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WHY REFORM EUROPE'S UNIVERSITIES?

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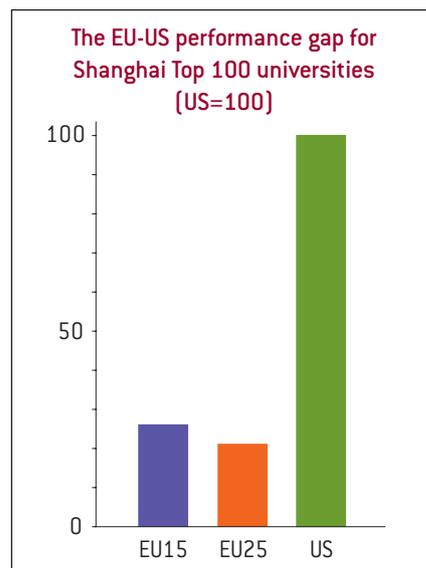
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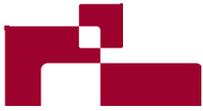
SUMMARY Recently published international rankings indicate that the performance gap between European and American universities is large and, in particular, that the best European universities lag far behind the best American universities. **The country performance index we construct using the Shanghai ranking confirms that, despite the good performance of some countries, Europe as a whole trails the US by a wide margin.** The reason for this situation, which contributes to Europe's lagging growth performance, is two-fold. First, Europe invests too little in higher education. Total public and private spending on higher education in EU25 accounts for barely 1.3% of GDP, against 3.3% in the US. This translates into average spending of less than €10,000 per student in EU25 versus more than €35,000 in the US. Second, European universities suffer from poor governance, insufficient autonomy and often perverse incentives. Our own survey of European universities shows that both factors contribute to the EU's poor performance and that reform should take place on both fronts, because autonomy also increases the efficiency of spending.



Source: Bruegel country performance index, see Table 1.

POLICY CHALLENGE

If Europe is to be a leader in the global knowledge economy – and if universities are to produce the top-level research needed to achieve this – comprehensive reform of higher education is the order of the day. While there is more than one university system that works, most European countries should invest an extra one percent of their GDP in higher education each year. The extra funding may be public or private. To make this additional funding ‘bite’, universities should be given more autonomy in budgets, hiring and remuneration.



EUROPEAN growth has been disappointing for the last 30 years but policymakers have only recently started to realise that Europe's growth performance is intimately linked with the research performance of its universities.

Europe invests too little in higher education. It is generally known that the European Union (EU) spends less than two percent of its GDP on research and development (R&D), compared to more than 2.5 percent in the United States (US). But the gap between Europe and the US is even wider for spending on universities than for R&D. In 2001, total (public and private) spending on higher education in EU25 accounted for barely 1.3 percent of GDP, against 3.3 percent in the US. In other words, every year Europe spends two percent of GDP less than the US. In terms of expenditure per student, the contrast is starker still, with an annual spend of €8,700 in EU25 versus €36,500 in the US.

But the unsatisfactory research performance of Europe's universities also results from inadequate institutions. European universities suffer from poor governance, insufficient autonomy and often perverse incentives.

Europe started to recognise some years ago that its university system faces a problem. A first step was the Bologna Declaration which initiated the creation of a 'European Higher Education Area'. Recently, a growing number of individual EU member states have introduced reforms of their university systems.

However, it is the recent publication of global rankings, such as the Shanghai Jiao Tong University Academic Ranking of World Universities (the 'Shanghai ranking'), which has made most policy-

makers aware of the magnitude of the problem and sparked a public debate on university reform.

The purpose of this policy brief is to examine what reforms are needed in order to enable European universities to produce world-class research and thus make the optimum contribution to growth¹.

In the first section of this brief, we draw conclusions from the Shanghai ranking both about European university research performance in relation to that of US institutions and about differences in performance between European countries. We then report on our own survey of European universities listed in the Shanghai ranking, which we use to establish what determines university research performance. We also use comprehensive US data to analyse the interplay between autonomy and funding in boosting university research performance. Finally, we make concrete proposals about how to improve the conditions for research at European universities with the objective of improving their contribution to growth.

