

College Quality, Finance, and Inequality

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“Higher Education and Social Inequality”

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Outline

- Landscape for higher education stratification research
- Theoretical approaches
- Research agenda for institutional stratification study

Warm-up activity

- Recommend a university in your country, which is not high on global ranking, but you believe it is unique and interesting. Please give us three reasons for your recommendation**

Landscape for higher education stratification research

Research program

- Lakatos: (in Popper's tradition)
 - Advocate "Research programme"
 - Accumulation of knowledge through inter-related research activities
- "Theoretical research program"
 - A particular, theoretical approach
 - Specific theories and hypotheses
 - empirical tests and cumulative evidence
 - further refinement/revision/expansion

Research program

- Academic research is not isolated, but occurs in academic community
- Relations between academic researches
- Different contribution to academia
 - To better understand and appreciate academic research
 - To better position one's own work
- E.g. Research programs in organization research
 - Institutional, population ecology, social network, resource-based approach, etc.

Research program

- Different types of research works
 - Ground-breaking research
 - Theoretical advancement or fine-tuning existing ones
 - Methodological contribution
 - Confirmation and accumulation of empirical evidence
 - Application or extension of theory in other fields
 - Interaction with other theories: competition, merge or variation

Research program: Neo-institutionalism theory

Ground-breaking work: Meyer & Rowan (1977)

Theoretical advancement: DiMaggio & Powell (1983)

Methodological improvement: Tolbert & Zucker (1983)

Empirical works

Accumulation of evidence

Extension of research topics

Dialogue with other theories

Edelman (1990)

Dobbin & Sutton (1993, 1998)

.....

Strang (1990)

Fligstein (1985)

Zhou (1993b)

Carroll & Hannan (1989)

Han (1993)

Zhou (1993a)

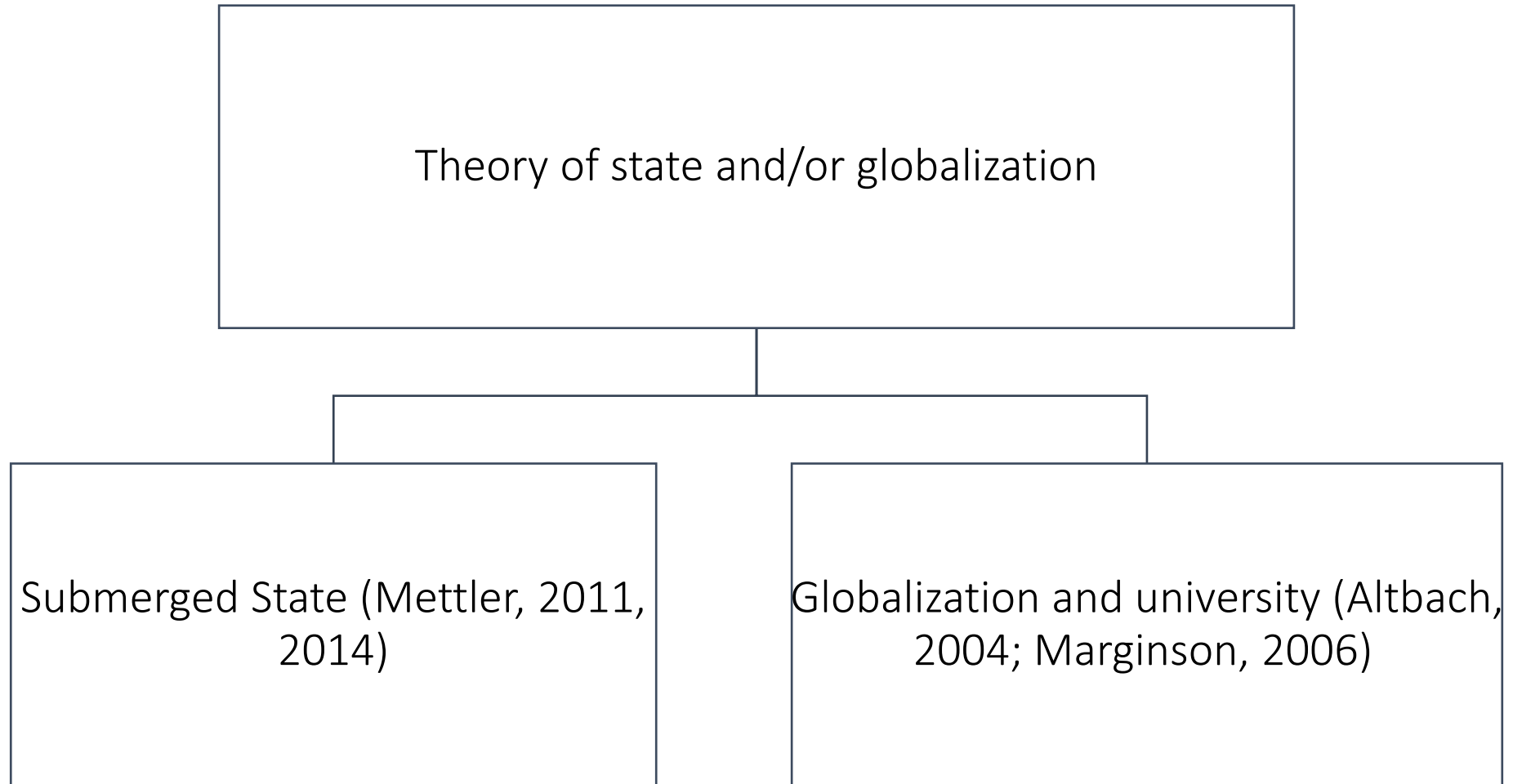
Further development (concept, operationalization, new applications)

Haunschild & Miner (1997)

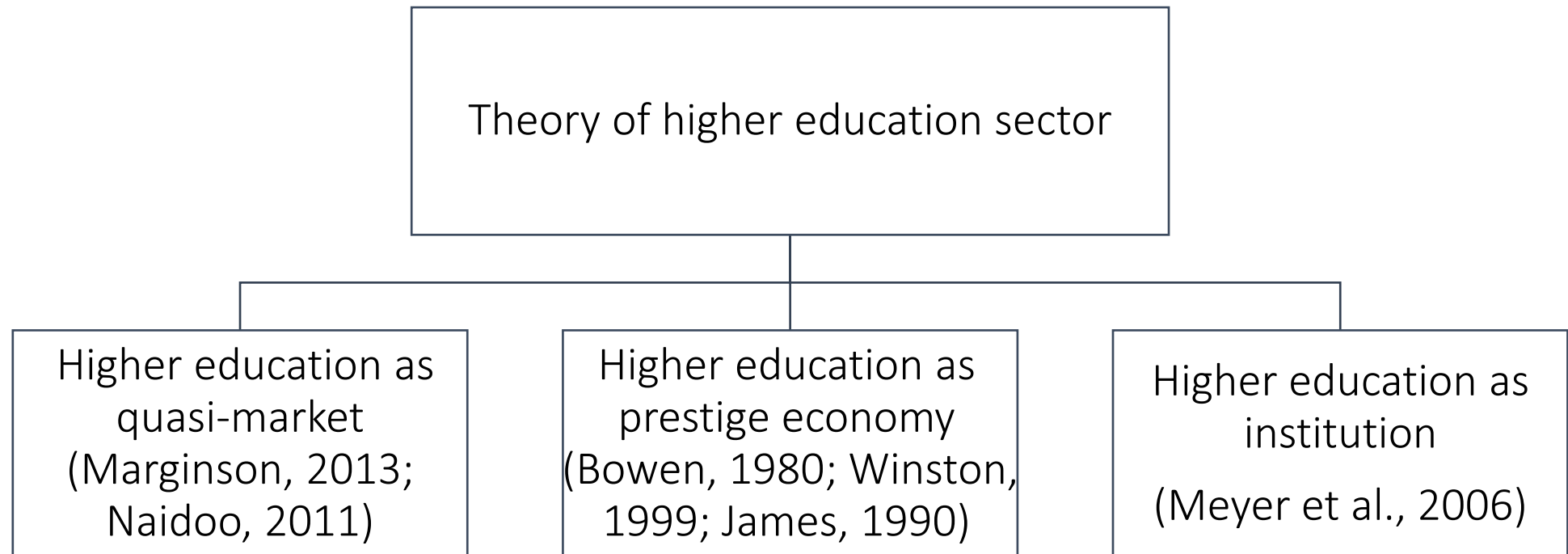
Landscape for stratification research

- “an intellectual tour”:
 - Focus on “forest”/landscape – research program, connections among studies and accumulation of knowledge
 - Not “trees” – individual studies, or specific methods/results
- Landscape for stratification research
 - Theory of state and/or globalization
 - Theory of higher education sector
 - Theory of institution stratification and organization segmentation

