Growth and the Financing and Governance of Higher Education

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Two main questions

- Should Europe invest more in higher education to grow faster?
- Are European universities properly governed?

Question 1: Growth and Higher Education Spending

- In 1999-2000, US devoted 3% of its GDP to tertiary education, versus only 1.4% in the EU

- In 1999-2000, 37.3% of US population aged 25-64 had completed a higher education degree, against only 23.8% of EU population

- Yes, say…
  - Growth theories that emphasize research & innovation
- On the other hand…
  - Asian Tigers grew fast while investing in low brow education

Nelson-Phelps

- A higher stock of human capital allows a country to catch up more rapidly with “best practice”

$$\dot{A} = f(h)(\overline{A} - a)$$

- Benhabib-Spiegel: a higher stock of human capital also speeds up frontier growth

$$\dot{A} = f(h)\left(\overline{A} - A\right) + g(h)\gamma A,$$

Krueger-Lindahl

- When restricting attention to OECD cross-country panel data, no significant relationship between stock of education and growth

Alternative approach

- Suppose:
  - Growth can be generated either by innovating or by imitating the frontier technology as in Benhabib-Spiegel…but in addition...
  - ….“Low brow” education provides skills for imitating...
  - ….“High brow” education provides skills for innovating
- Then, as a country moves closer to frontier, high brow education becomes increasingly important for growth.
- This approach can potentially explain Krueger-Lindahl puzzle.

Krueger-Lindahl puzzle

- Suppose two countries A and B at equal proximity “a” from frontier
- $S(A)+U(A)=S(B)+U(B)=h$ but $S(A)>S(B)$
- Then, if “a” close to one, country A will grow faster, if “a” close to zero, country B grows faster
- Thus h is not sufficient statistics to predict growth

Cross-country Analysis

Table 1: TFP Growth Equation (Fractions BL)

TFP GROWTH EQUATION (FRACTIONS BL)

	[1]	[2]	[3]	[4]	[5]
Proximity	-0.13	-0.216	-0.27	-0.24	-0.28
	(.075)	(.287)	(.063)***	(.29)	(.08)***
Fraction	-0.025	0.65	-0.89	0.3	-0.43
	(.094)	(.63)	(.26)***	(1.8)	(.24)*
Proximity*Fraction	-	-	1.07	0.4	1.11
			(.28)***	(1.6)	(.3)***
Country dummies	No	Yes	No	Yes	Groups
p-value country dummies	-	-	-	0	-
Proximity threshold	-	-	0.832	-	0.387
			(.044)	-	(.14)
Rank test (p value)	-	-	-	0.13	-
Number of observations	122	122	122	122	122

Note: standard errors in parentheses. Time dummies not reportes. In column [5], countries are grouped in the following way: Group 1: Canada, New Zealand, USA; Group2: Austria, Ireland, Italy, Norway, Portugal; Group3: Belgium, Finland, France, United Kingdom; Group 4: Denmark, Netherlands, Spain, Sweden, Switzerland; Group 5: Australia.
Proximity threshold indicates the value of Proximity above which Fraction is growth-enhancing. One, two and three * indicate significance at the 10, 5 and 1% level respectively.

Fixed Effect problem

- Correlations become insignificant if control for country fixed effects…..only 122 observations!!

The Identification Problem

- Education investments: endogeneity & omitted variables
- For example
  - some areas have higher productivity growth;
  - they end up richer & closer to the frontier;
  - they may spend more on high brow education as luxury of sorts

➢ Correlation but no causation

- Both cross-section & panel evidence are problematic

Cross-US states analysis: exploiting the “mistakes” of U.S. states

Why U.S. states?

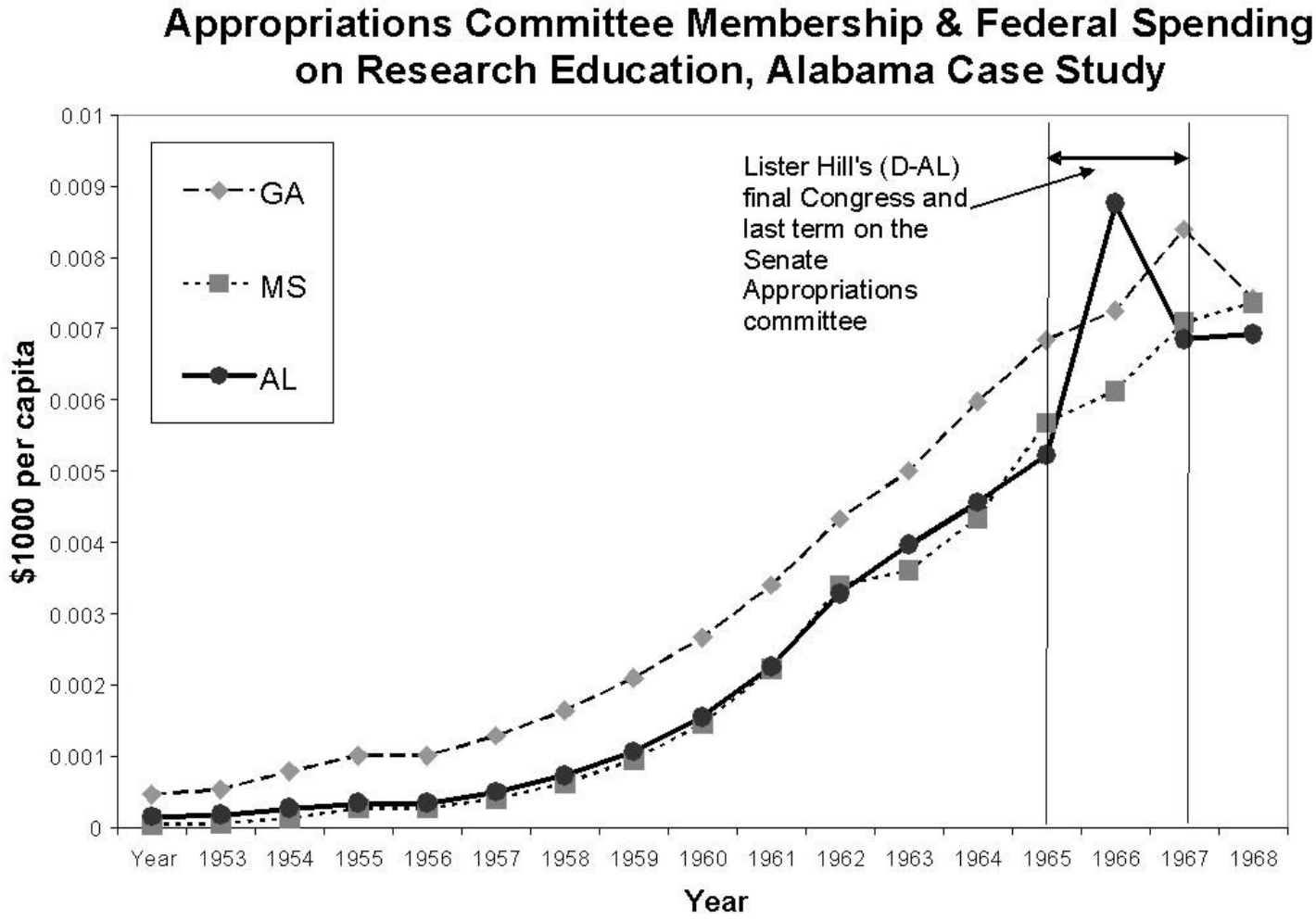
- Can analyze 26 cohorts in 48 states
- Strengths:
  - much more credible instruments available
  - data quality/comparability
- Problem that became a strength: Migration
  - new model fully integrates migration
  - migration of educated people interesting in itself (Bound, Groen, Kezdi, & Turner)
  - additional predictions we can test

