The role of education in enhancing productivity growth

Philippe Aghion

Schumpeterian Paradigm

- Long run growth driven by innovation
- Innovation driven by entrepreneurial investments (R&D…) which are themselves motivated by the prospect of monopoly rents
- Innovation involves creative destruction: new innovations replace old technologies

Schumpeterian Paradigm

- Frontier innovation and imitation requires different sets of policies and institutions
- Innovation requires:
  - removing all obstacles to competition and creative destruction
  - even greater emphasis on higher education

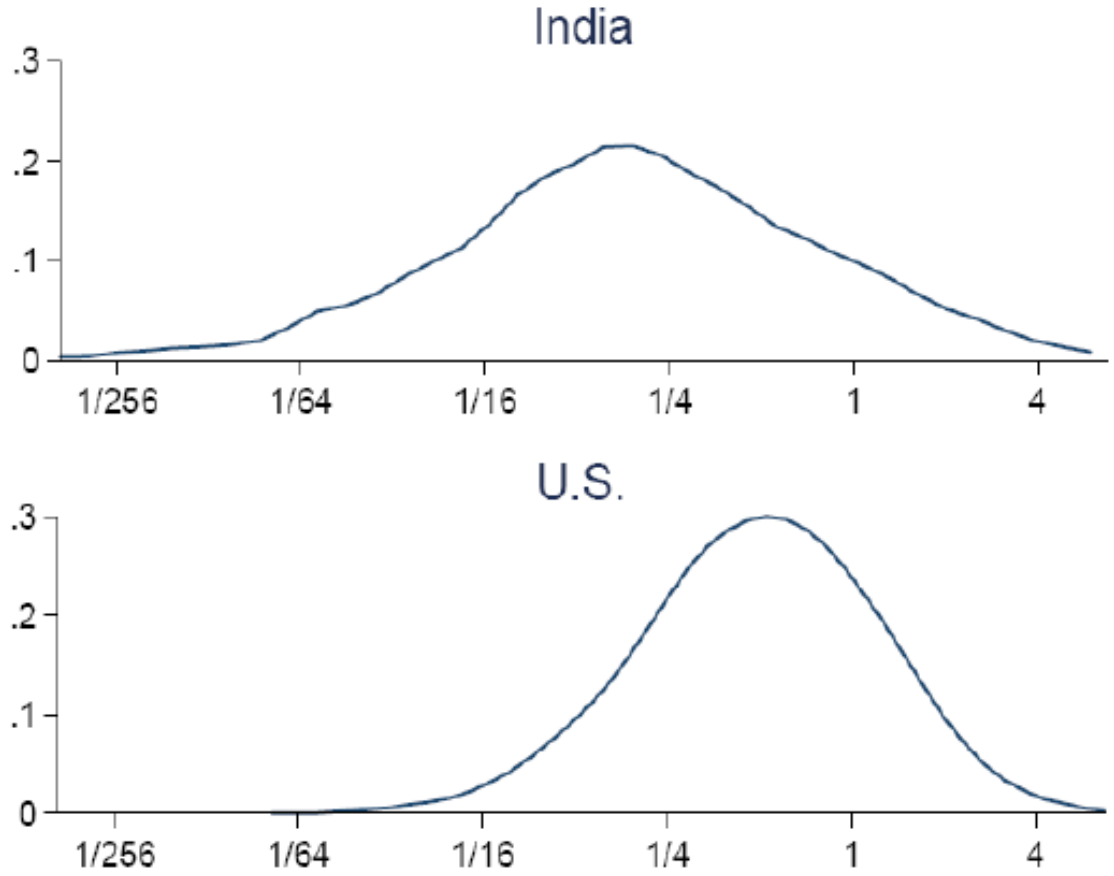
Education and growth

- Human capital as a factor of production (Lucas, Mankiw-Romer-Weil)
- Human capital as a mean to speed up catch-up growth and to foster innovation (Nelson-Phelps)

Enhancing productivity growth in emerging market economies

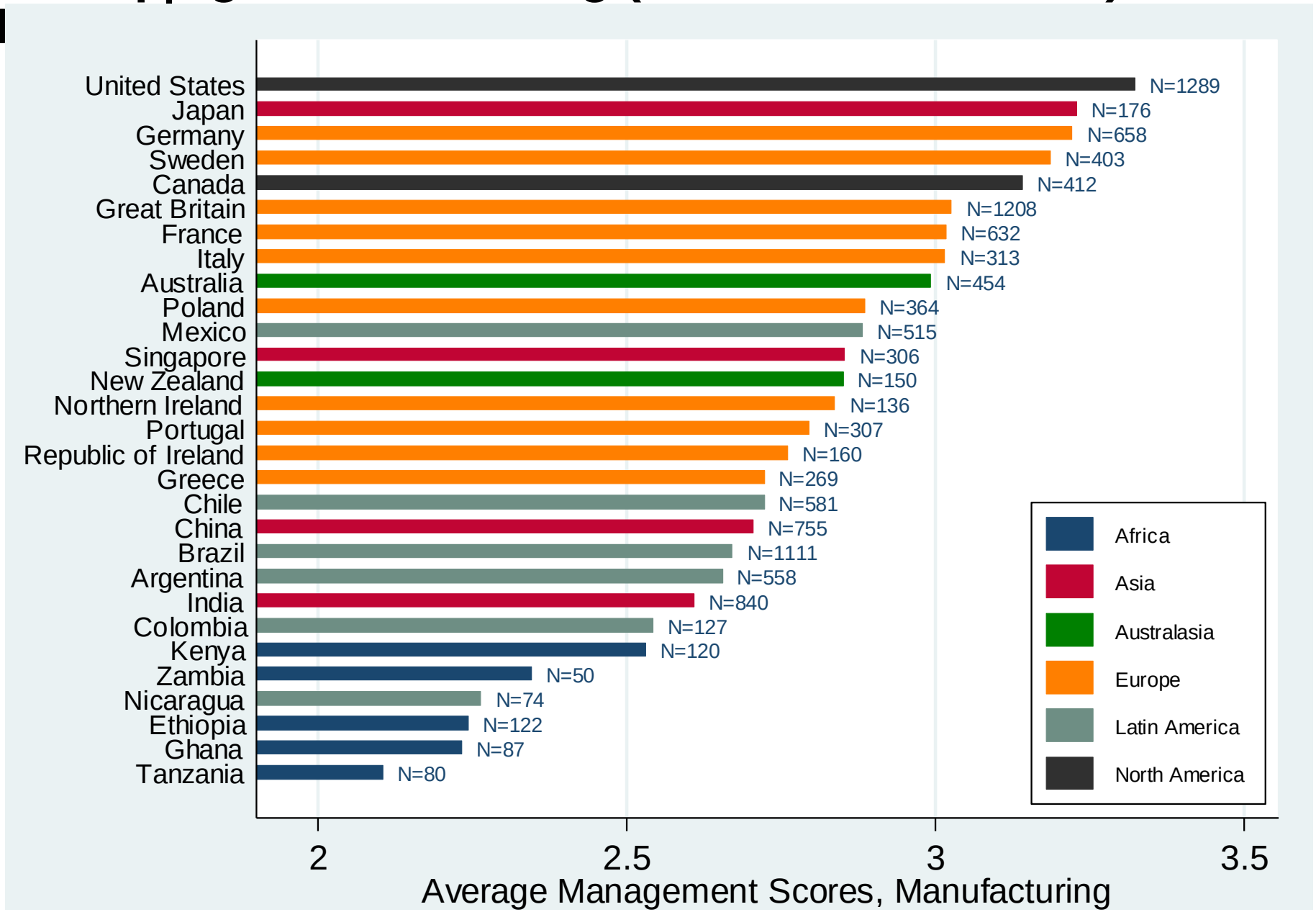
- Foster technology transfers
- Reallocate factors
- Improve management practices
- Education fosters those three levers of catch-up growth!!