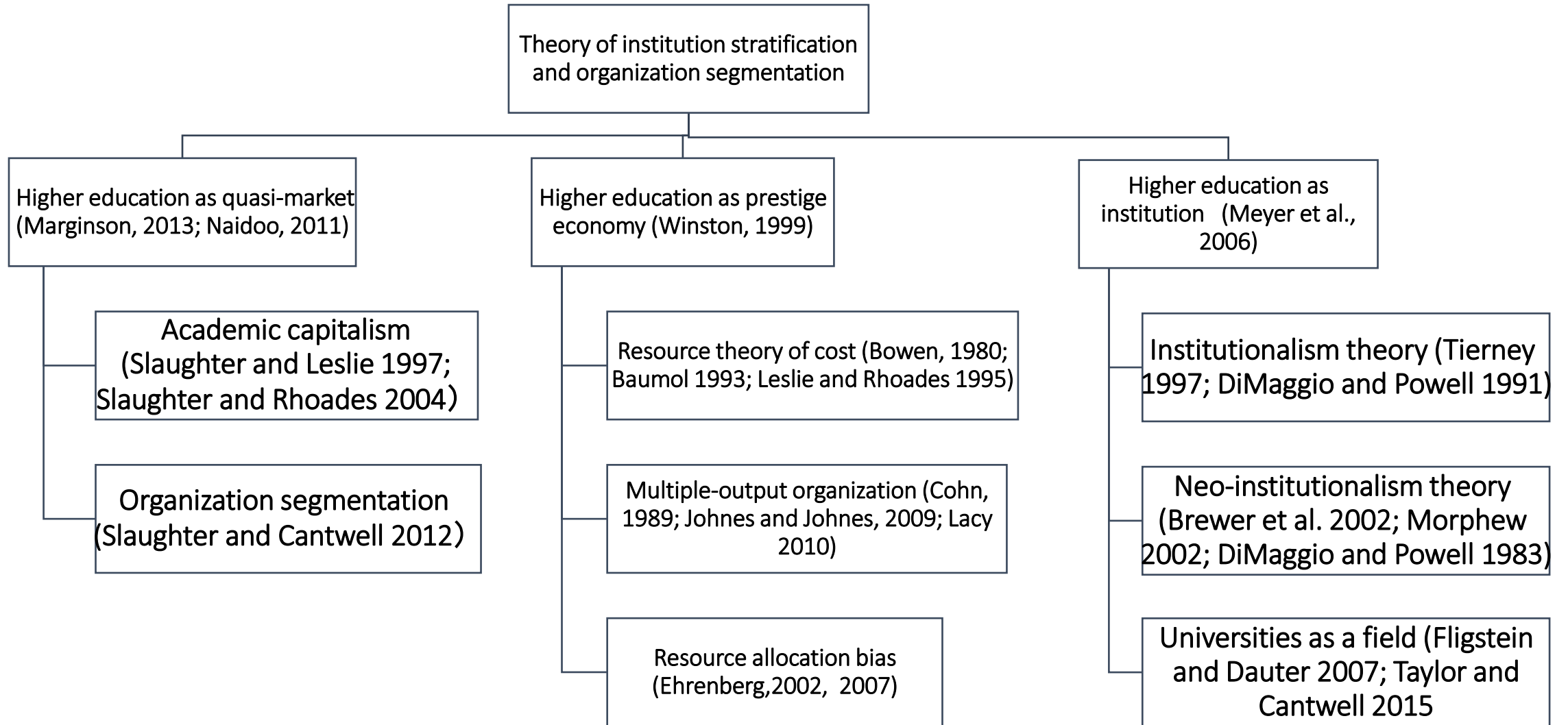
Landscape for stratification research



Landscape for stratification research

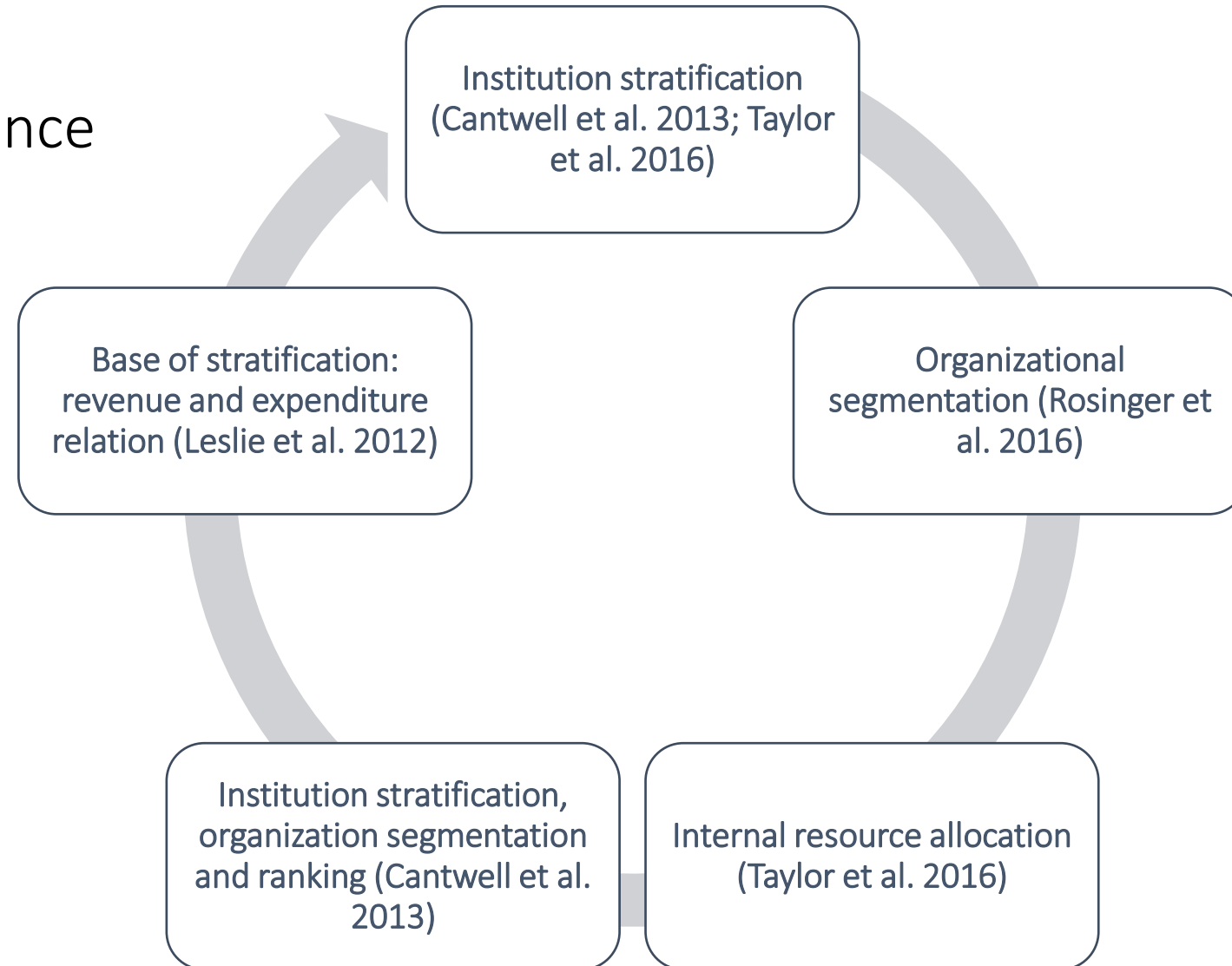


Landscape for stratification research



Landscape for stratification research

- Empirical evidence



Theoretical approaches

Q1: Where is the competition coming from?

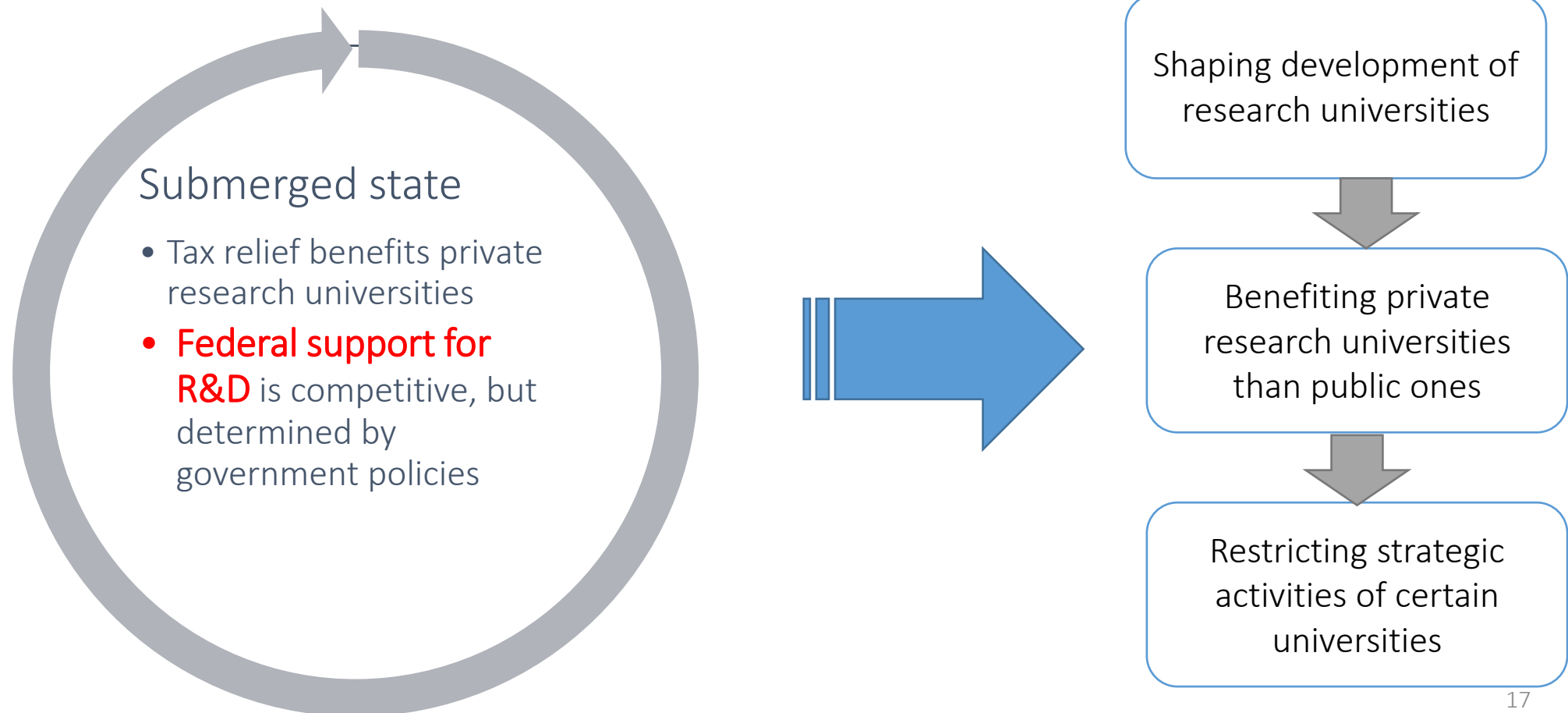
Submerged state and use of quasi-market approach