Logic of our Instruments

- Individual appointments to key appropriations committees generate state "mistakes" (arbitrary shocks) to education investments

- A vacancy on a appropriations committee happens to arise when the state's representative is "first in line" based on seniority & geography
- Once on the committee, the legislator needs to pay back his constituents.
- His position only gives him ability to deliver in specific forms especially "earmarked" grants to universities and highway funds.
- He ends up making education investments based on the forms of pork he can deliver.

Case Study: Alabama (Lister Hill)



The Estimating Equations

An Exemplary First-Stage Equation:

Expenditure on research universities per person in cohort = α_0 +

$\alpha_1 \cdot$ (Most senior in Census region x party) * (vacancy in region x party) +

$\alpha_2 \cdot$ (Top seniority decile in Census region x party) * (vacancy in region x party) +

Political variables (%vote by party in last election etc.) $\cdot \boldsymbol{\alpha}_3$ +

$\boldsymbol{\gamma}^{state} + \boldsymbol{\gamma}^{cohort} + time \cdot \mathbf{I}^{region} \boldsymbol{\delta} + \varepsilon$

The Second-Stage Equation:

Annual rate of growth = $\beta 0$ +

$\beta_1 \cdot$ Expenditure on research universities per person in cohort +

$\beta_2 \cdot$ Expenditure on 4-year colleges per person in cohort +

$\beta_3 \cdot$ Expenditure on 2-year colleges per person in cohort +

$\beta_4 \cdot$ Proximity $\cdot$ Expenditure on research universities per person in cohort +

$\beta_5 \cdot$ Proximity $\cdot$ Expenditure on 4-year colleges per person in cohort +

$\beta_6 \cdot$ Proximity $\cdot$ Expenditure on 2-year colleges per person in cohort +

$\boldsymbol{\gamma}^{state} + \boldsymbol{\gamma}^{cohort} + time \cdot \mathbf{I}^{region} \boldsymbol{\delta} + \varepsilon$

Note: Proximity is instrumented by patent-based proximity in 1960 in the state.