DISTRIBUTION OF PLANT TFP DIFFERENCES IN US VS. INDIA HIGHER US TFP DUE TO REALLOCATION - THINNER "TAIL" OF LESS PRODUCTIVE PLANTS

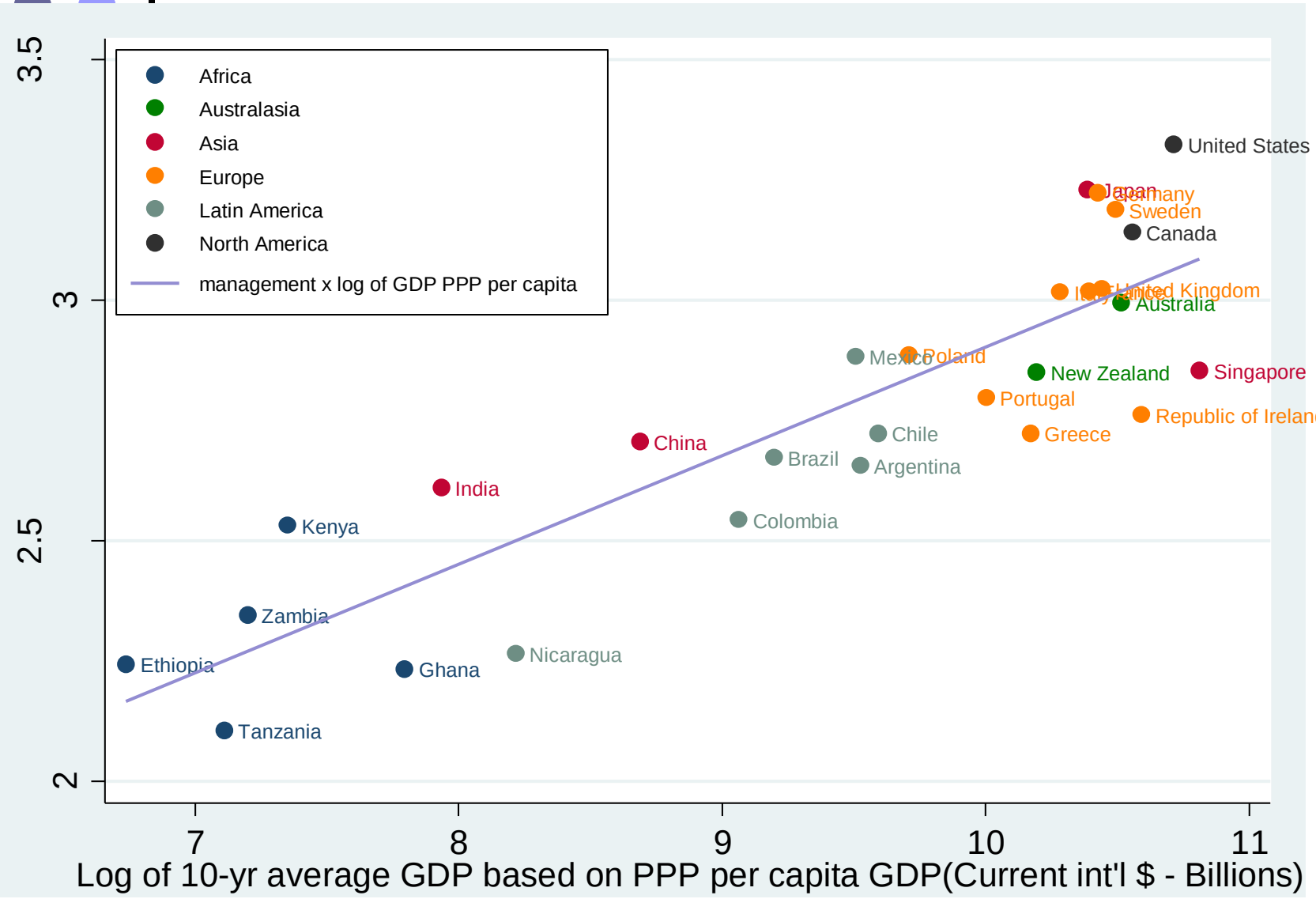


Source: Hsieh and Klenow (2009); US mean=1

Wide variation in management: US and Japan leading, developing nations trailing (includes 2013 wave)



Average management scores across countries are strongly correlated with GDP per capita



Data includes 2013 survey wave as of 9/20/2013. Africa data not yet included in the paper

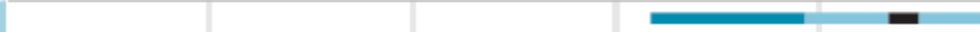
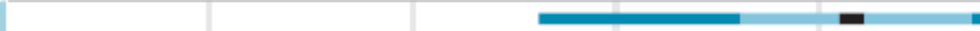
Why state intervention in education?

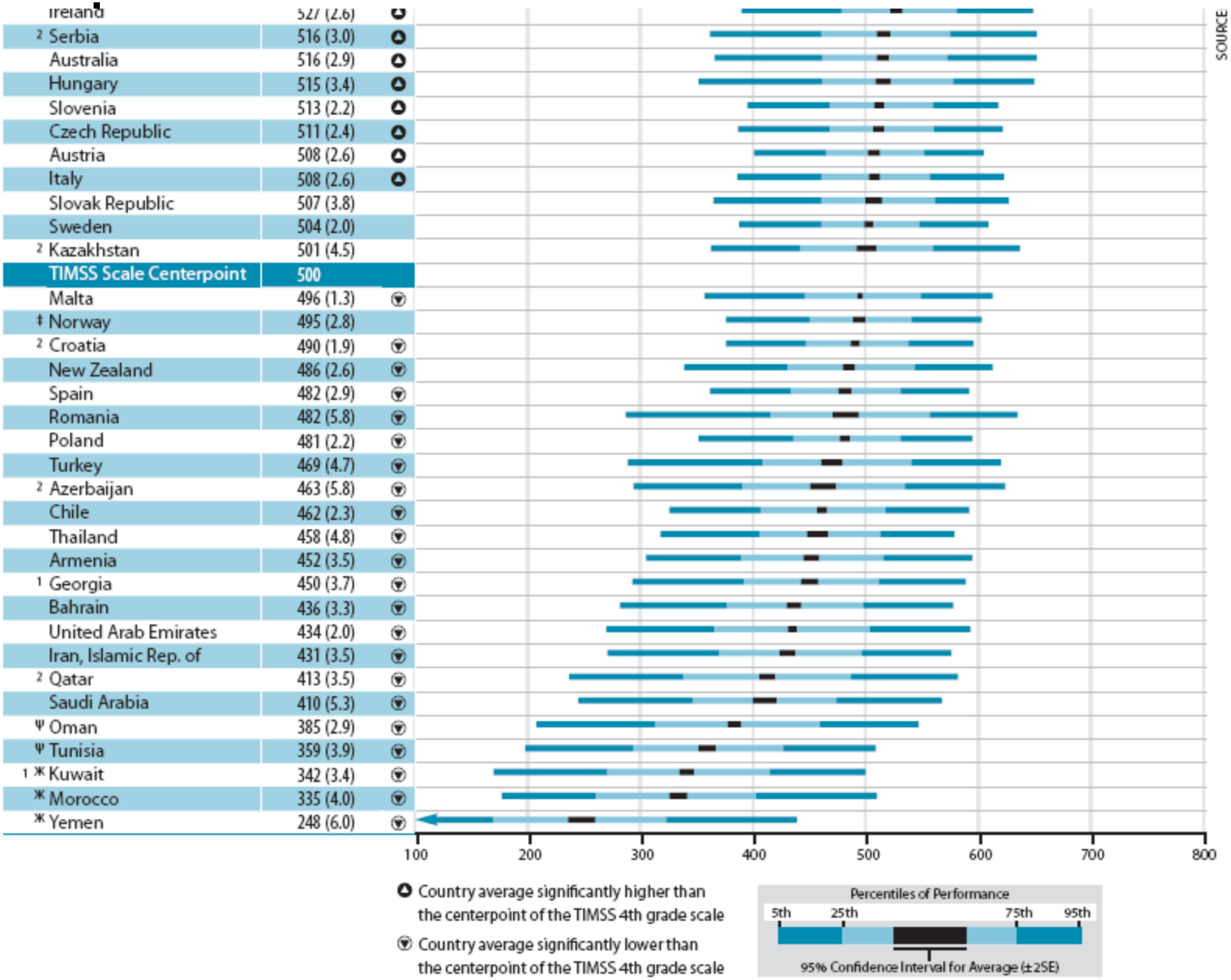
- Externalities
  - Contemporaneous
  - Integenerational
  - Growth externalities
- Credit constraints

Basic education

- Quality, not just quantity, of investment matters
- Hence the complementarity between investment and governance
- Illustration
  - PISA and growth

Exhibit 1.1: Distribution of Mathematics Achievement

Country	Average Scale Score	Mathematics Achievement Distribution
[2] Singapore	606 (3.2)	
Korea, Rep. of	605 (1.9)	
[2] Hong Kong SAR	602 (3.4)	
Chinese Taipei	591 (2.0)	
Japan	585 (1.7)	
† Northern Ireland	562 (2.9)	
Belgium (Flemish)	549 (1.9)	
Finland	545 (2.3)	
England	542 (3.5)	
Russian Federation	542 (3.7)	
[2] United States	541 (1.8)	
† Netherlands	540 (1.7)	
[2] Denmark	537 (2.6)	
[1 2] Lithuania	534 (2.4)	
Portugal	532 (3.4)	
Germany	528 (2.2)	
Ireland	527 (2.6)	
[2] Serbia	516 (3.0)	
Australia	516 (2.9)	
Hungary	515 (3.4)	
Slovenia	513 (2.2)	



✳ Average achievement not reliably measured because the percentage of students with achievement too low for estimation exceeds 25%.