- Resource allocation through market-like mechanism (Taylor et al. 2016)

Suzanne Mettler (2011) terms the web of policies that utilize market-like mechanisms “the submerged state.” This mode of government channels wealth upward to already-advantaged individuals, households, and organizations. However, because the submerged state operates via incentives, subsidies, and competition, this upward redistribution seems to result from economic processes rather than from policies. Policies, in other words, cloak themselves behind a veil of market-like allocation that denies their very status as policies. The submerged state thereby “disguises or subverts government’s role, making the real actors appear to be those in the market or private sector” (p. 9).

Submerged state and use of quasi-market approach

- Resource allocation through **market-like mechanism** (Taylor et al. 2016)



Research university as an organizational field

(Taylor et al. 2016)

- Fligsten and Dauter(2007): a field consists of organizations that face common opportunities and constraints
 - Field members share understanding of how resources are allocated and who possess status within the field
 - Field members tend to accept the de facto reality of stratification
- Taylor and Cantwell (2015): research universities in US as a field
 - Espouse to similar missions and compete for similar resources such as students, faculty, and revenue
 - Encompass multiple missions, practice cross-subsidization
 - Field hierarchy reflect resources gleaned through research enterprise
 - External research support confers both status and revenue → **competition** promotes a university's excellence and provides funds

Research university as an organizational field

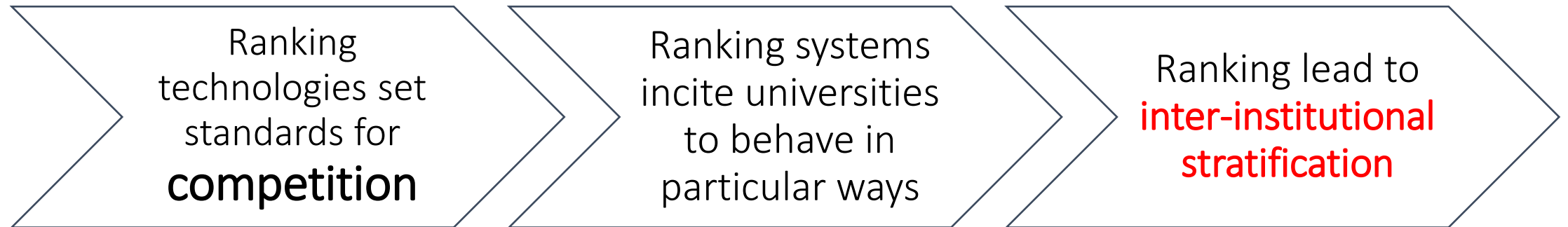
(Leslie et al. 2012)

- Neo-institutional theory: research universities constitute an organizational field
 - The standard practices of the field influence the behaviors of individual organizations → leading to isomorphism or similarity (DiMaggio and Powell 1983)
 - Research university will spend increasing amount of money on prestige generating activities such as research
 - Pursuit of prestige from research implies engagement in research **competition** nationally or globally

Global ranking as disciplinary technology

(Cantwell et al. 2013)

- Foucault (1990,1984,1979): governance technology both regulates and produces behavior
 - Technology that assess GRU status also evaluate and shape the behavior of the organizations they serve
 - Global ranking plays the role of disciplinary technology → ranking systems as mechanisms to evaluate and regulate universities



Global ranking as disciplinary technology

(Cantwell et al. 2013)

- Foucault (1990,1984,1979): governance technology leads to organizational segmentation

Evaluation technology focuses on research output (ARWU)

Ranking confer status to most research productive institutions

Research productivity offers both status and reputation → S&E are valued

Encouraging universities to advantage S&E as pursuit of status

Q2: How does institutional hierarchy occur in prestige economy?

Organizational perspective

- Two perspectives
 - Organizational theory perspective: prestige is based on research output, global ranking evaluates and shape institution hierarchy



Academic capitalism brings stratification

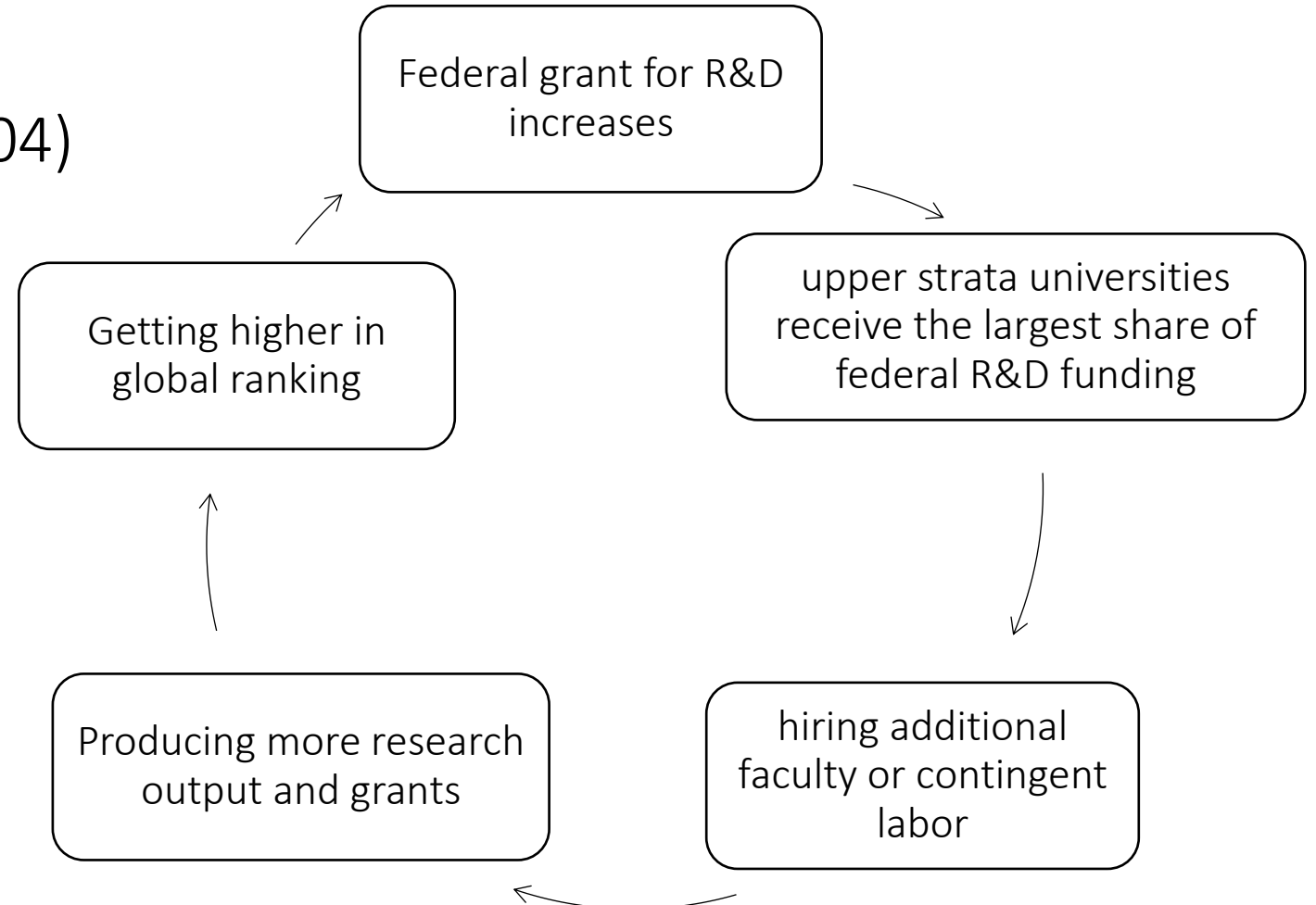
(Cantwell et al. 2013)