1. COUNTRY PERFORMANCE

The debate on the funding and governance of European universities has been stirred considerably

by the publication, since 2003, of the Shanghai ranking which measures university research performance. Constructed by a group of Chinese scholars, the Shanghai ranking is a weighted average of six different indicators (see Box 1). While the weights are admittedly somewhat arbitrary, the main advantage of the index is its reliance on publicly available information.

Table 1 presents a detailed account of relative country performance, looking successively at the Top 50, Top 100, Top 200 and Top 500 universities in the Shanghai ranking. To understand how to read this table, consider first the column 'Top 50'. The best university in the Top 50 is given a score of 50, the next best university is given 49, and so on, down to a score of 1 for the lowest performing university within the Top 50. For each country (or region), we then compute the sum of Top 50 Shanghai rankings that belong to this country, and divide the sum by the country's population. Finally, all the country scores are divided by the US score, so that each entry in the column 'Top 50' can be interpreted as a fraction of the US per capita performance for the Top 50 universities. This gives our Country Performance Index for the Top 50 universities. The same logic applies, respectively, to the 'Top

Box 1: The Shanghai ranking

This index aggregates six different indicators of research performance:

- The number of alumni from the university winning Nobel Prizes in physics, chemistry, medicine, and economics and Fields Medals in mathematics.
- The number of university faculty winning Nobel Prizes in physics, chemistry, medicine, and economics and Fields Medals in mathematics.
- The number of articles (co-)authored by university faculty published in Nature and Science.
- The number of articles (co-)authored by university faculty published in Science Citation Index Expanded and Social Sciences Citation Index.
- The number of highly cited researchers from the university in 21 broad subject categories.
- The academic performance with respect to the size of the university.

Note that the Shanghai ranking tends to undervalue countries where a great deal of academic scientific research takes place outside universities (the Max Planck Institutes in Germany) or in centres whose researchers are affiliated with several universities (the CNRS laboratories in France). This partly explains the poor performance of France and Germany in Table 1.

¹ This policy brief does not deal with all the various roles and functions of universities, solely their research function.

An upcoming Bruegel Blueprint will provide a fuller analysis of how universities perform against a broader set of objectives. Furthermore, this policy brief does not discuss the potential of EU-level policy to add value.

This will also be dealt with in the upcoming Blueprint.



100', 'Top 200' and 'Top 500' columns, where the best university receives a score of, respectively, 100, 200 and 500, and the last one receives a score of 1. There are, obviously, fewer zero entries in a column as one moves from the Top 50 to the Top 500 as it is easier for a country to have universities appearing in the Top 500 than in the Top 50.

Table 1 reveals several interesting findings:

- First, the United States completely dominates all European countries in the Top 50 universities. Only Switzerland and the United Kingdom rival the US on a per capita basis. By contrast, the EU15 and EU25, with a greater population than the US, score much lower.
- Second, the top 4 US states (Massachusetts, California, New York and Pennsylvania) score better than any European state in the Top 50 and Top 100.
- Third, country performance gaps close as one enlarges the number of universities considered. In particular, the gap between the EU15 or the EU25 and the US narrows as one moves from the Top 50 to the Top 500. In part this is due to the way the scores are constructed, but it mostly reflects a reality: American universities dominate European universities in the top tier (the Top 50 and Top 100), but Europe has many good universities in the second (the next 100) and the third (the next 300) tiers.
- Fourth, there are major differences among European countries: Switzerland, the UK and Sweden do particularly well, even in the Top 100, where they outperform (Switzerland and Sweden) or almost match (the UK) the United States on a per capita basis. Other Nordic countries (Denmark and Finland), Belgium and the Netherlands also do fairly well in the

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
Czech Republic	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

Source: Bruegel computation based on the Shanghai Jiao Tong University Academic Ranking of World Universities (2006).
Note: All figures are rounded.

Top 200 and Top 500. In contrast, southern and eastern Europe lag far behind. France and Germany do relatively poorly, except in the third tier, the universities ranked between 301 and 500.