PISA and growth

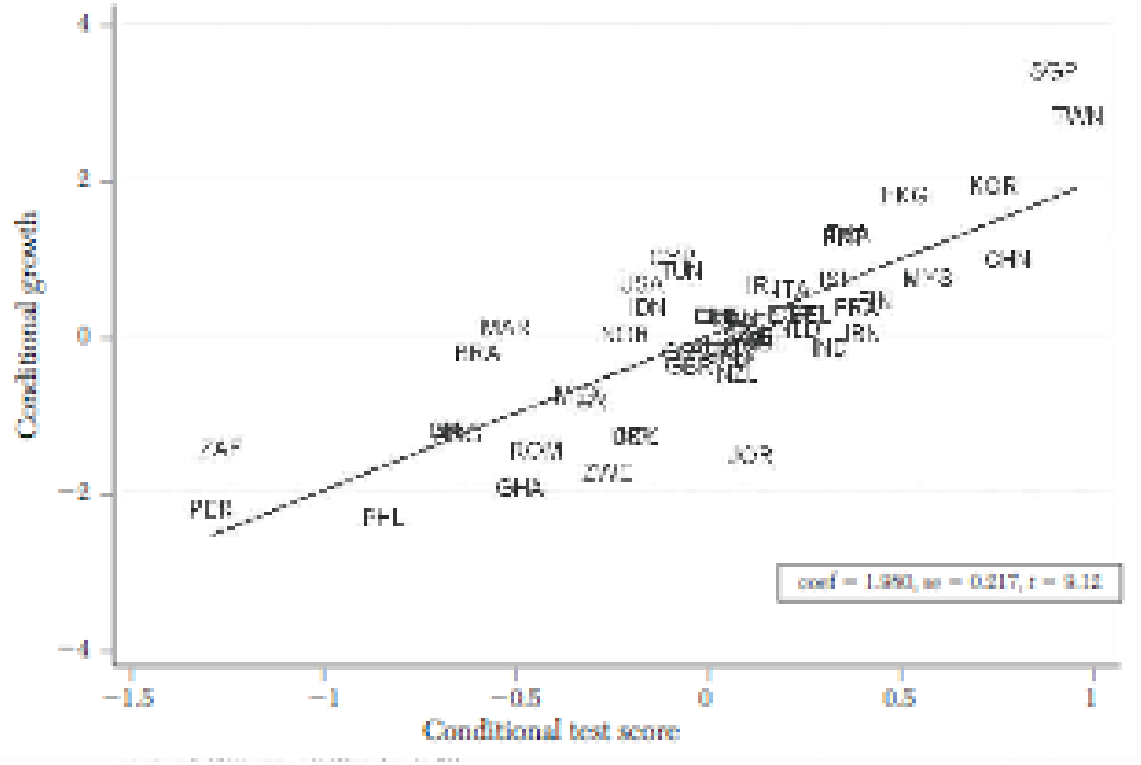


Figure 7. Added-Variable Plot of Growth and Test Scores

Notes: Added-variable plot of a regression of the average annual rate of growth (in percent) of real GDP per capita in 1960–2000 on the initial level of real GDP per capita in 1960, average test scores on international student achievement tests, and average years of schooling in 1960. Author calculations; see table 2, column 2.

Years of schooling and growth

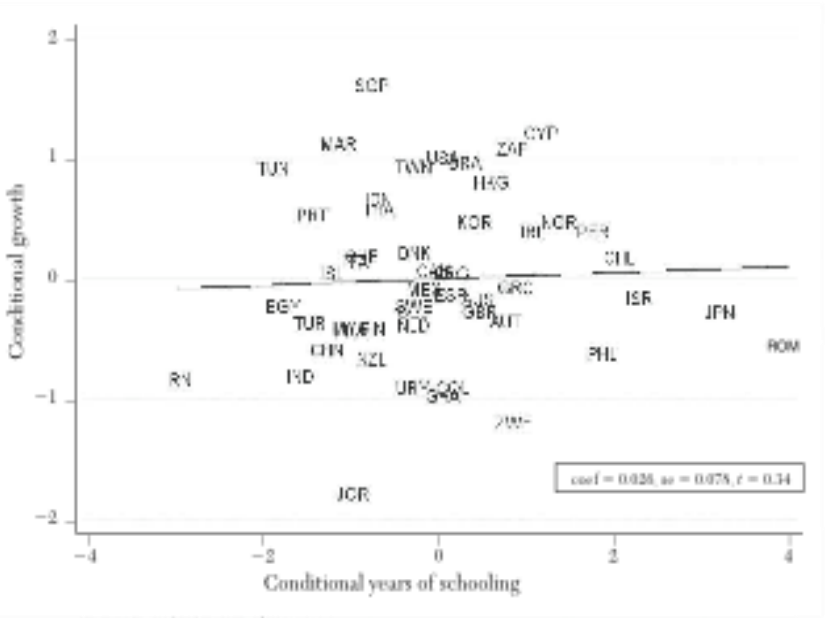


Figure 8. Added-Variable Plot of Growth and Years of Schooling with Test Score Controls

Notes: Added-variable plot of a regression of the average annual rate of growth (in percent) of real GDP per capita in 1960–2000 on the initial level of real GDP per capita in 1960, average test scores on international student achievement tests, and average years of schooling in 1960. Author calculations; see table 2, column 2.

The Finnish experience

- Same chances for all
- No early selection but instead tutorship system
- Invest in teacher quality (Chetty et al.)
- Good compromise between national standards and local autonomy

Teaching methods

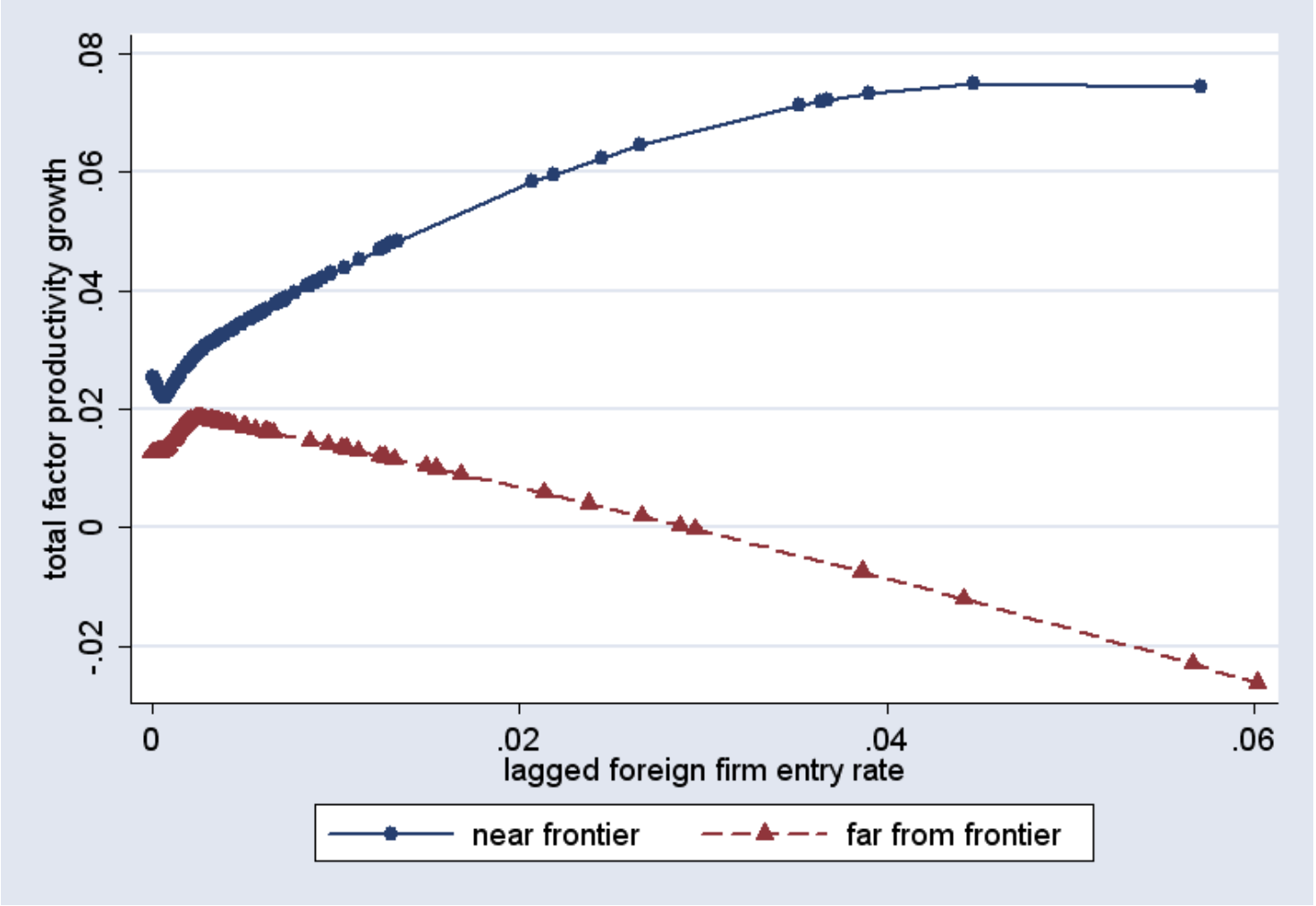
- Avoid too vertical
  - Algan et al (2013)
- Avoid too horizontal
  - Flawed Swedish reform

Thus….