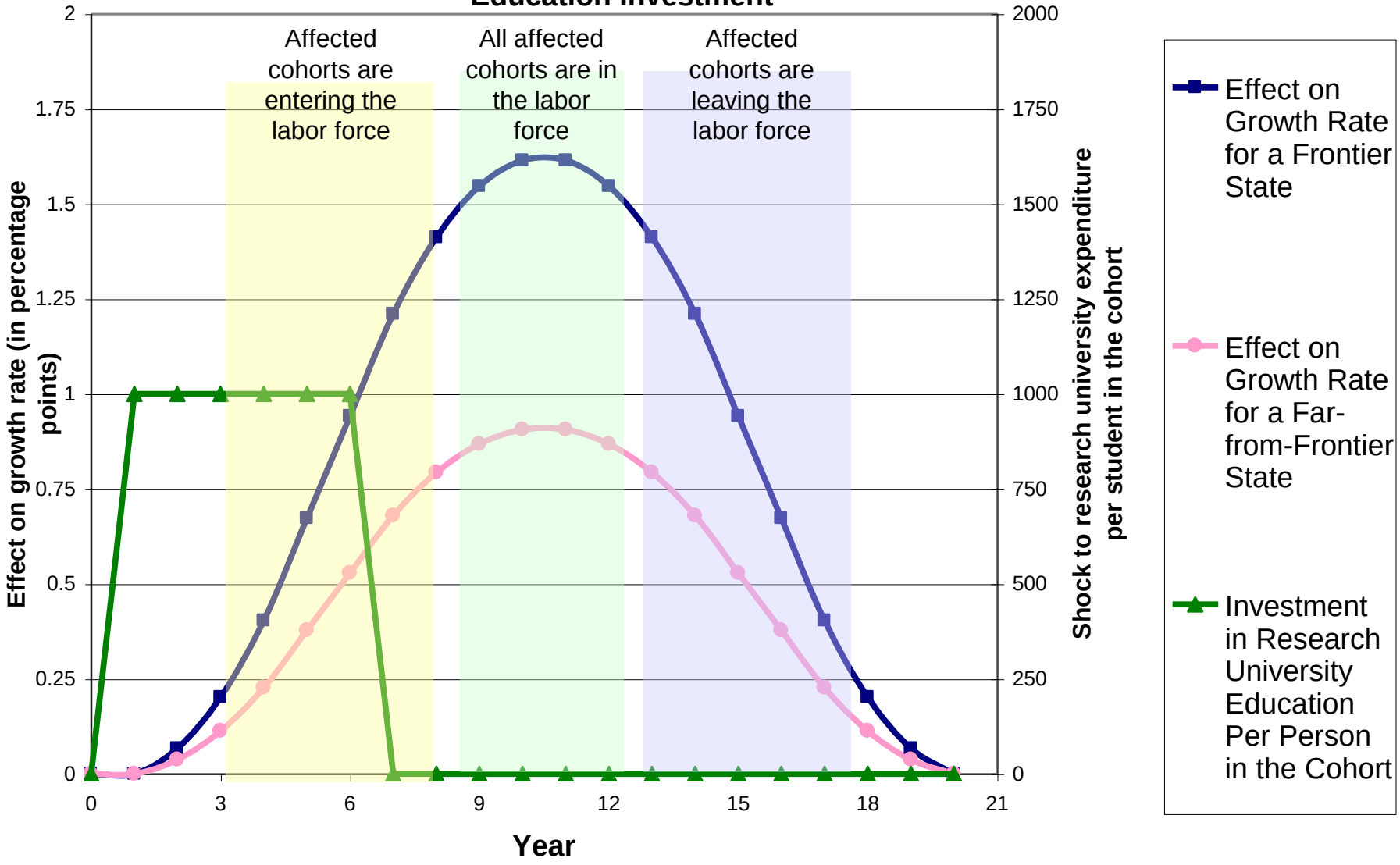
First-Stage for Research-Type Spending

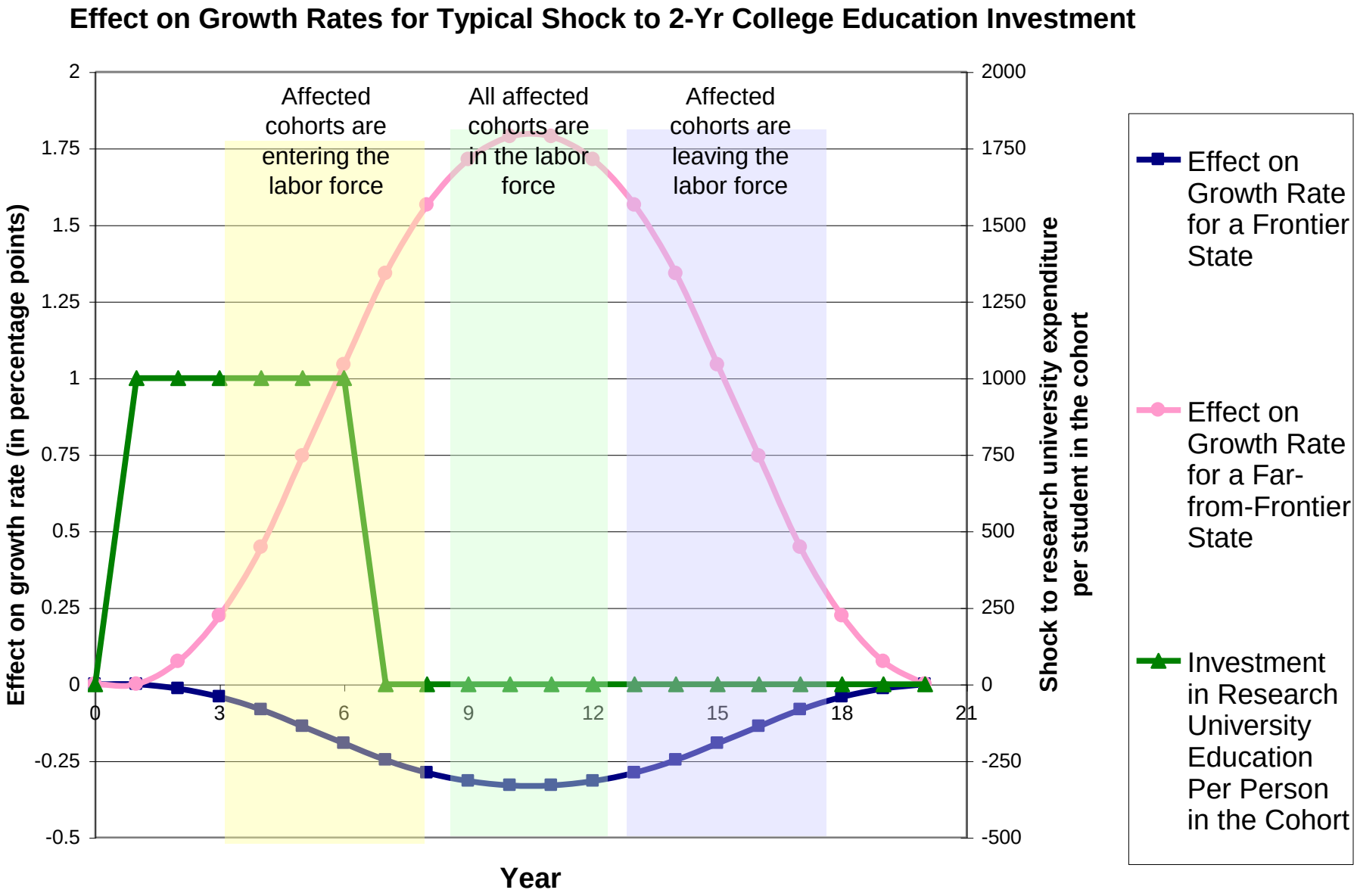
	Exp on Research Univ per Person in Cohort
Excluded instruments:	
House: (Most senior in Census region x party) * (vacancy in region x party)	**135.2** **(42.1)**
House: (Top senority decile in Census region x party) * (vacancy in Census region x party)	**103.1** **(31.8)**
Senate: (Most senior in Census region x party) * (vacancy in region x party)	**180.2** **(77.3)**
Senate: (Top senority decile in Census region x party) * (vacancy in Census region x party)	**93.1** **(46.7)**
Other covariates listed on previous slide	**Yes**
State & Cohort indicator variables	**Yes**
Census division linear time trends	**Yes**
F-statistic, excluded instruments	**9.08**