- 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

Academic capitalism brings stratification

(Cantwell et al. 2013)

- Slaughter and Leslie (1997)
- Slaughter and Rhoades (2004)



Economic perspective

- Two perspectives

- Economic perspective: prestige is based on peer quality and institution wealth



Economics of higher education hierarchy

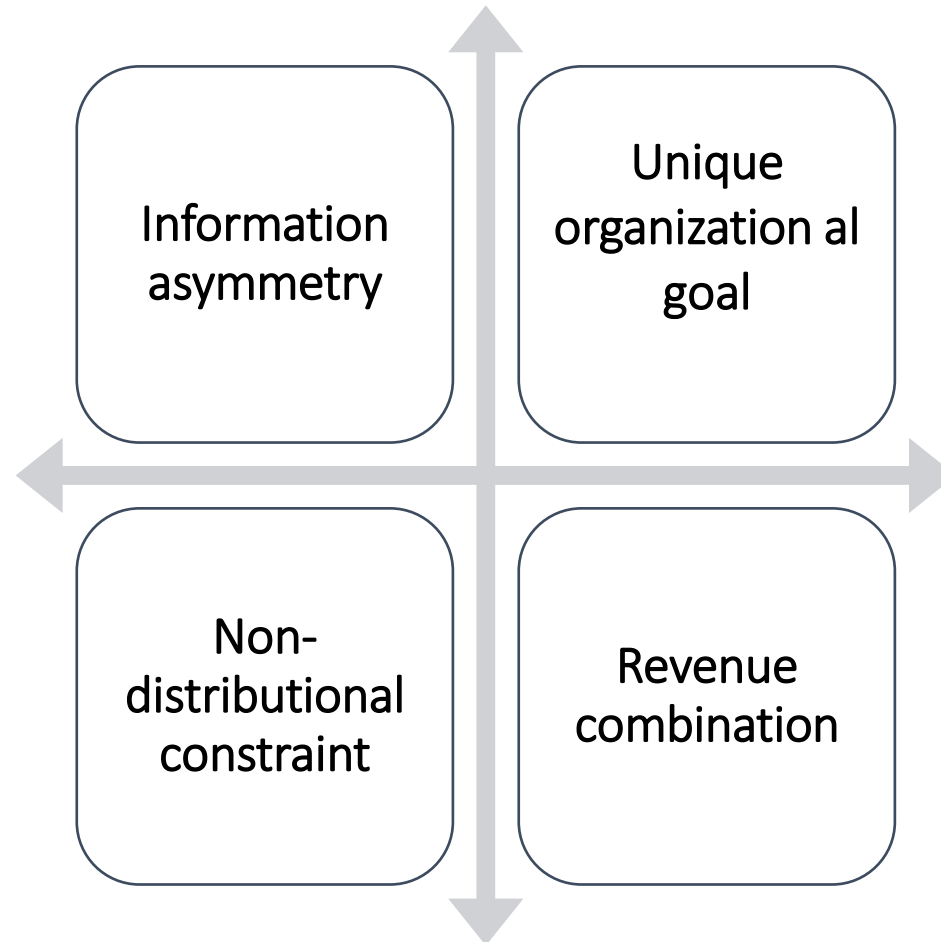
□ Winston (1999)

- Nature of higher education and how to understanding the economics of higher education

Higher education is a business: it produces and sells educational services to customers for a price and it buys inputs with which to make that product. Production is subject to technological constraints. Costs and revenues discipline decisions and determine the long-run viability of a college or university. “But higher education is not just a business.” While that statement is often meant to imply that higher education is nobler than business—more decent and humane in the purposes it serves—it can also mean that even in economic terms higher education is, in important ways, simply different from a business.