- Productivity growth in EMEs is fostered by better performing schools
- Performance hinges on a combination between teacher quality, efficient tutorship and good synergy between central and local levels

Enhancing innovation-based growth

- Investment in higher education
- Full liberalization of product market (creative destruction)
- Full liberalization of labor market (flexibility and training)


total factor productivity growth
-.02
0
.02
.04
.06
.08
0
.02
.04
.06
lagged foreign firm entry rate
near frontier
far from frontier

Importance of graduate education and research

Cross-country analysis

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.

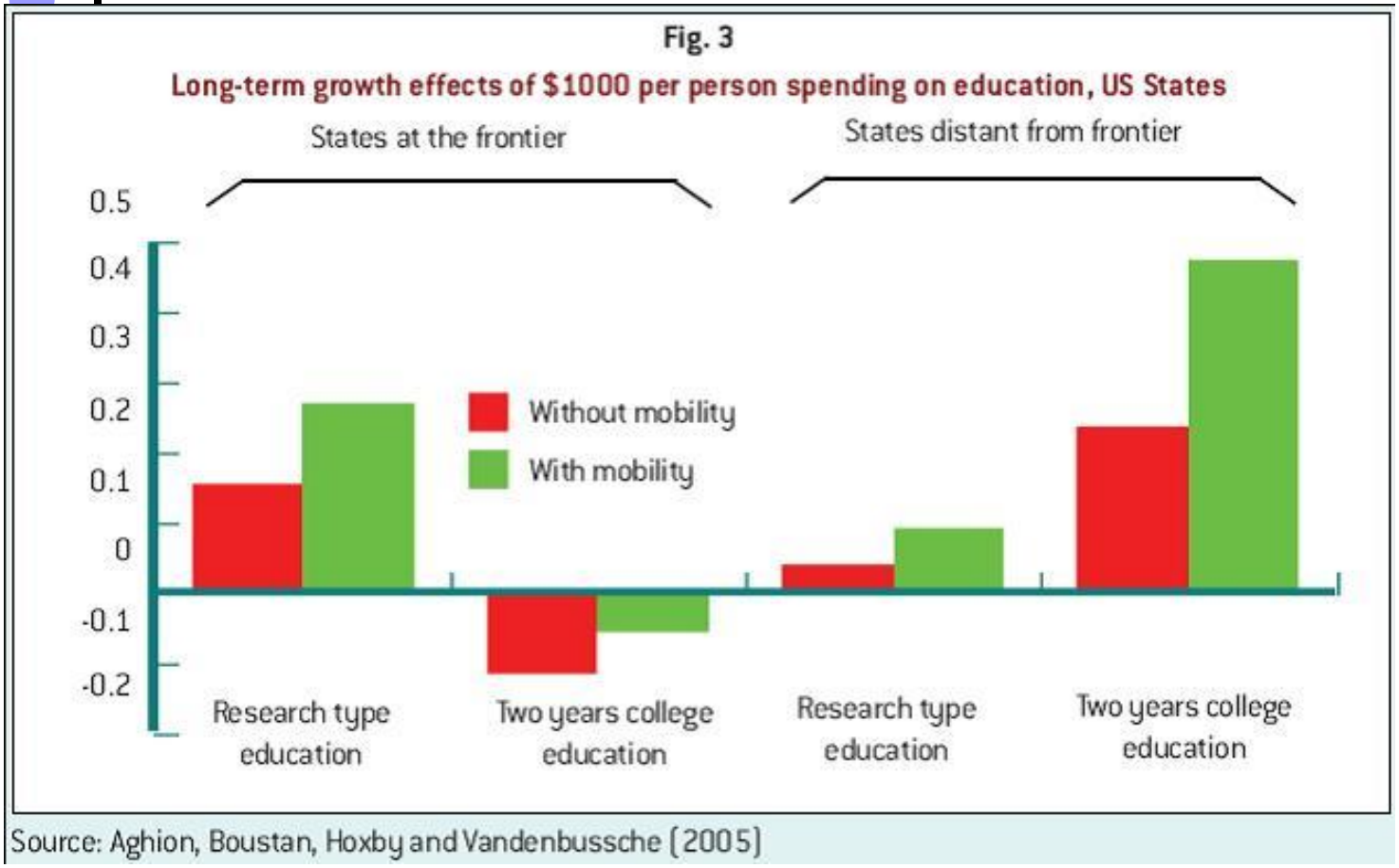


Fig. 3
Long-term growth effects of $1000 per person spending on education, US States
States at the frontier
States distant from frontier
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
Without mobility
With mobility
Research type education
Two years college education
Research type education
Two years college education
Source: Aghion, Boustan, Hoxby and Vandenbussche (2005)

Effect on Growth Rates for Shock to Research-Type Education Investment
Frontier State, High Autonomy vs. Low Autonomy Universities