Synthesis of results: Education investment measured by spending; migration “allowed”

Effects for far-from-frontier states (0.5 of frontier)	
Expenditure (M) on research-type ed per person in cohort	0.127
Expenditure (M) on 4-yr college ed per person in cohort	-0.063
Expenditure (M) on 2-yr college ed per person in cohort	0.211
Effects for at-the-frontier states	
Expenditure (M) on research-type ed per person in cohort	0.254
Expenditure (M) on 4-yr college ed per person in cohort	0.094
Expenditure (M) on 2-yr college ed per person in cohort	-0.045

Figure 15: Effect on Growth Rates for Typical Shock to Research-Type Education Investment




Effect on Growth Rates for Typical Shock to 2-Yr College Education Investment
Affected cohorts are entering the labor force
All affected cohorts are in the labor force
Affected cohorts are leaving the labor force
Effect on growth rate (in percentage points)
Shock to research university expenditure per student in the cohort
Year
Effect on Growth Rate for a Frontier State
Effect on Growth Rate for a Far-from-Frontier State
Investment in Research University Education Per Person in the Cohort
2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
-0.25
-0.5
2000
1750
1500
1250
1000
750
500
250
0
-250
-500
0
3
6
9
12
15
18
21

Results: Education investment measured by spending; migration un-done

Effects for far-from-frontier states (0.5 of frontier)	
Expenditure (M) on research-type ed per person in cohort	0.079
Expenditure (M) on 4-yr college ed per person in cohort	-0.008
Expenditure (M) on 2-yr college ed per person in cohort	0.149
Effects for at-the-frontier states	
Expenditure (M) on research-type ed per person in cohort	0.157
Expenditure (M) on 4-yr college ed per person in cohort	0.051
Expenditure (M) on 2-yr college ed per person in cohort	-0.024

Thus…

- Both from cross-country and from cross-US states analysis, we find that investments in high-brow education are more growth-enhancing for states closer to the technological frontier

… and that, conversely, investments in low-brow education are more growth-enhancing for states that are far from the technological frontier

Question 2: Governance and Performance of Universities

Do universities with different governance perform differently?

- in terms of productivity/influence measures like the Shanghai ranking?
- in terms of real outcomes like effects on economic growth?

By “governance”, we mean who decides academic, financial, and research questions.

- a central government?
- the university itself?

Part 1: European Universities

Indices of university productivity and influence

The Shanghai index puts weights on 6 criteria:

1. Alumni winning Nobel Prizes and Fields Medals (10%)
2. Faculty winning Nobel Prizes and Fields Medals (physics, chemistry, medicine and economics) and Field Medals in mathematics (20%)
3. Articles published in Nature and Science (20%)
4. Articles in Science Citation Index-expanded and Social Science Citation Index (20%)
5. Highly cited researchers in 21 broad subject categories (20%),
6. Academic performance with respect to the size of an institution (10%)

The ranking is oriented towards pure science, as opposed to applied science, social science, or the humanities.

- We'll examine the overall index (500=top, 1=bottom) and highly cited researchers, the broadest-based component.

Figure 1: the EU-US performance gap for Shanghai Top 100 universities (US=100)

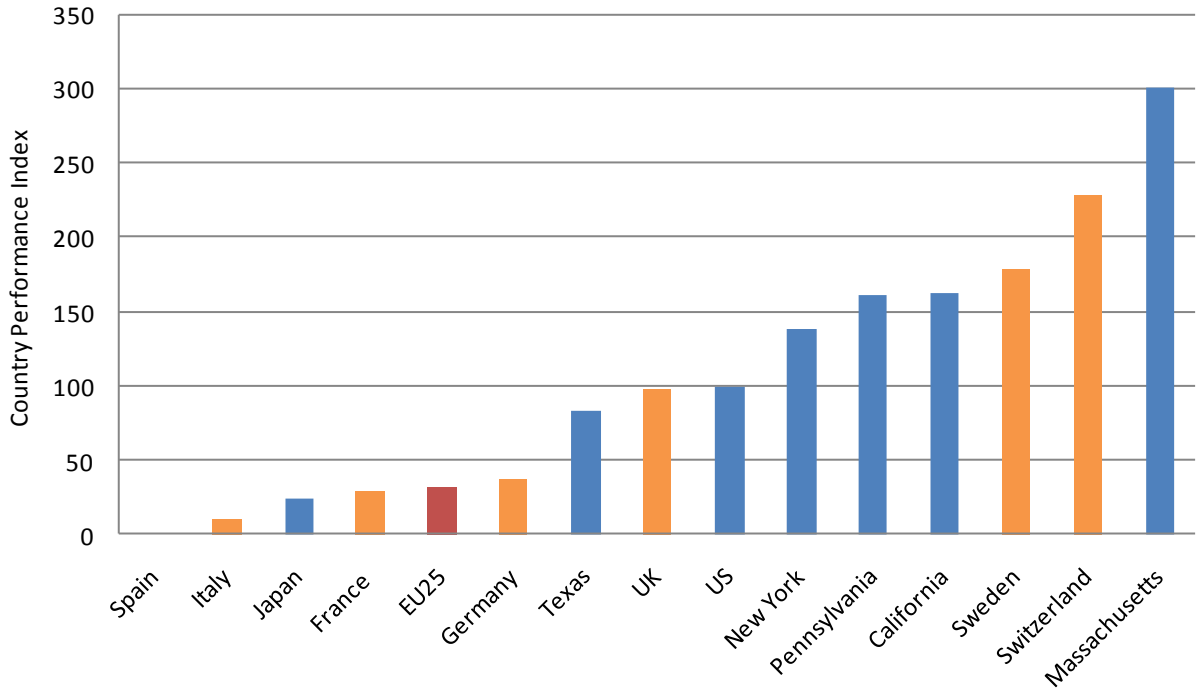


Table 1: Country performance index (US= 100)