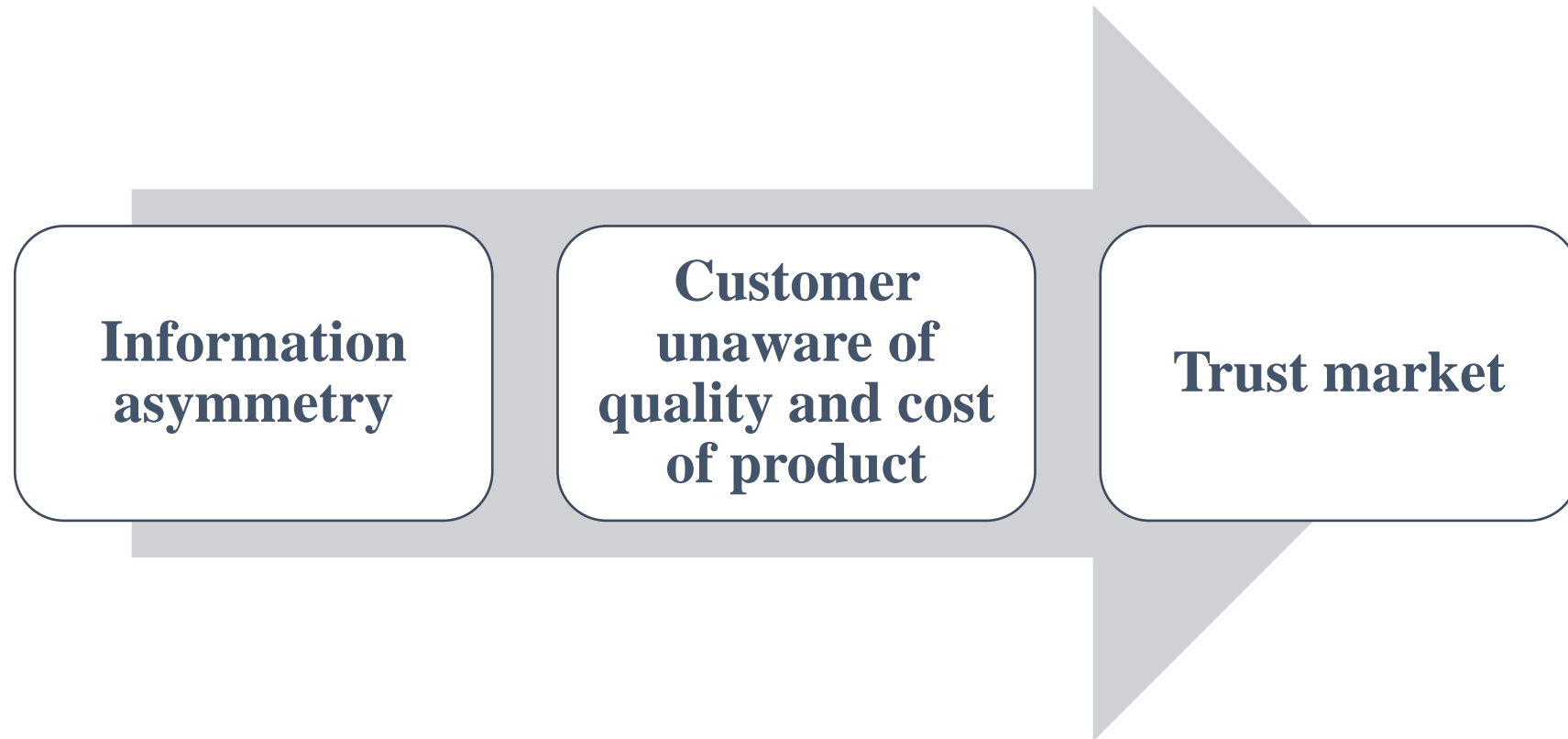
Economics of higher education hierarchy

□ Higher education as a nonprofit enterprise



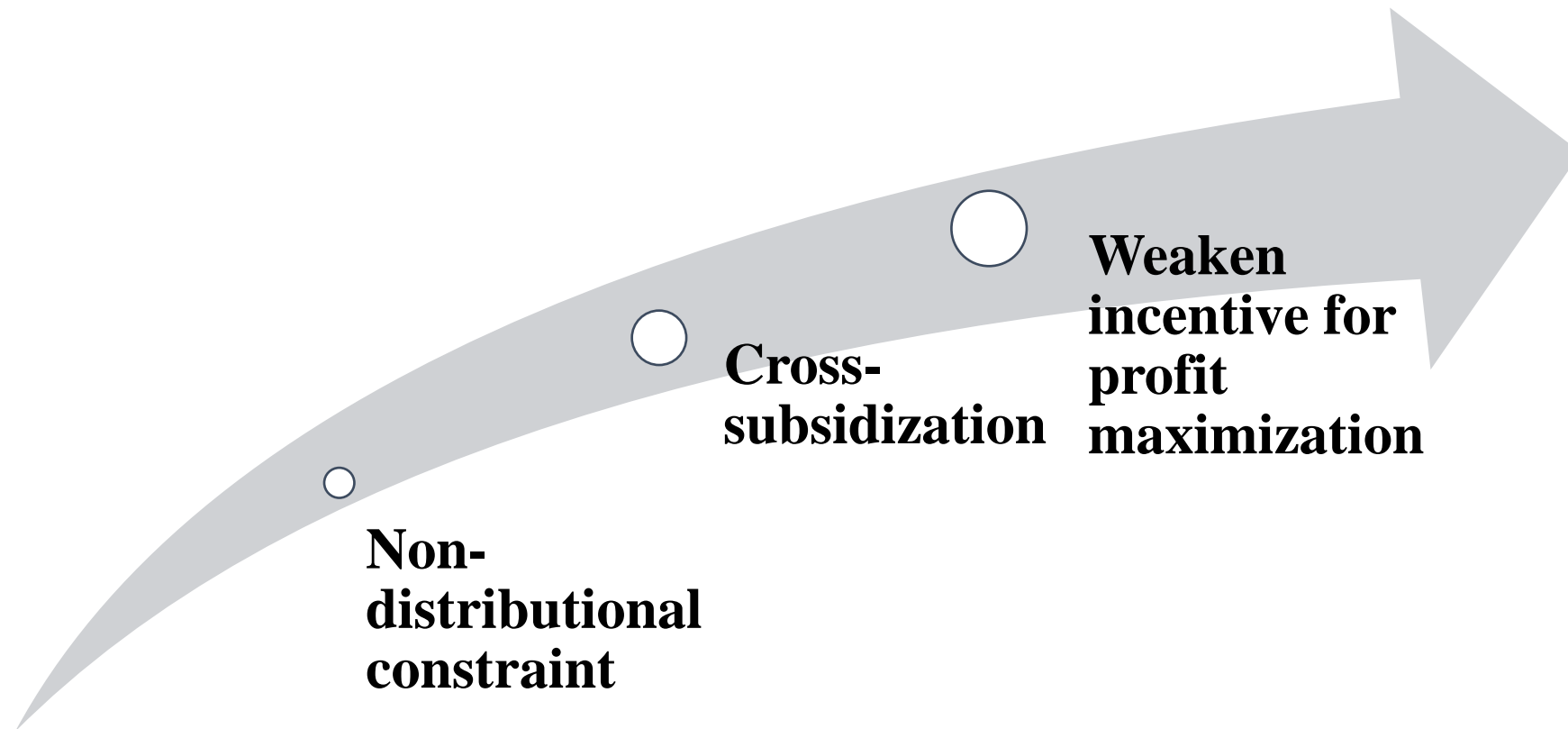
Economics of higher education hierarchy

- Information asymmetry



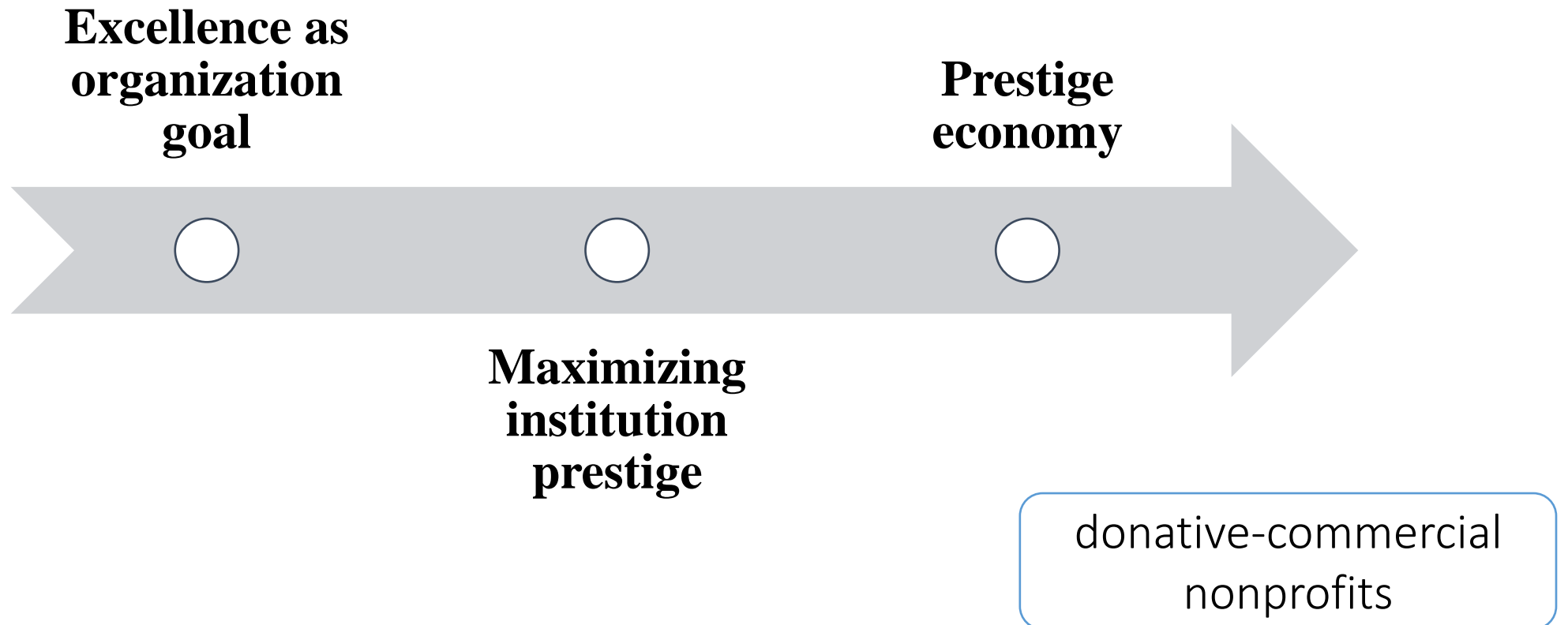
Economics of higher education hierarchy

- **Non-distributional constraint**



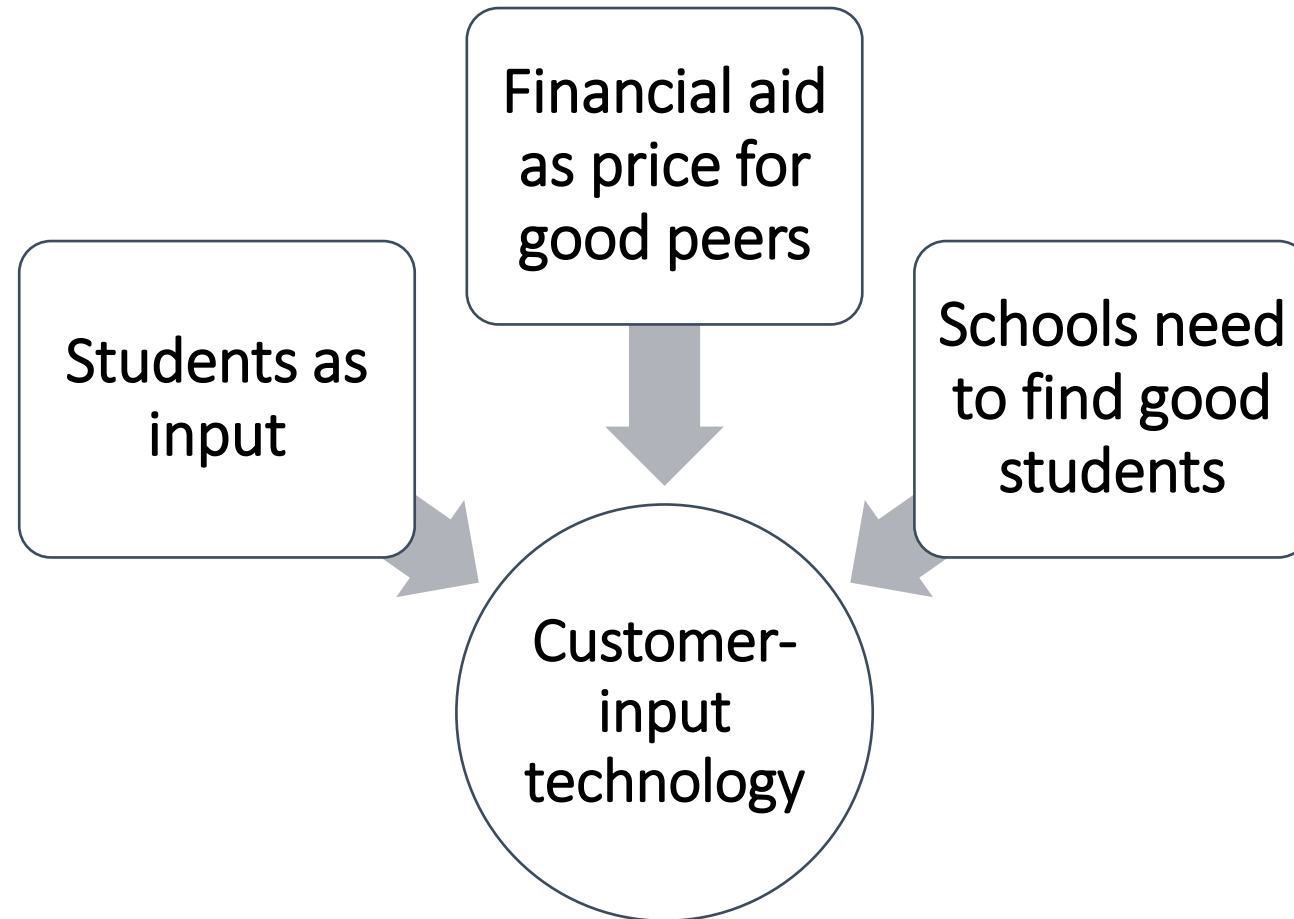
Economics of higher education hierarchy

- **Excellence as organization goal**



Economics of higher education hierarchy

□ Peer effect: customer-input technology

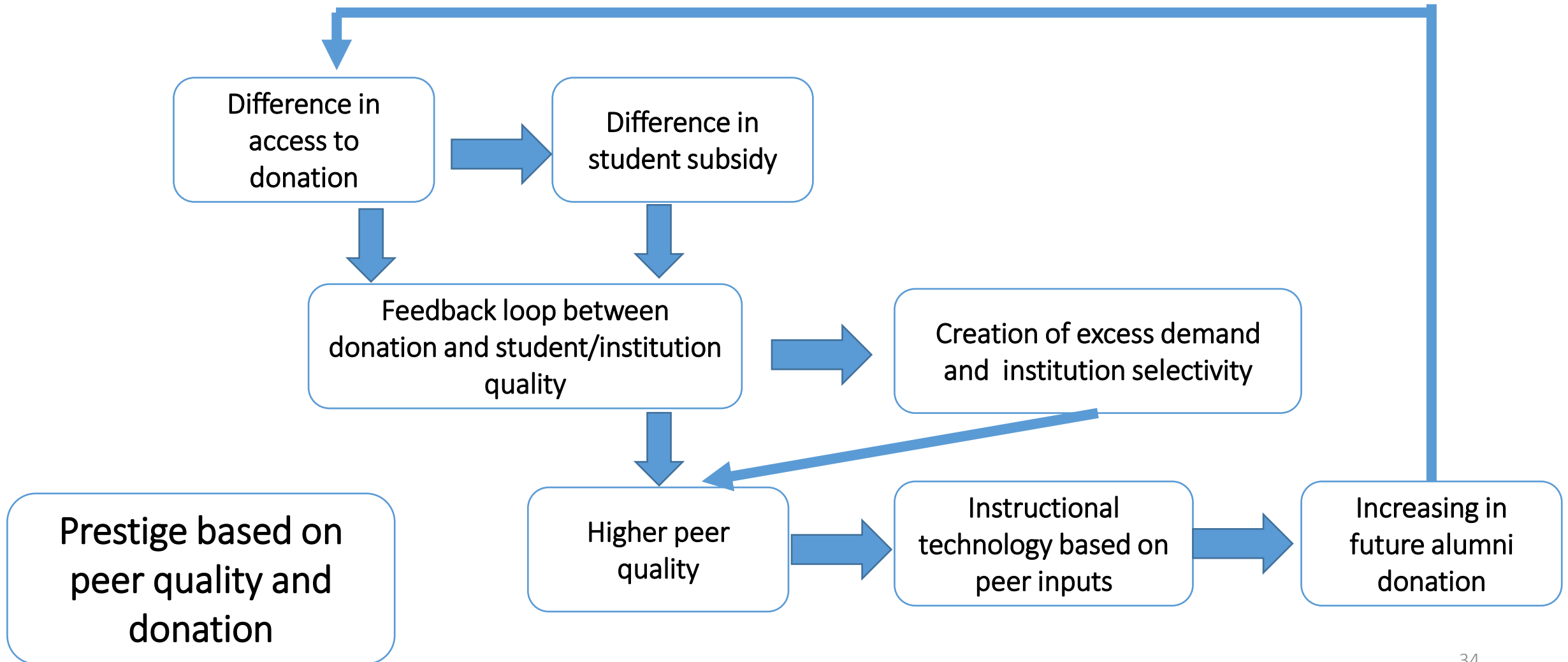


Economics of higher education hierarchy

- Higher education as a nonprofit enterprise
 - Donative-commercial nonprofits can and do subsidize their customers, selling them a product at a price that is below the costs of its production
 - The sustainable excess of production cost over price is a defining economic characteristics of higher education, both public and private; for all customers, not just cross-subsidize some at the expense of others



Formation of institution hierarchy



Economics of

▣ Subsidy and student quality

Table 2
Subsidies and Student Quality

<i>Ranked by Dollar Value of Subsidy</i>	<i>Percent Applicants Accepted</i>	<i>Mean SAT Score</i>	<i>Percent in Top 10 Percent of H.S. Class</i>	<i>Percent National Merit Semifinalists</i>
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>
All Institutions	83.2%	970	19.7%	0.7%
Public	88.1%	940	14.7%	0.3%
Private	78.0%	990	22.7%	1.0%
Decile 1	67.1%	1090	37.5%	2.7%
Decile 2	78.6%	1000	22.5%	0.9%
Decile 3	81.6%	950	19.2%	0.6%
Decile 4	85.1%	970	18.8%	0.6%
Decile 5	84.9%	950	18.2%	0.6%
Decile 6	87.1%	940	16.5%	0.4%
Decile 7	86.9%	940	16.6%	0.4%
Decile 8	88.6%	930	14.7%	0.2%
Decile 9	87.1%	940	16.5%	0.4%
Decile 10	84.7%	920	12.3%	0.2%

Economics of

□ Subsidy and education technology

Table 3

Subsidies, Demand Augmentation, and Educational Technologies