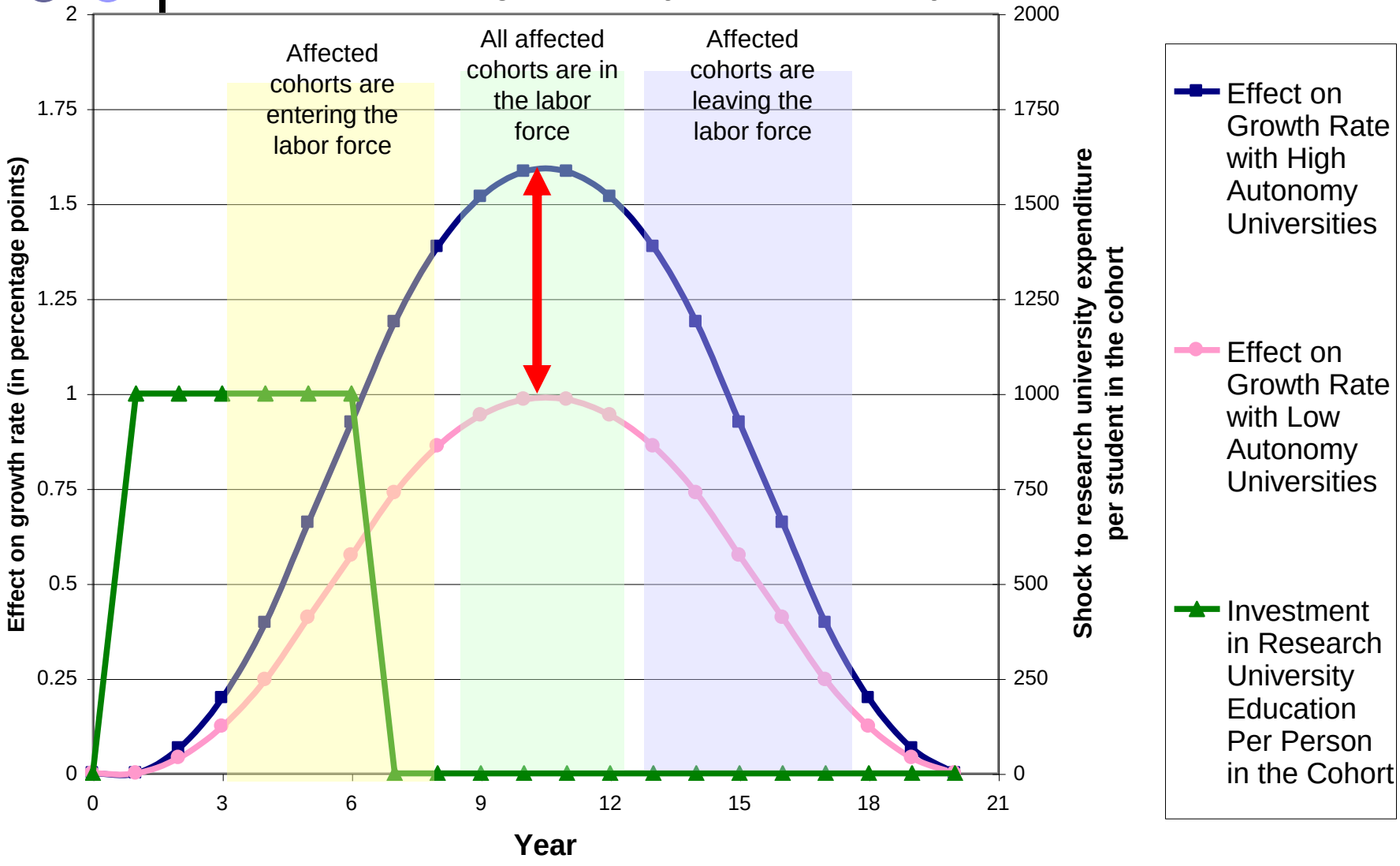
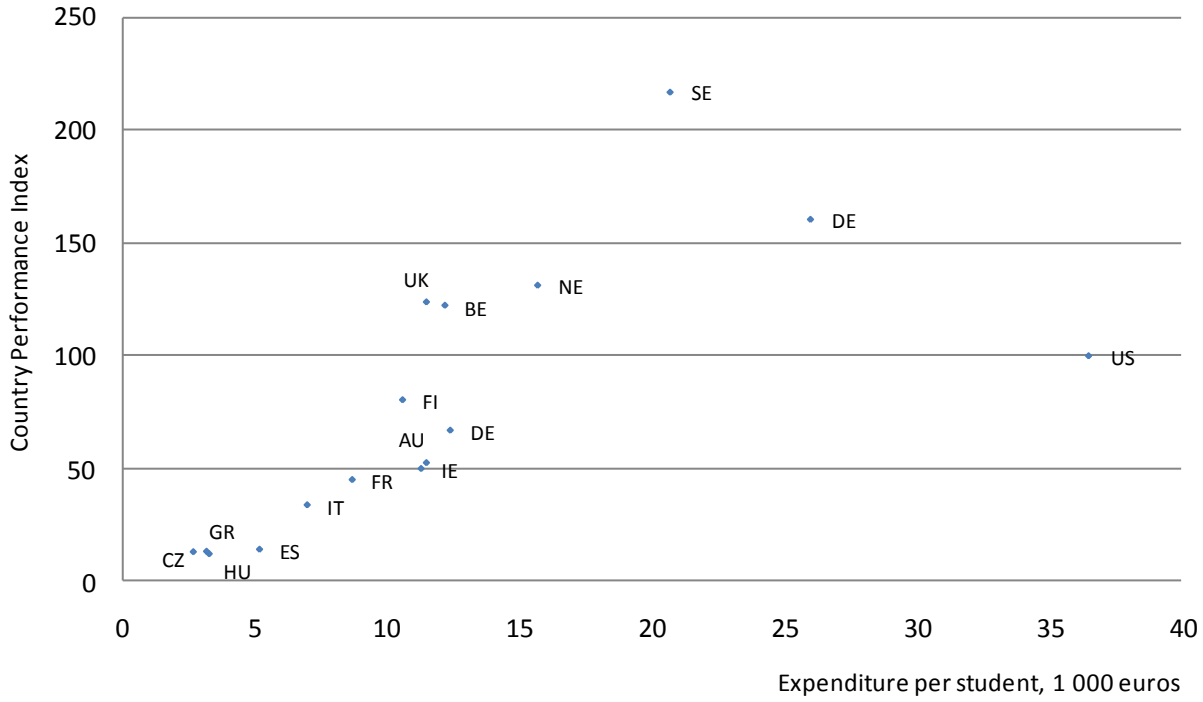
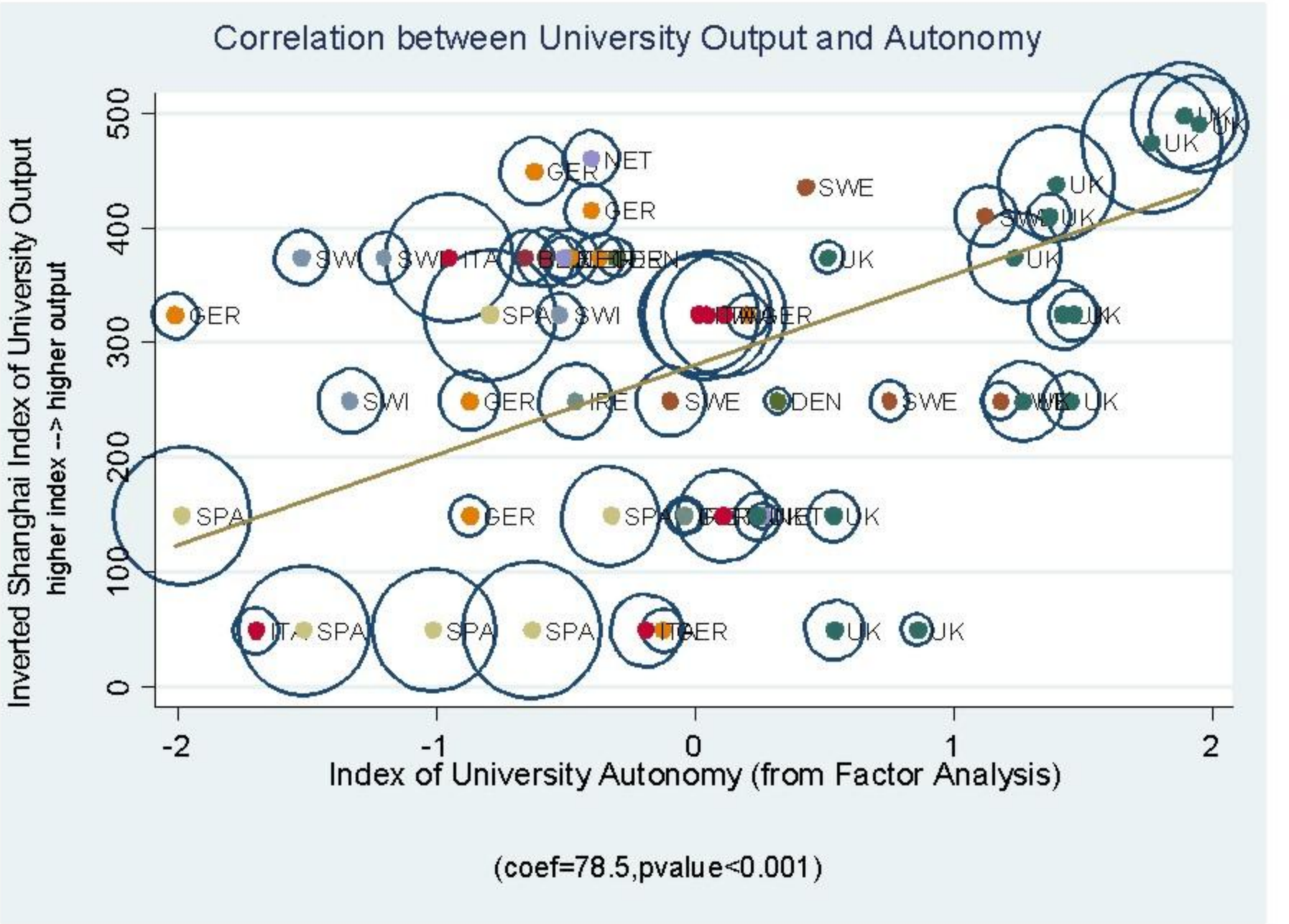
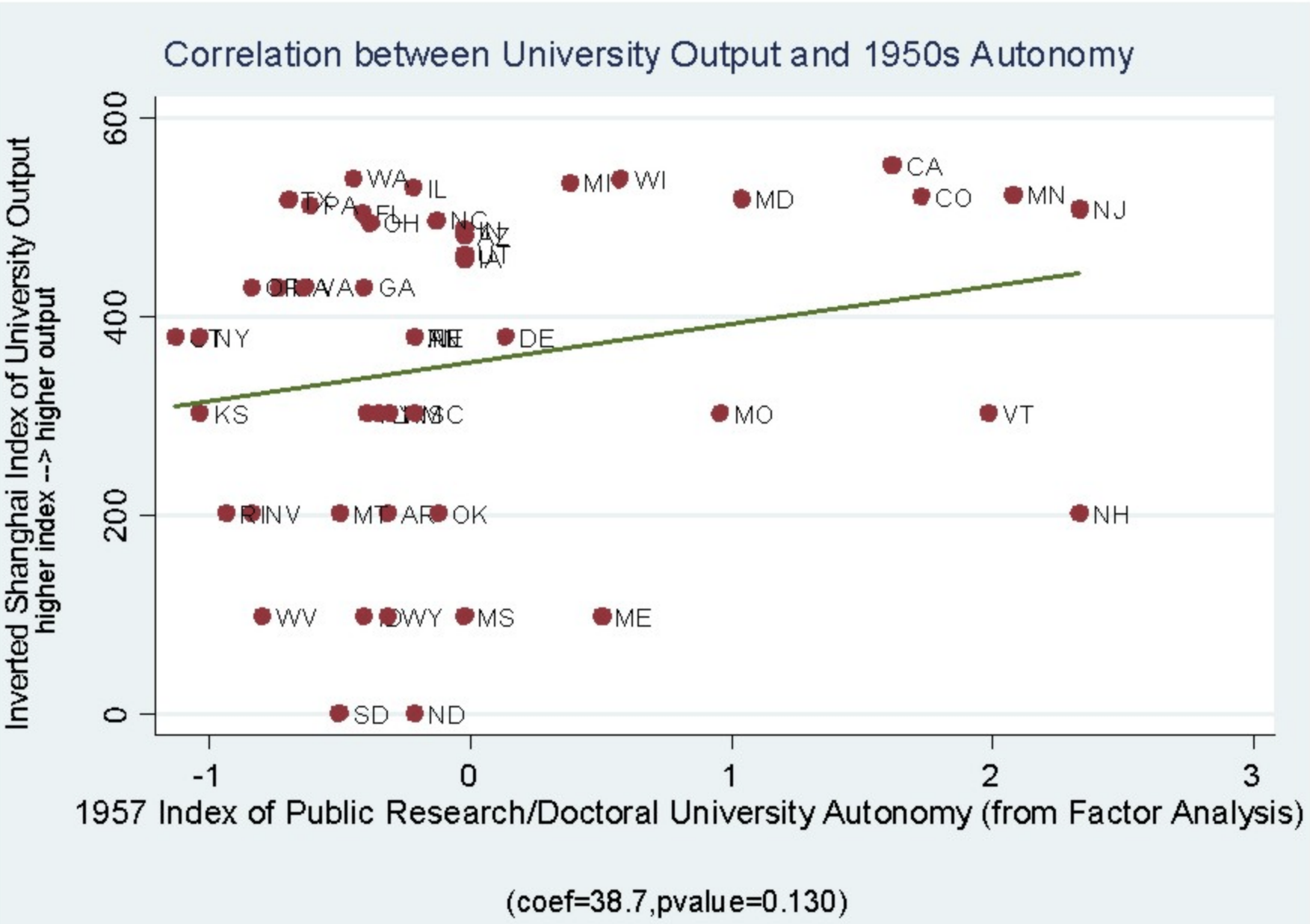
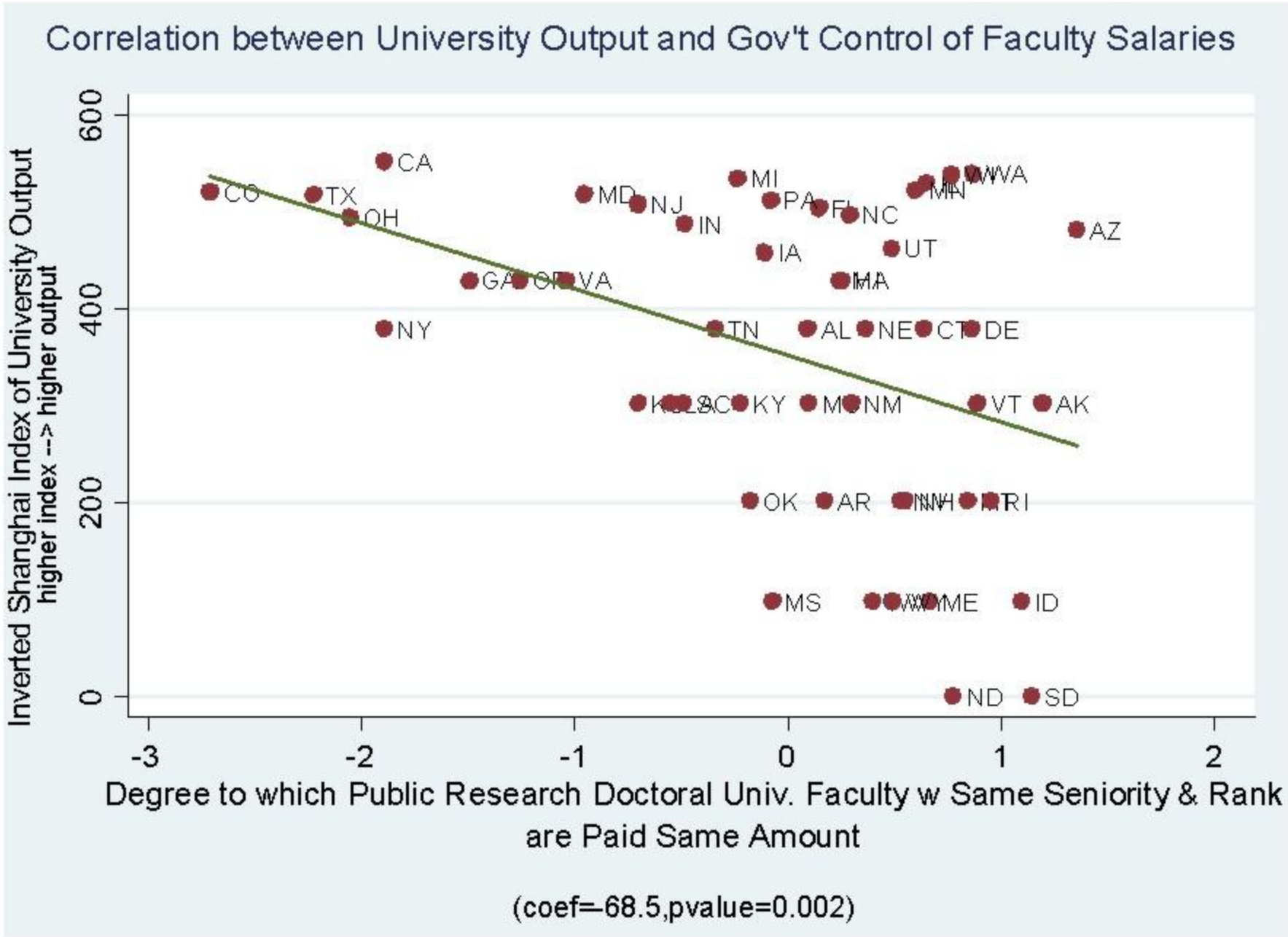