Country	Population (millions)	Shanghai ranking			
		Top 50	Top 100	Top 200	Top 500
Austria	8	0	0	0	53
Belgium	10	0	0	61	122
CzechRepublic	10	0	0	0	13
Denmark	5	0	75	114	161
Finland	5	0	46	75	81
France	60	3	15	29	45
Germany	83	0	17	37	67
Greece	11	0	0	0	12
Hungary	10	0	0	0	13
Ireland	4	0	0	0	50
Italy	58	0	0	11	34
Netherlands	16	20	51	76	131
Poland	38	0	0	0	4
Spain	43	0	0	0	14
Sweden	9	7	117	179	217
UK	60	72	86	98	124
EU15	**383**	**13**	**26**	**41**	**67**
EU25	**487**	**10**	**21**	**32**	**54**
Australia	20	0	31	66	101
Canada	32	39	54	63	104
Japan	128	14	17	24	27
Norway	5	0	66	91	107
Switzerland	7	97	166	228	230
US	**294**	**100**	**100**	**100**	**100**
California	36	234	199	163	103
Massachusetts	6	449	308	302	263
New York	19	196	167	139	148
Pennsylvania	12	111	177	161	115
Texas	23	33	61	83	103

Summary of the Purely Suggestive Evidence

The figures and table *suggest*:

- EU & Japanese universities are under-productive & under-influential relative to US, UK, and Canadian universities,
- Gap between EU and US narrows as one moves from Top 50 to Top 500
- Within the EU there are important differences:
  - Good performers regardless of the measure include: the UK, Netherlands, Switzerland, Sweden
  - Poor performers include: Spain, Italy, Austria, France, Germany