2. WHAT EXPLAINS RESEARCH PERFORMANCE IN EUROPE?

An obvious starting point for economists is money. Table 2 presents aggregate data on the levels of private and public expenditure on higher education across countries. The main findings are that:

- Richer countries spend relatively more on higher education than poorer countries.
- The US spends a lot more on higher education than any European country, especially thanks to private funding. But public spending alone is relatively higher than in the EU.
- The Nordic countries also spend a lot, with most of the money coming from public sources.
- The UK spends surprisingly little (more on this later).

There is a strong positive correlation between expenditure per student

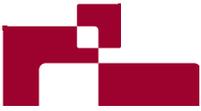


Table 2: Public and private expenditure on higher education, 2001

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

on the ten countries for which the response rate was at least 25 percent and the number of respondents at least two³. This left us with a total sample of 66 universities, with an average response rate of 41 percent for the ten countries considered. We were able to check that, for each country, respondent universities have an average Shanghai 500 rank fairly close to that of the whole population of universities from that country, so that we could be satisfied of the representativity of our sample⁴.

Table 3 provides country averages on a variety of dimensions⁵. It confirms the high degree of heterogeneity between countries for the universities in the Top 500:

- Southern European countries (Italy and Spain) have very large (more than 40 thousand students on average) but not well-funded universities.
- Sweden and the Netherlands have universities of average size (20-25 thousand students), and better funded.
- The UK and Switzerland have small (10-15 thousand students)

² The 2006 Shanghai ranking includes roughly 200 European universities belonging to the EU25 and Switzerland.

³ The ten countries are: Belgium (4 responses out of 7 universities in the Shanghai 500 ranking), Denmark (2 out of 5), Germany (11 out of 40), Ireland (2 out of 3), Italy (9 out of 23), Netherlands (4 out of 12), Spain (6 out of 9), Sweden (5 out of 11), Switzerland (6 out of 8) and the UK (17 out of 43). We left out France, because only 4 out of 21 universities responded and, moreover, university budgetary data are not comparable with those of other countries.

⁴ In fact, respondents had a somewhat higher rank for all countries except for Spain.

⁵ We obtain very similar results when looking at medians rather than averages.

Source: European Commission, DG Research, for expenditure as percent of GDP. Figures in euros per student were obtained by applying these percentages to GDP and dividing by the number of full-time equivalent students.

* Not available. Note: Not PPP converted.

and country performance (measured by the Top 500 performance values in Table 1), as shown in Figure 1.

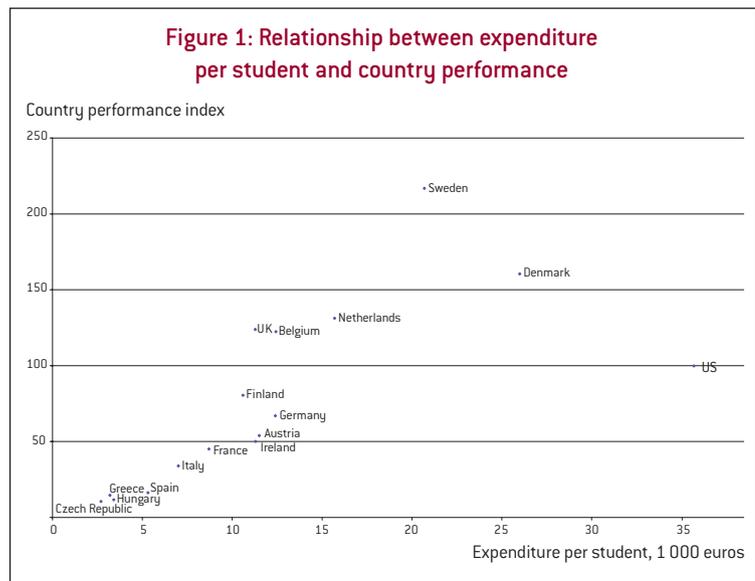
However, these aggregate data do not indicate how the money is split between higher education institutions, in particular between research-oriented and teaching-oriented universities. In the remainder of this section we therefore present the results of a survey questionnaire which elicits information on individual budgets and on the governance of top research performers.