<i>Ranked by Dollar Value of Subsidy</i>	<i>Undergraduates in Dorms</i>	<i>Undergraduates over Age 25</i>	<i>Undergraduates in Vocational Programs</i>	<i>Schools with Part-Time Degree Prog.</i>	<i>Schools with Adult Education</i>
	(1)	(2)	(3)	(4)	(5)
All Institutions	46.5%	32.1%	9.6%	88.5%	81.7%
Public	29.2%	39.9%	6.4%	95.1%	92.6%
Private	56.3%	23.6%	13.0%	81.7%	70.2%
Decile 1	60.7%	23.7%	5.4%	67.6%	66.9%
Decile 2	58.0%	26.1%	7.7%	84.5%	73.5%
Decile 3	47.1%	29.7%	9.4%	92.2%	80.5%
Decile 4	47.3%	31.2%	9.2%	93.8%	82.0%
Decile 5	43.7%	34.0%	9.7%	94.7%	86.9%
Decile 6	42.3%	33.5%	10.3%	93.0%	85.8%
Decile 7	40.2%	35.5%	10.2%	95.1%	90.8%
Decile 8	40.1%	36.4%	9.0%	92.9%	92.0%
Decile 9	38.1%	35.0%	12.2%	93.8%	87.4%
Decile 10	34.1%	35.6%	12.6%	77.5%	70.5%

Economics of h

- Hierarchy of college and universities

Table 1
Costs, Prices, Subsidies, and Hierarchy, 1995

<i>Ranked by Dollar Value of Subsidy</i>	<i>Enrollments</i>	<i>Average Student Subsidy</i>	<i>Costs: Educational "E&G&K"</i>	<i>Price: Net Tuition & Fees</i>	<i>Price/Cost Ratio</i>
	(1)	(2)	(3)	(4)	(5)
	FTE	\$	\$	\$	%
All Institutions	3,500	8,200	12,000	3,800	31.5%
Public	5,100	8,700	9,900	1,200	12.4%
Private	1,700	7,700	14,200	6,500	45.9%
Decile 1	3,300	22,800	28,500	5,700	20.1%
Decile 2	3,800	11,100	14,900	3,800	25.4%
Decile 3	4,300	9,300	12,300	3,000	24.4%
Decile 4	4,500	8,200	11,000	2,800	25.6%
Decile 5	3,700	7,300	9,900	2,600	26.6%
Decile 6	3,900	6,500	9,400	2,900	30.8%
Decile 7	3,500	5,800	8,700	2,900	33.1%
Decile 8	3,500	5,100	8,400	3,300	39.5%
Decile 9	2,900	4,100	8,700	4,600	52.5%
Decile 10	1,600	1,800	7,900	6,100	77.4%

Q3: Why do research universities prioritize investment for research and how does this influence stratification?

Research brings prestige to institution

(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)

Research brings prestige to institution

(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

Academic capitalism brings deeper stratification

(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 public 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**

Q4: Where does organizational segmentation come from?