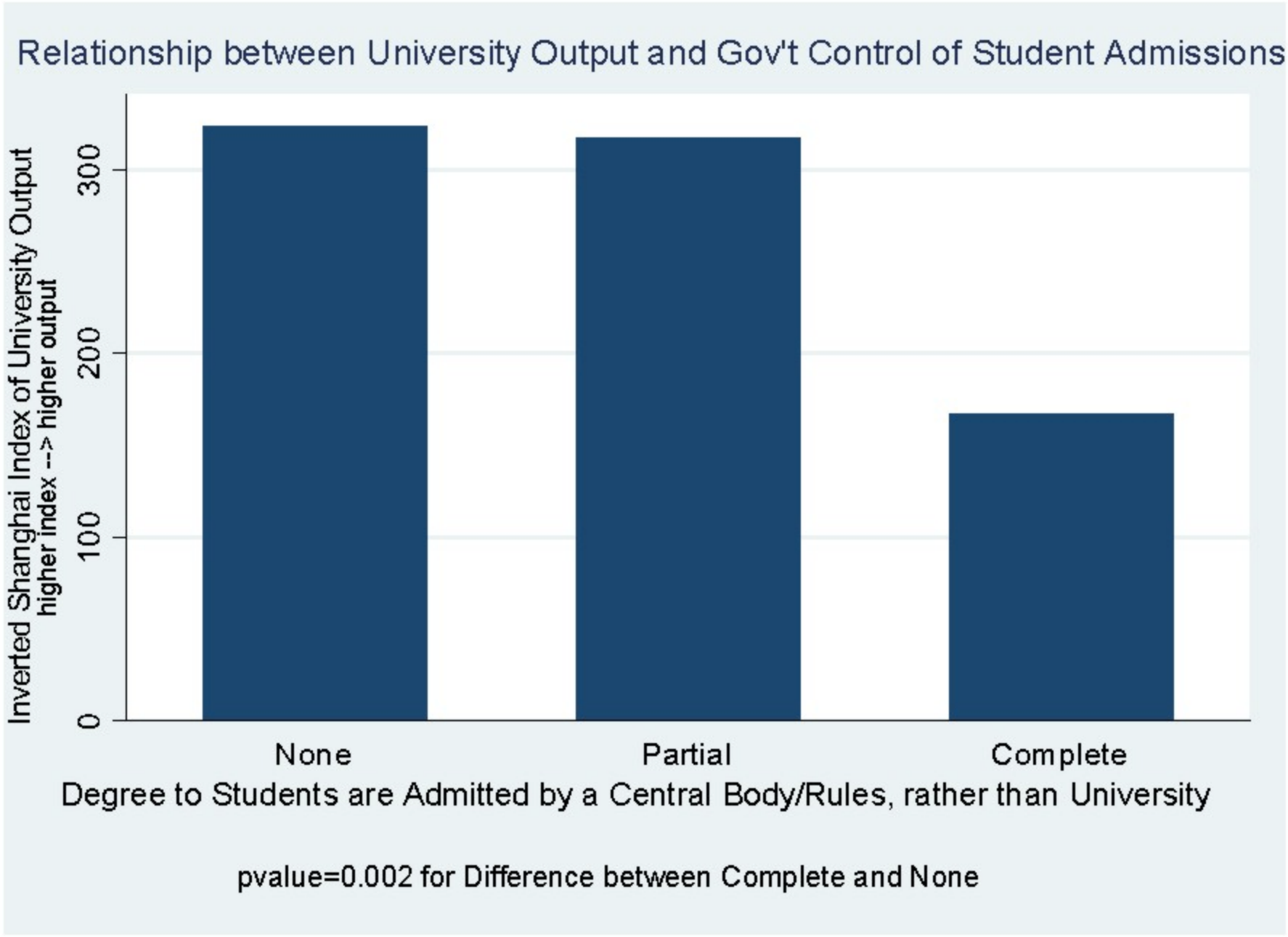
Figure 2: Relationship between expenditure per student and country performance