A survey of European universities

A survey questionnaire was sent to the European universities in the 2006 Top 500 Shanghai ranking². We received 71 responses, an

overall response rate of 36 percent, which can be considered very satisfactory. We decided to focus

Figure 1: Relationship between expenditure per student and country performance



Source: Country performance index: Table 1; Expenditure per student: Table 2.



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.

and very well funded universities. Comparing with the aggregate information on expenditure in Figure 1, one observes that the UK significantly favours top research performers since the universities in our sample (which belong to the group of top universities) have a budget per student about twice as large as the average for all universities in the country.

There is also a great deal of heterogeneity – albeit with some general trends – as far as university governance is concerned:

- State intervention is clearly pervasive, even when universities are not public.
- Wage-setting autonomy is rare, with Sweden and the UK being the prime exceptions.
- Building ownership by the university is commonplace (except in the Nordic countries and Switzerland).
- Hiring autonomy is prevalent, except in southern Europe.
- Endogamy (measured as the percentage of faculty trained in house at PhD level) seems to be negatively correlated with country size: it is high in small countries (Belgium, Denmark, Ireland and Sweden, but not in Switzerland which is highly

open to hiring scholars with PhDs from other institutions), and small in large countries (Germany, Italy and the UK, but not in Spain). This finding clearly reflects the absence of significant academic mobility between European countries.

A striking fact is thus the high variance in university governance across European countries, even among those which are performing well in terms of research. For example, among the three European countries with the best performance index, endogamy is high in Sweden but low in Switzerland and the UK, and universities are mostly public in Denmark, Sweden and Switzerland whereas they are mostly private in the Netherlands and the UK.

One dimension where there is little variance across European countries is the age of universities. Top European universities are old institutions: the average age of the 66 universities in our sample is nearly 300 years. It ranges from 220 years in the Netherlands to 450 years in Italy. The only outlier is Denmark where the average age is only 60 years. This suggests that European universities have much

accumulated knowledge, but may also be complicated to reform.

Preliminary evidence

Our survey allows us to examine how budget per student and various measures of university governance correlate with research performance as measured by the Shanghai ranking. Table 4 shows that the research performance of a university is:

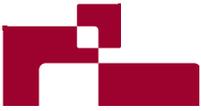
- positively correlated with the size of its budget per student: the higher

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.



the budget per student, the better the performance;

- negatively correlated with its degree of public ownership: private universities perform better than public institutions;
- positively correlated with its budget autonomy: not being required to have its budget approved by governmental authorities is associated with better performance;
- not correlated with its building ownership: more autonomy with respect to buildings is not associated with better performance;
- positively correlated with its hiring and wage-setting autonomy: universities that decide on faculty hiring and set faculty wages do better;
- negatively correlated with its degree of endogeneity in faculty hiring: universities which tend to hire their own graduates as faculty do less well.

Taken together these results suggest that the research performance of a university is positively affected by all our measures of university autonomy (except for building ownership), and also by funding. However, they do not tell us: (i) which of these autonomy indicators dominates and how interrelated they are; (ii) whether funding and autonomy improve performance separately from one another, or whether there are positive interactions between the two. We now try to answer these questions with appropriate statistical instruments.

Funding and autonomy

We use 'regression analysis', a statistical technique for the investigation of relationships between variables, to assess the effect of budget and governance on research performance as measured by Shanghai rankings.

We are interested in the effect of budget and university governance on university research performance. However we need to begin by taking into account two other factors that also affect Shanghai rankings, our measure of university research performance. The first is the size of the university. All other things being equal, larger institutions are likely to have a better Shanghai ranking because they have more researchers. We do not have data on the number of researchers in our survey so we proxy the size of the university by the number of students. The second factor is the age of the university. All other things being equal, older institutions may have a better Shanghai ranking because they have more alumni.

As expected, the regression analysis indicates that the research performance of universities is positively associated with their size and their age. More importantly, it also confirms the existence of a positive linkage between budget per student and research performance. These effects are statistically significant. Once these three important factors (size, age and money) are taken into account, it turns out that one of the six governance indicators reported in Table 4, namely budget autonomy, has a statistically significant effect on research performance. The others have no statistical impact on performance.