1. PERFORMANCE AND SPENDING PER STUDENT

Figure 2: Relationship between expenditure per student and country performance

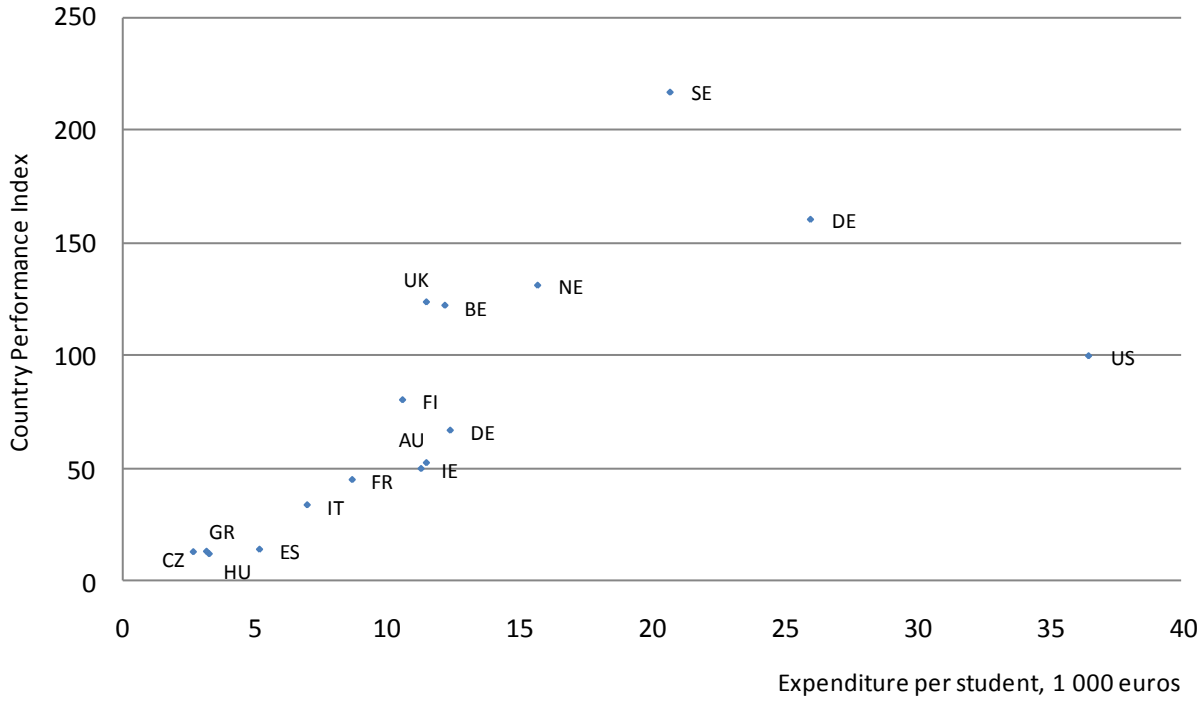


Table 2: Public and private expenditure on higher education, 2001

Country	As % of GDP			In thousand euros per student		
	Public	Private	Total	Public	Private	Total
Austria	1.4	0.1	1.5	11.0	0.5	11.5
Belgium	1.4	0.2	1.6	10.6	1.6	12.2
Czech Republic	0.8	0.1	0.9	2.3	0.4	2.7
Denmark	2.7	0.0	2.7	25.6	0.4	26.0
Finland	2.1	0.1	2.2	10.3	0.3	10.6
France	1.0	0.2	1.2	7.5	1.2	8.7
Germany	1.1	0.1	1.2	11.5	0.9	12.4
Greece	1.2	0.0	1.2	3.3	0.0	3.3
Hungary	1.1	0.3	1.4	2.6	0.6	3.2
Ireland	1.2	0.2	1.4	9.7	1.6	11.3
Italy	0.8	0.2	1.0	5.6	1.4	7.0
Netherlands	1.3	0.3	1.6	13.0	2.7	15.7
Poland	1.1	.*	.*	1.7	.*	.*
Spain	1.0	0.3	1.3	4.0	1.2	5.2
Sweden	2.1	0.2	2.3	18.9	1.8	20.7
UK	0.8	0.3	1.1	8.4	3.1	11.5
EU25	1.1	0.2	1.3	7.3	1.4	8.7
Japan	0.5	0.6	1.1	6.5	7.3	13.8
US	1.5	1.8	3.3	16.6	19.9	36.5

2. GOVERNANCE: A SURVEY OF EUROPEAN UNIVERSITIES

A survey on governance was sent to European universities in the top 500 of the Shanghai ranking in 2006

- 196 universities, 14 countries
- University characteristics: age, public/private, # of students, faculties (medicine, law, natural sciences…).
- University operating independence:
  - Does the university set its own curriculum?
  - Does the university select its own students or is there centralized allocation?
  - To what degree does the university select its own professors?
  - Is there strong endogamy (% of professors with PhD from their university), which suggests that hiring is not open?
  - What is the role of state in setting wages?
  - Are all professors with the same seniority paid the same wage?
  - What share of funding is core public funding that the university can influence only through politics?
  - What share of funding can be controlled by the university? For instance, does the university control its tuition or compete for research grants?
  - What is the composition of the university board (# of faculty, students, scientific personnel...).
  - What are the voting rights of board members?

REPRESENTATIVENESS OF THE SURVEY

As of this time, the response rate to the survey has not been uniformly high: 71 or 36% of targeted universities

Country	No. of Universities	Responded	Response rate
Switzerland	8	6	75%
Ireland	3	2	67%
Spain	9	6	67%
Belgium	7	4	57%
Sweden	11	5	45%
Denmark	5	2	40%
UK	43	17	40%
Italy	23	9	39%
Netherlands	12	4	33%
Germany	40	11	28%
Finland	5	1	20%
France	21	4	19%
Austria	7	0	0%
Greece	2	0	0%

REPRESENTATIVENESS OF THE SURVEY

The universities that responded, however, were fairly representative of their country's universities:

Countries	Shanghai ranking, top to bottom	
	All universities	Universities in the sample
Switzerland	318	344
Belgium	272	314
Sweden	266	290
Netherlands	267	279
Denmark	260	276
UK	258	272
Germany	207	266
EU**	215	245
EU	210	233
Ireland	101	151
Italy	127	151
France	194	101
Spain	101	84
Finland	126	1
Austria	130	n.a.
Greece	101	n.a.

Table 3: Characteristics of the universities in the sample (country averages)

Country	Age (years)	Number of students (thousands)	Budget per student (1 000€)*	Public status*	Budget autonomy§	Building ownership§	Hiring autonomy§	Wage-setting autonomy§	Faculty with in-house PhD (%)
Belgium	284	21.7	11.3	0.5	0.4	1.0	1.0	0.0	63
Denmark	59	18.2	11.4	1.0	1.0	0.3	0.5	0.5	40
Germany	289	26.2	9.6	0.9	0.0	0.5	0.8	0.0	40
Ireland	259	16.3	12.7	0.5	0.5	1.0	1.0	0.0	49
Italy	444	44.9	10.1	1.0	0.9	1.0	0.4	0.0	24
Netherlands	217	21.4	20.5	0.8	0.8	1.0	0.8	0.2	33
Spain	342	44.8	7.0	1.0	0.5	1.0	0.5	0.0	69
Sweden	266	27.1	16.2	0.8	0.8	0.2	1.0	1.0	58
Switzerland	326	12.8	26.2	0.8	0.1	0.4	0.8	0.0	24
UK	242	14.6	24.5	0.5	0.9	0.9	1.0	0.8	8
Total	**290**	**24.9**	**16.1**	**0.8**	**0.6**	**0.8**	**0.8**	**0.3**	**29**

Source: Bruegel survey.

* PPP adjusted. * 1 if public, 0 if private. § 1 if yes, 0 if no.

Table 4: Correlation between budget and university governance, and research performance*

Characteristics	Correlation coefficient
Budget per student	+0.61
University governance:	
Public status*	-0.35
Budget autonomy§	+0.16
Building autonomy§	-0.01
Hiring autonomy§	+0.20
Wage setting autonomy§	+0.27
Faculty with in-house PhD	-0.08

* Measured by the (logarithm of the) Shanghai ranking

* 1 if public, 0 if private. § 1 if yes, 0 if no.

Table 5: Effect of budget and autonomy on research performance*

Variable	Effect on research performance
Size of the university	+
Age of the university	+
Budget per student	+
Budget autonomy	+
Interaction between budget and autonomy	+

* Measured by the (logarithm of the) Shanghai ranking

Part 2: Governance in US panel regressions

Measures of University Autonomy

- Percent Private
  - Private research universities are assumed to be more autonomous than any public research university since they would score high on every measure of financial and academic autonomy

Measures of University Autonomy

- A public (state) university is maximally autonomous if…
  - It sets its own faculty salaries (no mandatory adherence to a statewide schedule)
  - It sets its own tuition
  - It has lump sum budgeting (as opposed to line item budgeting)
  - It can shift funds among major categories of expenditure
  - It retains & controls tuition revenues
  - It retains & controls other revenues—for instance, from grants
  - It has no ceilings on external faculty positions (it need not hire faculty internally)
  - It has no ceilings on external non-faculty positions (it need not hire administrators or technicians internally)
  - It has freedom from pre-audits of its expenditures
  - Its year-end balances are carried over (not returned to the state)