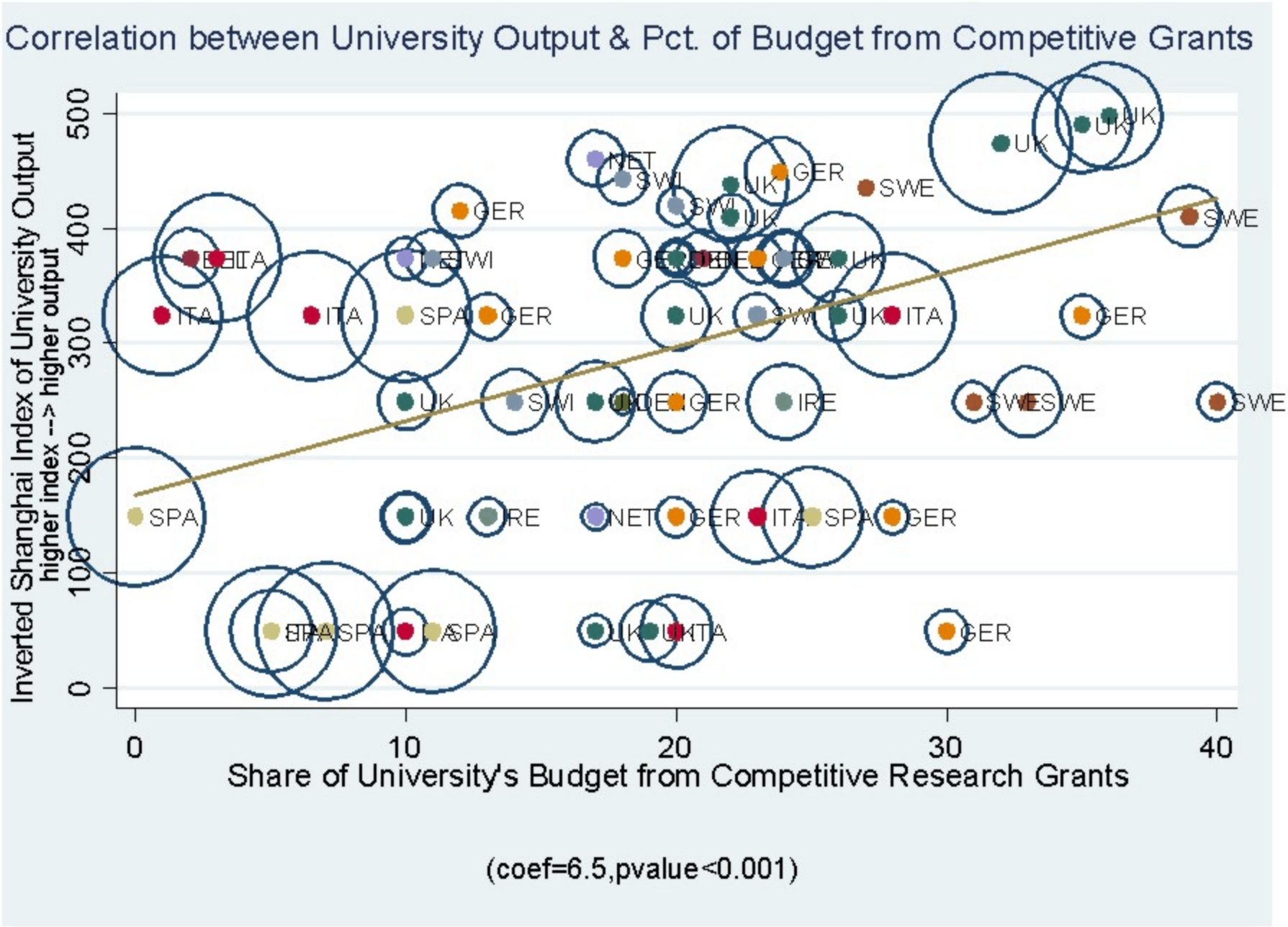


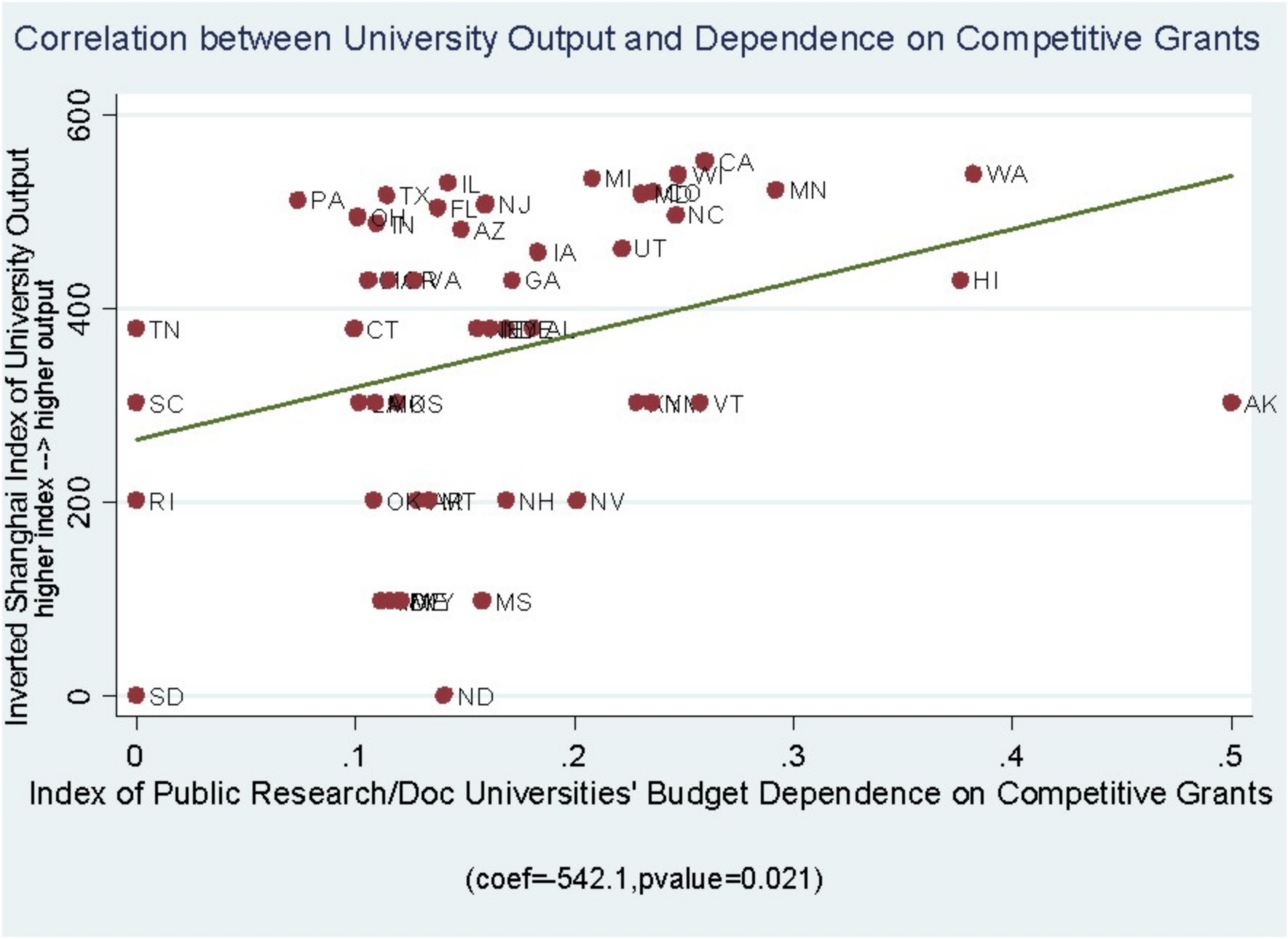

Correlation between University Output and Autonomy
Inverted Shanghai Index of University Output
higher index --> higher output
0
100
200
300
400
500
-2
-1
0
1
2
Index of University Autonomy (from Factor Analysis)
(coef=78.5,pvalue<0.001)
NET
GER
SWE
UK
SWI
ITA
SPA
IRE
DEN


Correlation between University Output and 1950s Autonomy
Inverted Shanghai Index of University Output
higher index --> higher output
600
400
200
0
-1
0
1
2
3
1957 Index of Public Research/Doctoral University Autonomy (from Factor Analysis)
(coef=38.7,pvalue=0.130)
WA
IL
MI
WI
CA
MD
CO
MN
NJ
GA
DE
KS
MO
VT
NH
MT
OK
WV
MS
ME
SD
ND


Correlation between University Output and Gov't Control of Faculty Salaries
Inverted Shanghai Index of University Output
higher index --> higher output
600
400
200
0
CA
CO
TX
OH
MD
NJ
IN
MI
PA
NC
AZ
IA
UT
GA
VA
NY
TN
AL
NE
CT
DE
KY
NM
VT
AK
OK
AR
RI
MS
ME
ID
ND
SD
-3
-2
-1
0
1
2
Degree to which Public Research Doctoral Univ. Faculty w Same Seniority & Rank
are Paid Same Amount
(coef=-68.5,pvalue=0.002)


Relationship between University Output and Gov't Control of Student Admissions
Inverted Shanghai Index of University Output
higher index --> higher output
0
100
200
300
None
Partial
Complete
Degree to Students are Admitted by a Central Body/Rules, rather than University
pvalue=0.002 for Difference between Complete and None


Correlation between University Output & Pct. of Budget from Competitive Grants
Inverted Shanghai Index of University Output
higher index --> higher output
0
100
200
300
400
500
0
10
20
30
40
Share of University's Budget from Competitive Research Grants
(coef=6.5,pvalue<0.001)


Correlation between University Output and Dependence on Competitive Grants
Inverted Shanghai Index of University Output
higher index --> higher output
600
400
200
0
CA
MI
WI
WA
MN
PA
TX
IL
FL
NJ
MD
NC
OH
TN
AZ
IA
UT
VA
GA
HI
TN
CT
SC
VT
AK
RI
NH
NV
MS
SD
ND
0
.1
.2
.3
.4
.5
Index of Public Research/Doc Universities' Budget Dependence on Competitive Grants
(coef=-542.1,pvalue=0.021)

Thus….