But our main result is not simply that more money or more autonomy is good for research performance. It is that more money has much more impact when it is combined with budget autonomy. To be more precise: we find that having budget autonomy doubles the effect of additional money on university research performance.

Hence, increasing budget per

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

student helps research performance, and having budget autonomy doubles this beneficial effect.

This message, based on the research performance of European universities, is reinforced by an analysis of US universities .

3. LESSONS FROM US EVIDENCE

The United States provide a wealth of information that can be used to go one step further in the analysis of research performance. We have access to a rich data set across US states and over time on education spending and patenting. For each state, we have annual information on university funding and governance and on patenting. We are able, therefore, to examine the effect of university funding and governance on innovation activity directly, rather than solely on university research performance.

There is considerable variation in university governance across states. States vary not only in the relative importance of private versus public universities, but also in the degree of autonomy granted by state authorities to public universities. Sometimes, even neighbouring states display sharp differences in governance. For instance, public universities in Illinois enjoy on average rather low autonomy,



while their neighbours in Ohio enjoy high autonomy. These differences are persistent over time and often go back to the idiosyncratic origin of American universities, which in turn reflect differences in the preferences of university founders (eg Benjamin Franklin founded the private University of Pennsylvania, whereas Thomas Jefferson was the founder of the public University of Virginia).

Our strategy is to take US states' differences in university autonomy as given and then ask the following question: Does a given investment in higher education produce more patenting in a US state if universities in that state are more autonomous? The details of the statistical test are reported in Box 2. The answer to our question is a resounding 'yes'. As illustrated in Figure 2, the effect of additional spending on patenting is roughly twice as high for states with more university autonomy. Autonomy therefore greatly enhances the efficiency of spending. This result confirms and nicely complements the one from Section 2.

4. CONCLUSIONS

In this brief we have investigated the relationship between university governance and funding on the one hand and various measures of performance on the other hand. In the first section we have tried to link our Country Performance Index based on the Shanghai ranking of universities to different aspects of university governance drawn from a survey questionnaire. In the second section of the brief we have assessed how university autonomy affects the patenting impact of university research funding.

Several interesting findings come

out of our investigation.

First, the performance gap between Europe and America is large, in particular for the best-performing universities.

Second, as we broaden the investigation from the Top 50 to the Top 500 universities in the Shanghai ranking, the relative performance of European countries improves compared to the US. This, in turn, suggests strongly that quality variance is lower among European universities than among their American counterparts. It also suggests that what Europe lacks most is top-class universities.

Third, there is more than one model of university system that appears to work. For example, both Switzerland and Sweden are doing

well with mostly public universities, while the UK also performs well with a higher share of private universities, but also higher tuition fees and a higher degree of student selection. The UK, however, differs significantly from Switzerland and Sweden in one respect. All three perform very well in the top tier (Top 50 and Top 100), but the UK performs relatively less well in the remainder of the Top 500. This is due to the fact that the UK concentrates its less than average higher education budget (in terms of GDP) heavily on its top institutions.

Indeed, a fourth lesson is that money helps performance.

Fifth, autonomy is good for research performance.

Box 2: University funding, autonomy and innovation: data and methodology

Data

For research expenditure, we use the detailed data in Aghion et al [2007]⁶ on how much each state spent on each type of education in all years from 1947 to 2004. We know in particular from these time series how much each US state spent on a given cohort of individuals (eg born in year X) in each year. Thus we know how much was spent on average on each individual at every stage of his or her studies (from primary school to post-graduate college).

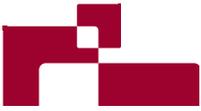
For governance, we consider two alternative measures of university autonomy at the state level: (i) the percentage of universities that are private, keeping in mind that private universities are, on average, more autonomous than public universities; (ii) an aggregate autonomy index for public universities, which is constructed on the basis of several component factors. This index takes the maximum value when the public universities in the state: (a) set their own faculty salaries; (b) set their own tuition fees; (c) have lump-sum budgeting (as opposed to line item budgeting); (d) can shift funds among major expenditure categories; (e) retain and control tuition revenue and/or grants; (f) have no ceiling on external faculty positions (and therefore need not hire faculty internally); (g) have no ceiling on external non-faculty positions (administrators or technicians); (h) have freedom from pre-audits of their expenditure; (i) can carry over year-end balances (rather than returning them to the state). It emerges that, as in the case of European universities, the most statistically important component factor of this aggregate index is budget autonomy.