Measures of University Autonomy, Summing Up

- We have 2 key measures of autonomy of research universities
  - Percent of research universities that are private
    - Normalized to have mean zero and a standard deviation of 1
  - Index of autonomy for public research universities
    - Factor analysis is used to create a single index that gives weight to each of the factors listed on the previous slide
    - Index is normalized to have mean zero and a standard deviation of 1
- We record these measures as early as possible (1965 approx.) to avoid endogeneity
    - They don't change a great deal over time within a state anyway

Governance data

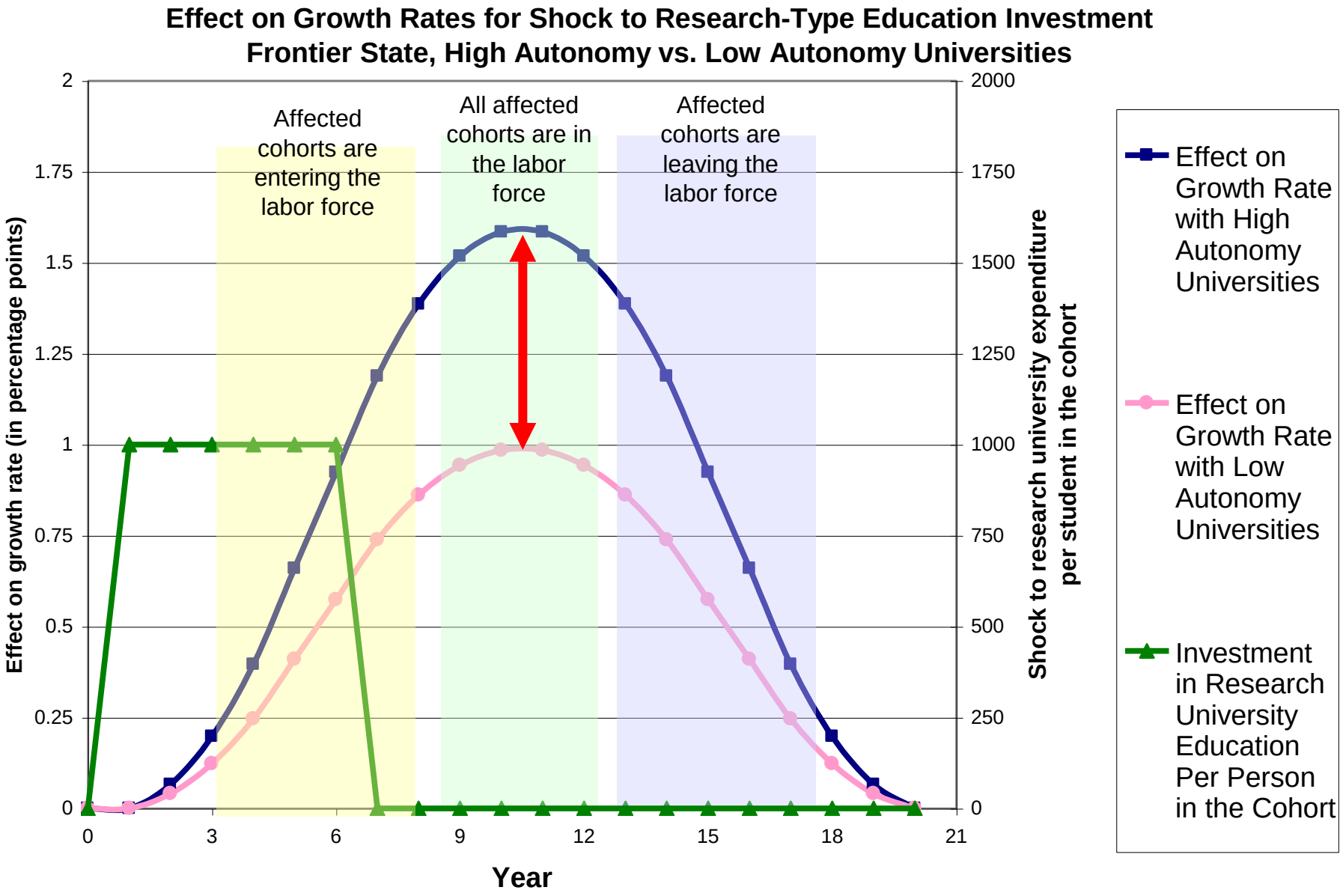
- All universities that have a Carnegie classification as research or doctoral universities
- Annual data from 1960 to 1995
- Data sources: US National Center for Education Statistics, J. Frederic Volkwein's autonomy data, Education Commission of the States, NSF, WebCASPAR Integrated Science and Engineering Resources Data System