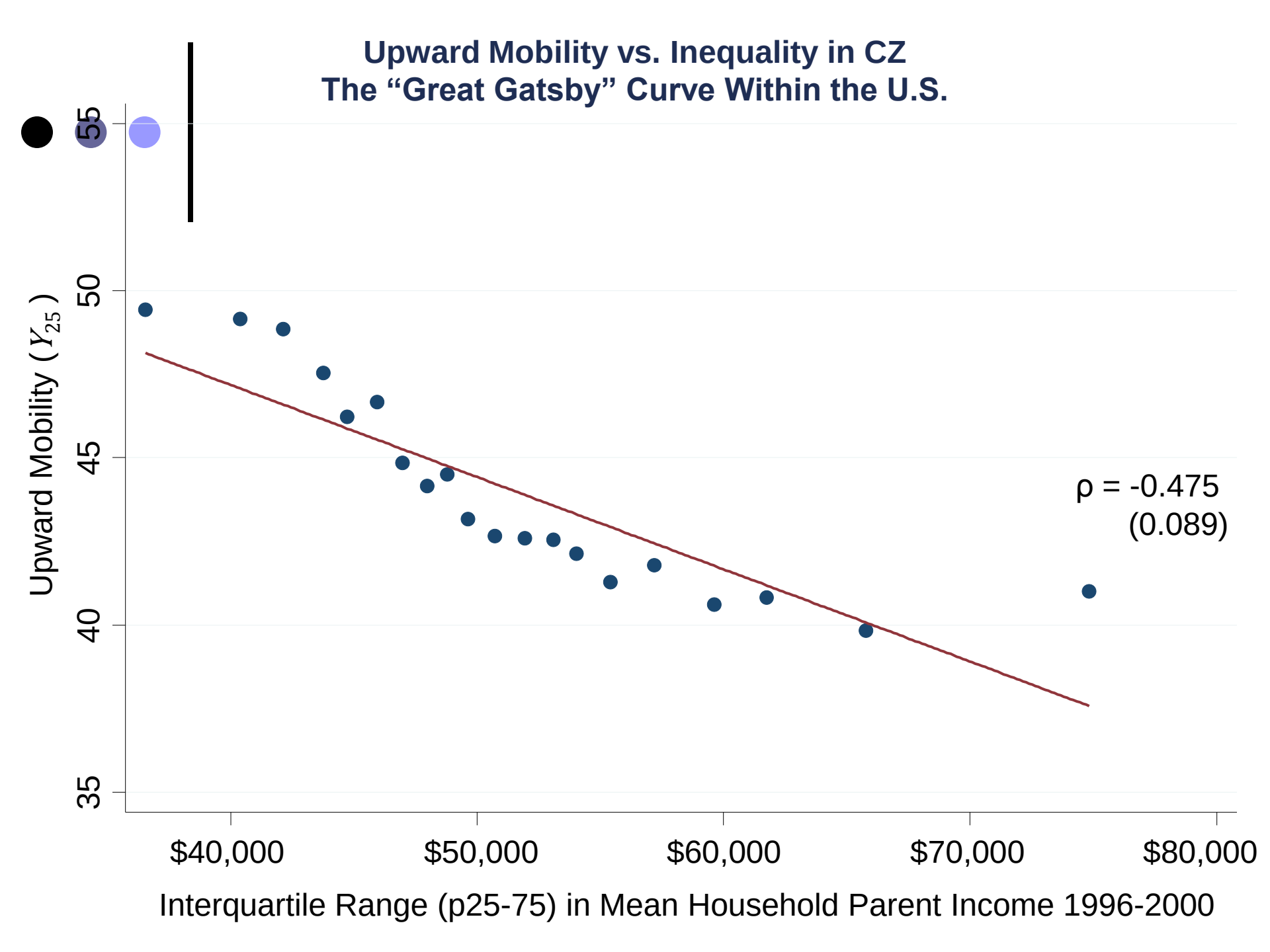
- Innovation-based growth requires performing universities
- Performance hinges on a combination between finance, autonomy, and competition for grants

Conclusion

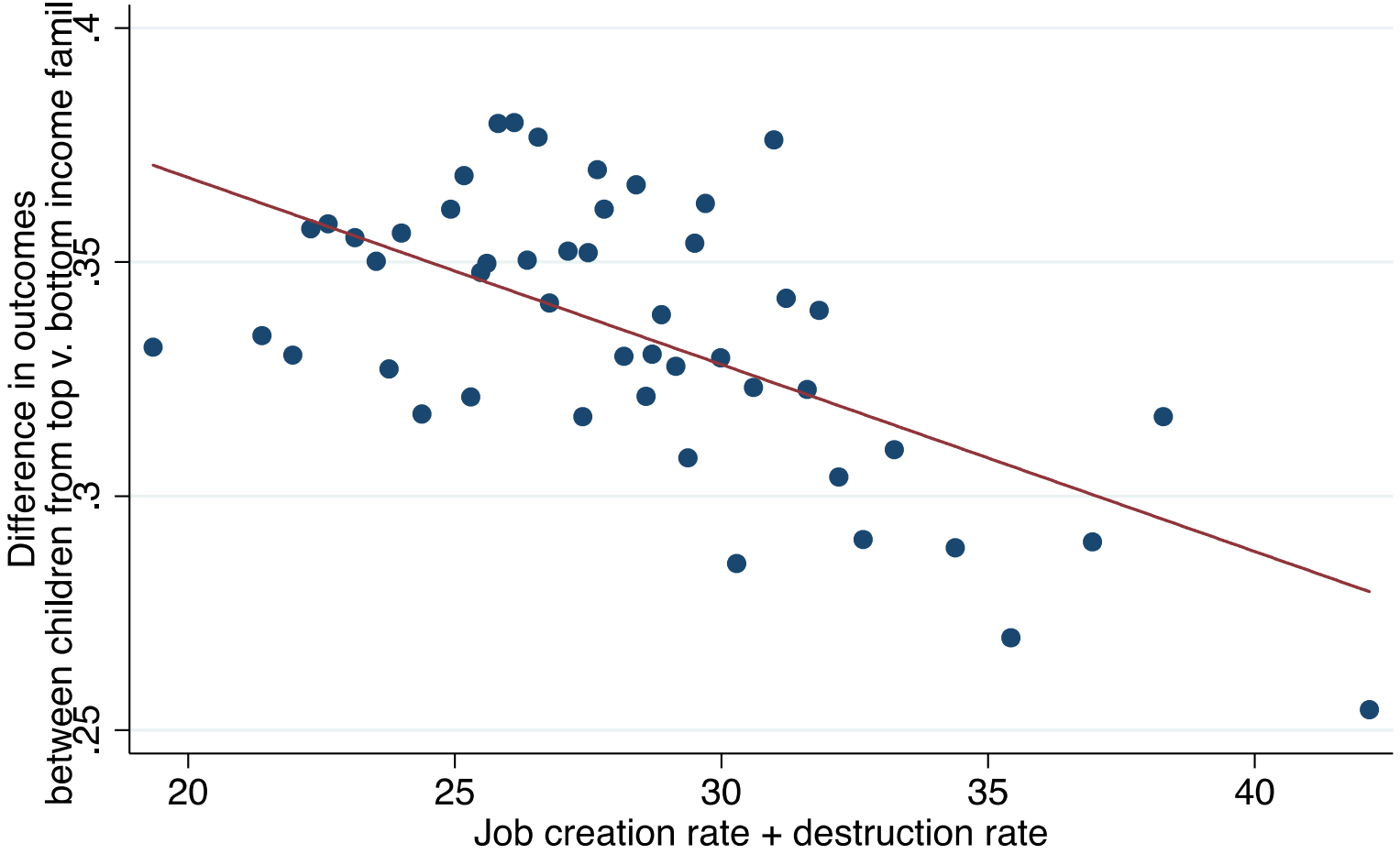
- Catch-up growth requires high-quality primary and secondary education
- Innovation-based growth also requires good research and graduate education
- Complementarity between funding and governance
- Importance of evaluation tests (PISA, Shanghai,…)

Inclusive growth

- Good-quality schooling also enhances social mobility and reduces inequality….
- ….thereby favoring more inclusive growth!!
- So does more competition and entry!


Upward Mobility vs. Inequality in CZ
The "Great Gatsby" Curve Within the U.S.
55
50
45
40
35
Upward Mobility (Y_{25})
ρ = -0.475
(0.089)
$40,000
$50,000
$60,000
$70,000
$80,000
Interquartile Range (p25-75) in Mean Household Parent Income 1996-2000

Intergenerational mobility and creative destruction



The relative mobility measure comes from the Equality of Opportunity Project.
It is the slope coefficient of a within MSA regression of child income rank against parent income rar