Statistical test

We examine the effect on patenting in a US state of increasing research education funding by \$1,000 per year and per person over a sustained period, respectively in states with highly autonomous universities and in states with less autonomous universities.

Figure 2 illustrates a key result from our test: states with highly autonomous universities enjoy an accumulated impact of research education funding on innovation which is roughly twice as high as that enjoyed by states with less autonomous universities.

⁶ Philippe Aghion, Leah Boustan, Caroline Hoxby and Jerome Vandenbussche, *Exploiting States' Mistakes to Evaluate the Impact of Higher Education on Growth*, mimeo, Harvard [2007].



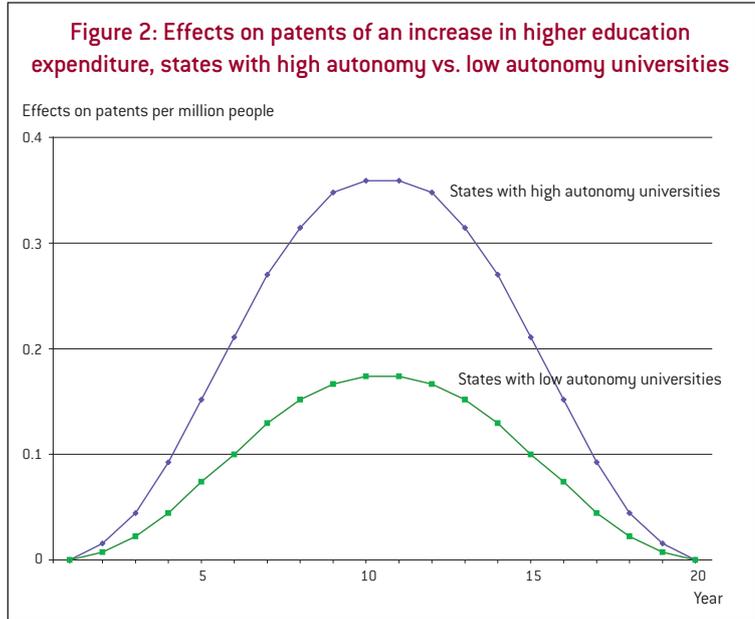
Sixth, autonomy and funding are complementary: more autonomy increases the extent to which additional research funding improves performance.

Policy lessons

What should be done to improve the performance of European universities?

1. European countries should invest more in their university systems. On average, EU25 members spend 1.3 percent of GDP on higher education, against 3.3 percent in the US. European countries should increase higher education funding by at least one percentage point over the next ten years. It remains an open question how public budgets and private funding including tuition fees can share the burden of this increase.

2. For this effort to pay off, European universities should become more autonomous, in particular with regard to budgets, and also in hiring, remuneration, course design and student selection, particularly at Master's level. What matters for good performance is both money and good governance. The two are complementary: increasing university budgets has more impact with good governance and improving



Source: Authors' own computations.

Note: The increase in expenditure is assumed to last from year 1 to 6. The effect on patenting accordingly starts in year 2, peaks in years 10 and 11, and ends in year 20.

governance has more impact with higher budgets. We are aware, however, that greater autonomy can be perverse and that it must be accompanied by greater performance evaluation.

Of course this brief has focused mainly on the research function of universities and has left aside politically sensitive issues of tuition fees and student selection, which are perhaps more directly related to the teaching function, although they also impact on research. Yet we are confident that a reform stressing increased budget per student and greater autonomy [together with greater evaluation]

will be performance enhancing, either alone or as part of a more radical overhaul of the university system, involving tuition fees and student selection. So far, our partial evidence, which will be further examined in a forthcoming Bruegel Blueprint, leads us to believe that there is more than one university system that works and, therefore, that there are diverse paths to university reform.

We are very grateful to Aida Caldera, Indhira Santos and Alexis Walckiers for their excellent research assistance, and to colleagues across European universities in helping with the university survey used in

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