Academic capitalism brings organization segmentation

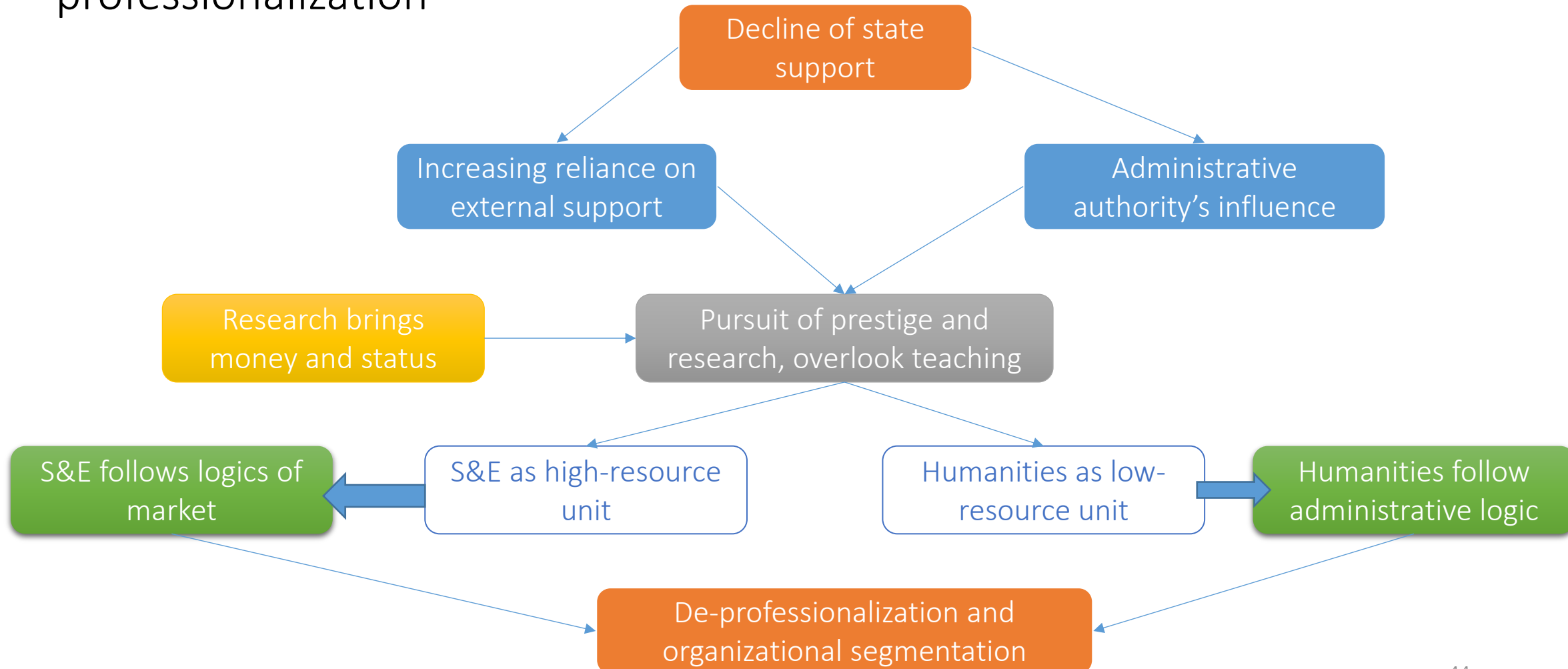
(Cantwell et al. 2013)

- Academic capitalism indicates new forms of organization that segment universities



Organization segmentation (Rosinger et al. 2016)

- Interactions between organizational segmentation, academic work and professionalization



Research agenda for institution-level inequality study

Q1: Any evidence on institutional stratification?

Latent class analysis with mean comparison

(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 from IPEDS, NSF R&D survey, CAE's endowment data
 - Separate analysis for public and private universities
 - Tracking time trend

Latent class analysis with mean comparison

(Taylor et al. 2016)

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)

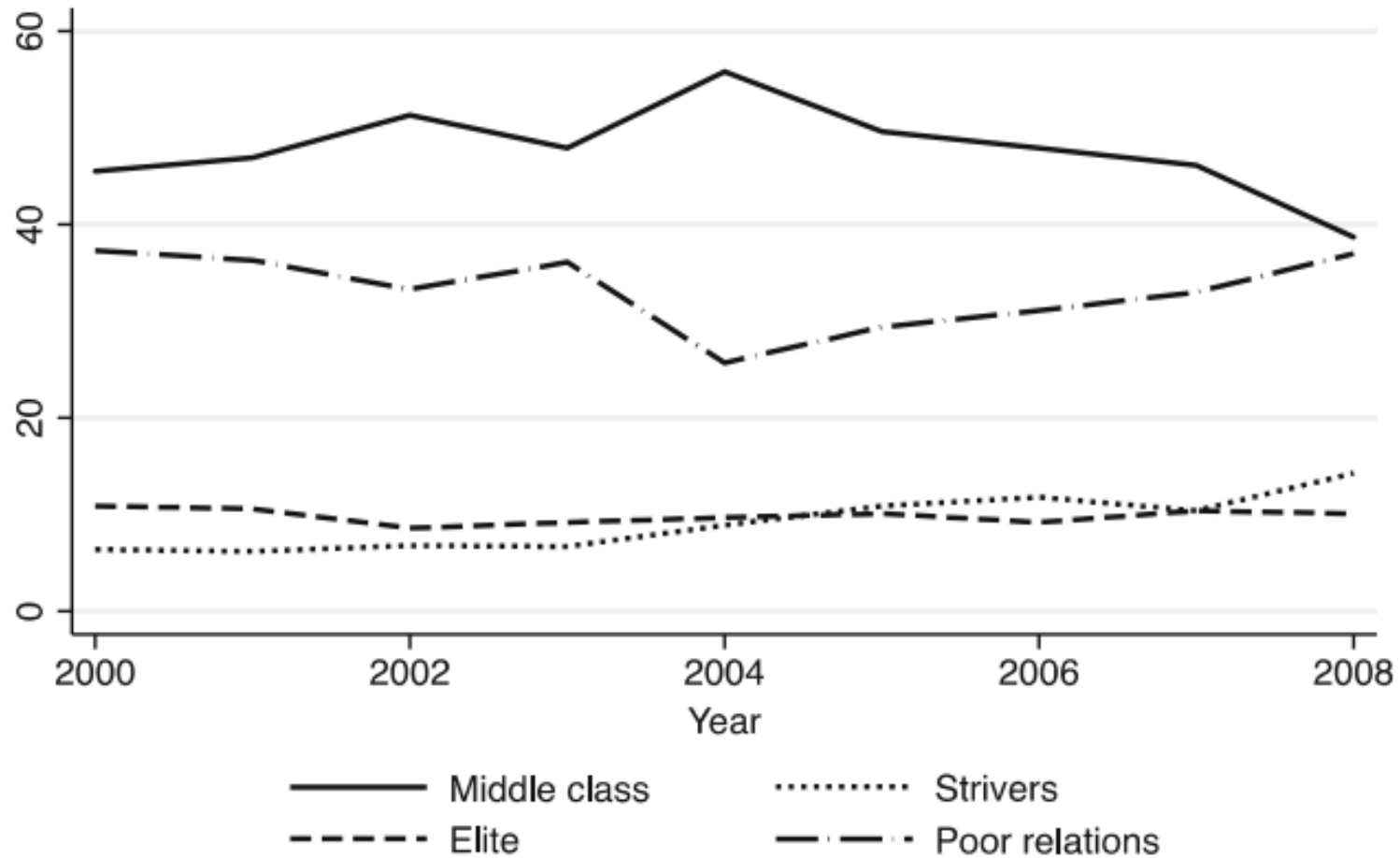


Fig. 4.1 Percent of public universities located in each of four latent classes over time,

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)

