

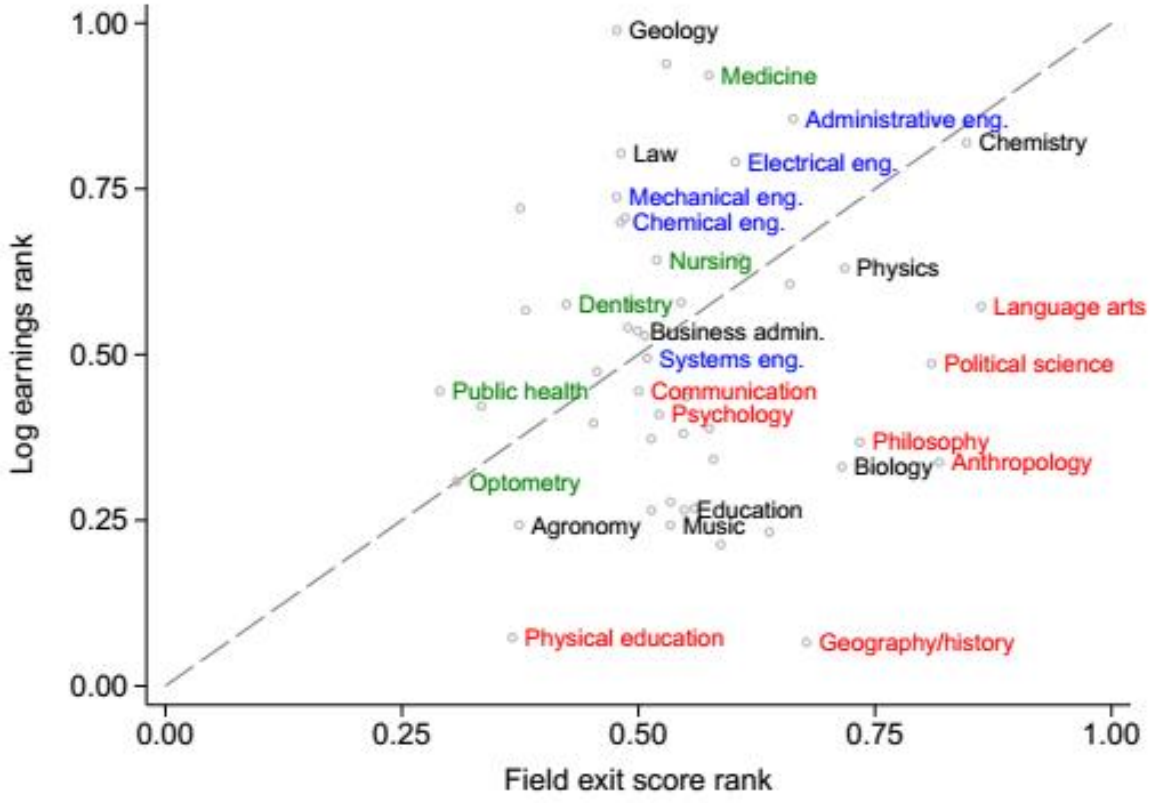


FIGURE 6. Earning vs. field-specific learning ranks by major group