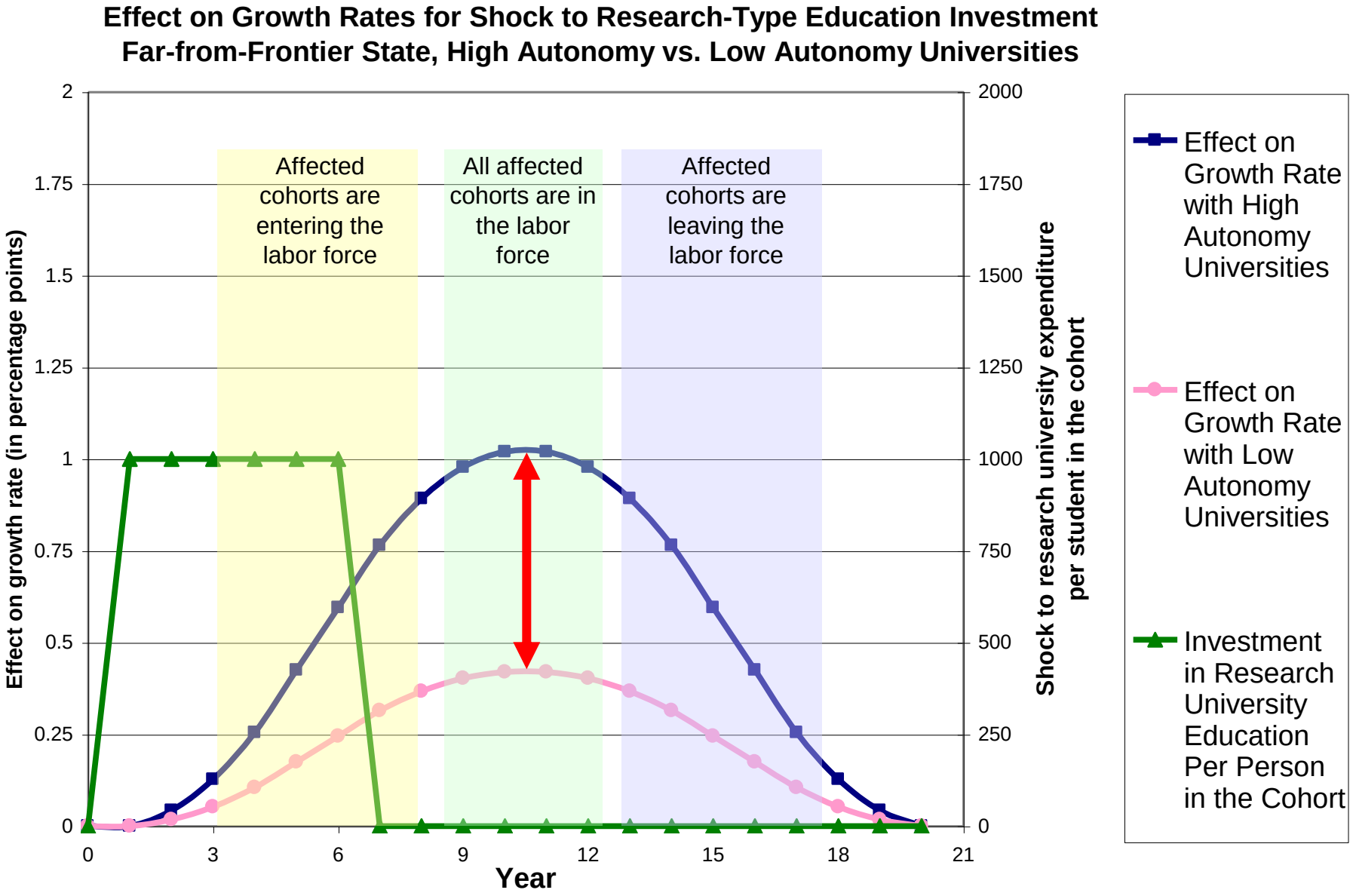
How University Autonomy Changes the Growth Effects of Investments in Research Universities

Dependent variable: Annual rate of growth, gross state product per employee in $2004	
Expenditure (thousands) on research universities per person in cohort	-0.025
Proximity * Expenditure (thousands) on 4-year colleges per person in cohort	**0.199**
Share Private * Proximity * Expenditure (thousands) on research universities per person in cohort	-0.024
Share Private * Expenditure (thousands) on research universities per person in cohort	**0.026**
Share Private * Proximity	**3.395**
Public Univ Autonomy * Proximity * Expenditure (thousands) on research universities per person in cohort	-0.020
Public Univ Autonomy * Expenditure (thousands) on research universities per person in cohort	**0.074**
Public Univ Autonomy * Proximity	**0.634**

How University Autonomy Changes the Growth Effects of Investments in Research Universities, continued

Effects of Expenditure on Research Universities (thousands) per person in the Cohort	
at 0.5 on the frontier (distant) states with average private share in research universities and average autonomy in public universities	**0.070**
at 0.5 on the frontier (distant) states with high private share in research universities and average autonomy in public universities	**0.096**
at 0.5 on the frontier (distant) states with average private share in research universities and high autonomy in public universities	**0.144**
at 0.5 on the frontier (distant) states with high private share in research universities and high autonomy in public universities	**0.170**
at the frontier states with average private share in research universities and average autonomy in public universities	**0.164**
at the frontier states with high private share in research universities and average autonomy in public universities	**0.190**
at the frontier states with average private share in research universities and high autonomy in public universities	**0.238**
at the frontier states with high private share in research universities and high autonomy in public universities	**0.264**


Effect on Growth Rates for Shock to Research-Type Education Investment
Frontier State, High Autonomy vs. Low Autonomy Universities
Affected cohorts are entering the labor force
All affected cohorts are in the labor force
Affected cohorts are leaving the labor force
Effect on growth rate (in percentage points)
Shock to research university expenditure per student in the cohort
Year
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
0
250
500
750
1000
1250
1500
1750
2000
0
3
6
9
12
15
18
21
Effect on Growth Rate with High Autonomy Universities
Effect on Growth Rate with Low Autonomy Universities
Investment in Research University Education Per Person in the Cohort


Effect on Growth Rates for Shock to Research-Type Education Investment
Far-from-Frontier State, High Autonomy vs. Low Autonomy Universities
Affected cohorts are entering the labor force
All affected cohorts are in the labor force
Affected cohorts are leaving the labor force
Effect on growth rate (in percentage points)
Shock to research university expenditure per student in the cohort
Year
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
0
250
500
750
1000
1250
1500
1750
2000
0
3
6
9
12
15
18
21
Effect on Growth Rate with High Autonomy Universities
Effect on Growth Rate with Low Autonomy Universities
Investment in Research University Education Per Person in the Cohort

Conclusion

- Growth in more advanced countries benefit more from more performing universities
- Performance hinges on a combination between finance and autonomy
- More than one model for achieving this combination