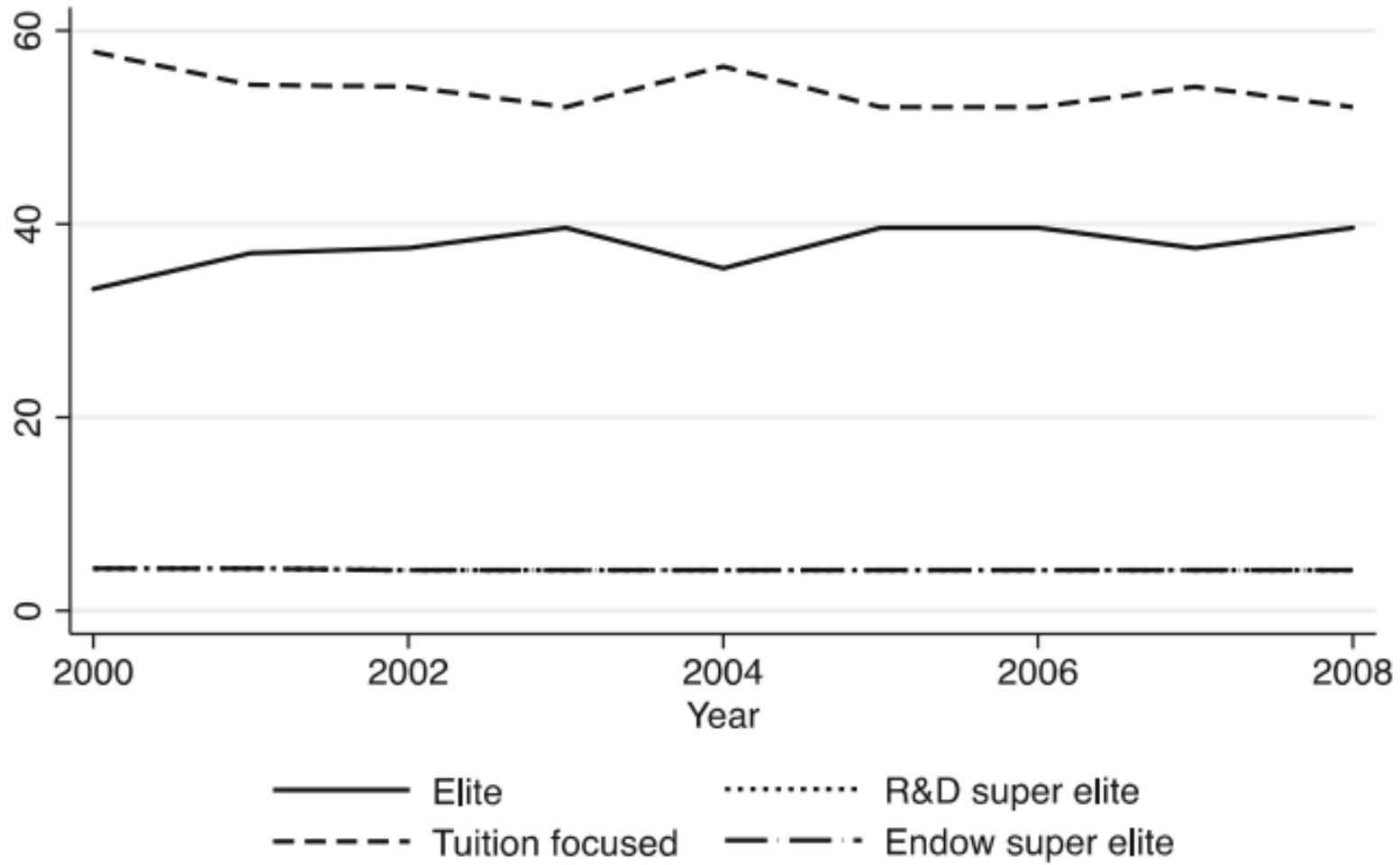


Fig. 4.2 Percent of private universities located in each of four latent classes over time, 2000–2008

Q2: Do institutions cross-subsidize research?

Fixed effect model

(Leslie et al. 2012)

- Two-way fixed effect model
 - IPEDS data from 1984/85 to 2007/08
 - Revenue and expenditure type data
 - 96 research extensive institutions as of 2007/08
 - Per FTE in dollars

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*** (0.020)	0.051** (0.019)	-0.197*** (0.020)	0.087*** (0.011)	0.080*** (0.005)	0.100*** (0.010)	0.111*** (0.011)
Appropriations	0.322*** (0.012)	0.108*** (0.011)	0.103*** (0.012)	0.092*** (0.006)	0.036*** (0.003)	0.090*** (0.006)	0.016* (0.006)
Grants and contracts	0.288*** (0.012)	0.500*** (0.011)	0.042*** (0.012)	0.098*** (0.007)	0.026*** (0.003)	0.042*** (0.006)	0.026*** (0.007)
Gifts	0.388*** (0.028)	0.555*** (0.026)	0.196*** (0.028)	0.160*** (0.015)	0.065*** (0.006)	0.132*** (0.014)	-0.014 (0.015)
Sales	0.014* (0.006)	0.017** (0.005)	0.060*** (0.006)	-0.010** (0.003)	-0.010*** (0.001)	0.003 (0.003)	-0.001 (0.003)
Other	-0.008 (0.012)	0.065*** (0.011)	0.172*** (0.012)	-0.008 (0.007)	-0.005 (0.003)	-0.011 (0.006)	0.024*** (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*** (0.059)	-0.031 (0.037)	-0.018 (0.030)	0.086* (0.039)	-0.012 (0.021)	0.052 (0.028)	0.304*** (0.013)
Grants and contracts	0.391*** (0.023)	0.786*** (0.015)	0.015 (0.012)	0.079*** (0.015)	0.032*** (0.008)	0.177*** (0.011)	-0.016** (0.005)
Gifts	0.118*** (0.024)	0.098*** (0.015)	0.023 (0.012)	0.087*** (0.016)	0.040*** (0.008)	0.116*** (0.011)	0.001 (0.005)
Sales	0.023* (0.009)	0.021*** (0.006)	-0.005 (0.005)	0.022*** (0.006)	-0.006 (0.003)	0.003 (0.004)	-0.006** (0.002)
Other	-0.011 (0.006)	0.029*** (0.004)	0.000 (0.003)	-0.010* (0.004)	-0.002 (0.002)	-0.005 (0.003)	-0.002 (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*** (0.041)	0.017 (0.038)	-0.022 (0.042)	0.133*** (0.023)	0.046*** (0.009)	0.075*** (0.020)	0.350*** (0.022)
× Year	0.007*** (0.002)	0.001 (0.002)	-0.010*** (0.002)	-0.003** (0.001)	0.002*** (0.000)	0.001 (0.001)	-0.013*** (0.001)
Appropriations	0.312*** (0.014)	0.191*** (0.013)	0.138*** (0.015)	0.100*** (0.008)	0.033*** (0.003)	0.083*** (0.007)	-0.014 (0.008)
× Year	0.003** (0.001)	-0.008*** (0.001)	-0.004*** (0.001)	0.000 (0.000)	0.001* (0.000)	0.001* (0.000)	0.001** (0.000)
Grants and Contracts	0.171*** (0.031)	0.492*** (0.029)	0.067* (0.032)	0.060*** (0.017)	0.018* (0.007)	0.059*** (0.015)	0.061*** (0.016)
× Year	0.005*** (0.001)	0.000 (0.001)	-0.001 (0.001)	0.001 (0.001)	0.000 (0.000)	-0.001* (0.001)	-0.001 (0.001)
Gifts	0.276*** (0.067)	0.293*** (0.062)	0.301*** (0.069)	-0.024 (0.037)	-0.024 (0.015)	0.119*** (0.033)	0.008 (0.035)
× Year	0.005 (0.004)	0.015*** (0.004)	-0.005 (0.004)	0.013*** (0.002)	0.005*** (0.001)	0.002 (0.002)	0.001 (0.002)
Sales	0.107*** (0.010)	-0.006 (0.010)	0.015 (0.011)	-0.028*** (0.006)	0.011*** (0.002)	-0.033*** (0.005)	0.001 (0.006)
× Year	-0.005*** (0.000)	0.002*** (0.000)	0.002*** (0.000)	0.001** (0.000)	-0.001*** (0.000)	0.002*** (0.000)	-0.000 (0.000)
Other	-0.289*** (0.053)	0.211*** (0.050)	0.055 (0.055)	-0.005 (0.030)	0.005 (0.012)	0.061* (0.027)	0.059* (0.028)
× Year	0.015*** (0.003)	-0.007** (0.002)	0.005 (0.003)	-0.000 (0.001)	-0.000 (0.001)	-0.004** (0.001)	-0.002 (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*** (0.113)	0.054 (0.072)	-0.097 (0.060)	-0.285*** (0.079)	0.103* (0.044)	0.052 (0.057)	0.419*** (0.026)
× Year	-0.043*** (0.007)	0.007 (0.005)	0.001 (0.004)	0.031*** (0.005)	-0.008** (0.003)	0.003 (0.004)	-0.009*** (0.002)
Grants and Contracts	0.323*** (0.040)	0.626*** (0.026)	0.149*** (0.021)	0.009 (0.028)	0.060*** (0.016)	0.187*** (0.020)	-0.004 (0.009)
× Year	0.001 (0.002)	0.006*** (0.001)	-0.007*** (0.001)	0.004** (0.001)	-0.002** (0.001)	-0.001 (0.001)	-0.000 (0.000)
Gifts	-0.071 (0.071)	-0.042 (0.045)	-0.058 (0.038)	0.087 (0.050)	-0.038 (0.028)	-0.040 (0.036)	-0.010 (0.016)
× Year	0.008* (0.004)	0.007** (0.002)	0.006** (0.002)	0.000 (0.003)	0.004** (0.002)	0.009*** (0.002)	0.000 (0.001)
Sales	-0.124*** (0.021)	0.025 (0.013)	-0.005 (0.011)	0.040** (0.015)	-0.005 (0.008)	0.008 (0.011)	-0.006 (0.005)
× Year	0.007*** (0.001)	0.000 (0.001)	0.000 (0.000)	-0.001 (0.001)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Other	-0.236*** (0.039)	-0.121*** (0.025)	-0.086*** (0.021)	0.099*** (0.028)	-0.056*** (0.015)	0.060** (0.020)	0.054*** (0.009)
× Year	0.017*** (0.003)	0.012*** (0.002)	0.006*** (0.002)	-0.008*** (0.002)	0.004*** (0.001)	-0.005** (0.002)	-0.004*** (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

Q3: Do inter-institutional stratification and organizational segmentation predicts ranking?

Panel Tobit model

(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 (3.188)	1.859 (3.355)
Logged R&D expenditures funded by federal government	9.003** (2.148)	11.16** (1.957)
Logged R&D expenditures funded by industry	0.975 (0.678)	1.287* (0.555)
Logged R&D expenditures funded by institution	−0.255 (0.132)	−0.214 (0.129)
Private control	14.94** (5.531)	20.35** (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 (1.072)	−0.890 (0.986)

Research agenda

- Shifting focus from input to process and output
 - Majority of research now focus on input difference, with few exceptions on output such as research publication (Halffman and Leydesdorff 2010)
- Consider a wider array of consequences
 - Connectedness of research universities worldwide
 - Presence in social media
 - Connection with industries
 - Earnings and other student development indicators

Research agenda

- Using administrative data to get system-wide picture of stratification, not just among top research universities
 - The big-data approach
- Paying attention to stratification among non-selective institutions
 - Community colleges
 - Non-selective baccalaureate institutions
 - For-profit ones

Thanks!

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