# Why reform Europe's universities?

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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. We show 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.

## 1. Introduction

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

Europe invests too little in higher education. It is by now widely known that the European Union (EU) spends less than two percent of its GDP on 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 universities than for R&D spending. In 2001, total (public and private) spending on higher education in EU25 accounted for barely 1.3 % of GDP, against 3.3 % in the US. In other words, Europe spends every year two percent

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of GDP less than the US. In terms of expenditure per student, the contrast is starker still, with an annual spending 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 recognize some years ago that its university system faces a problem. A first step was the Bologna Declaration that 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 only the recent publication of global rankings, such as the Shanghai Jiao Tong University Academic Ranking of World Universities (the "Shanghai ranking") has made most policymakers aware of the magnitude of the problem and sparked a public debate on university reform. These rankings tend to reinforce the evidence that the US is well ahead of Europe in terms of cutting-edge university research.

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 growth[2].

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 boosting their contribution to growth.

## 2. Country performance

The debate on the funding and governance of European universities has been stirred greatly by the publication, since 2003, of the so-called Shanghai index which measures university research performance. Constructed by a group of Chinese scholars, the Shanghai index 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 better see 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 grade 49, and so on down to a score of 1 for the least 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

[2] 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.

**Box 1 The Shanghai index**

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 a university faculty published in *Nature* and *Science*
— The number of articles (co-)authored by a university faculty published in Science Citation Index-expanded and Social Science 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 index 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.

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 100", "Top 200" and "Top 500" columns, where the best university receives a score of, respectively 100, 200 and 500, and the last one always 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 among the latter than the former.

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 becomes more equalized as one enlarges the number of universities considered. In particular the gap between the EU15 or the EU25 and the US narrows down 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 important differences among European countries: Switzerland, the UK and Sweden do particularly well, even in the Top 100, where they out-perform (Switzerland and Sweden) or almost match (the UK) the United States on a per capita basis. The rest of Scandinavia (Denmark and Finland), Belgium and the Netherlands also do pretty well in the Top 200 and Top 500. By 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.

**Table 1** Country performance in the Shanghai ranking (measured as percentages of the US per capita performance)

| *Country* | *Population (in million)* | *Top 50* | *Top 100* | *Top 200* | *Top 500* |
|---|---|---|---|---|---|
| Austria | 8.2 | 0.0 | 0.0 | 0.4 | 52.6 |
| Belgium | 10.4 | 0.0 | 0.0 | 61.3 | 122.4 |
| Czech republic | 10.2 | 0.0 | 0.0 | 0.0 | 13.1 |
| Denmark | 5.4 | 0.0 | 74.6 | 113.5 | 160.5 |
| Finland | 5.2 | 0.0 | 45.5 | 75.4 | 80.5 |
| France | 60.2 | 3.0 | 15.2 | 28.6 | 45.1 |
| Germany | 82.5 | 0.0 | 17.00 | 36.5 | 67.0 |
| Greece | 11.1 | 0.0 | 0.0 | 0.0 | 12.2 |
| Hungary | 10.1 | 0.0 | 0.0 | 0.0 | 13.3 |
| Ireland | 4.0 | 0.0 | 0.0 | 0.0 | 50.0 |
| Italy | 57.6 | 0.0 | 0.0 | 11.1 | 33.9 |
| Netherlands | 16.3 | 20.2 | 50.7 | 75.9 | 131.3 |
| Poland | 38.2 | 0.0 | 0.0 | 0.0 | 3.5 |
| Spain | 42.7 | 0.0 | 0.0 | 0.1 | 14.2 |
| Sweden | 9.0 | 6.7 | 116.5 | 178.8 | 216.9 |
| UK | 59.8 | 72.0 | 86.1 | 98.0 | 123.9 |
| | | | | | |
| EU15 | 383.3 | 12.7 | 26.0 | 41.0 | 67.3 |
| EU25 | 486.6 | 10.0 | 20.5 | 32.4 | 53.9 |
| | | | | | |
| Norway | 4.6 | 0.0 | 65.8 | 90.6 | 107.0 |
| Switzerland | 7.4 | 97.1 | 165.5 | 228.1 | 229.6 |
| Australia | 20.1 | 0.0 | 31.4 | 65.8 | 100.7 |
| Canada | 31.9 | 39.3 | 54.2 | 62.9 | 103.6 |
| Japan | 127.7 | 14.3 | 17.2 | 24.3 | 26.7 |
| | | | | | |
| USA | 293.7 | 100.0 | 100.0 | 100.0 | 100.00 |
| | | | | | |
| California | 36.1 | 234.2 | 198.5 | 163.2 | 103.2 |
| Massachusetts | 6.4 | 448.7 | 307.8 | 301.7 | 263.0 |
| New York | 19.3 | 195.7 | 167.4 | 138.7 | 147.7 |
| Pennsylvania | 12.4 | 110.7 | 176.9 | 161.0 | 115.2 |
| Texas | 22.9 | 32.7 | 60.9 | 82.8 | 102.5 |

## 3. What explains research performance in Europe?

An obvious starting point for economists is to look at 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.

**Table 2** Public and private expenditure on higher education in 2001

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

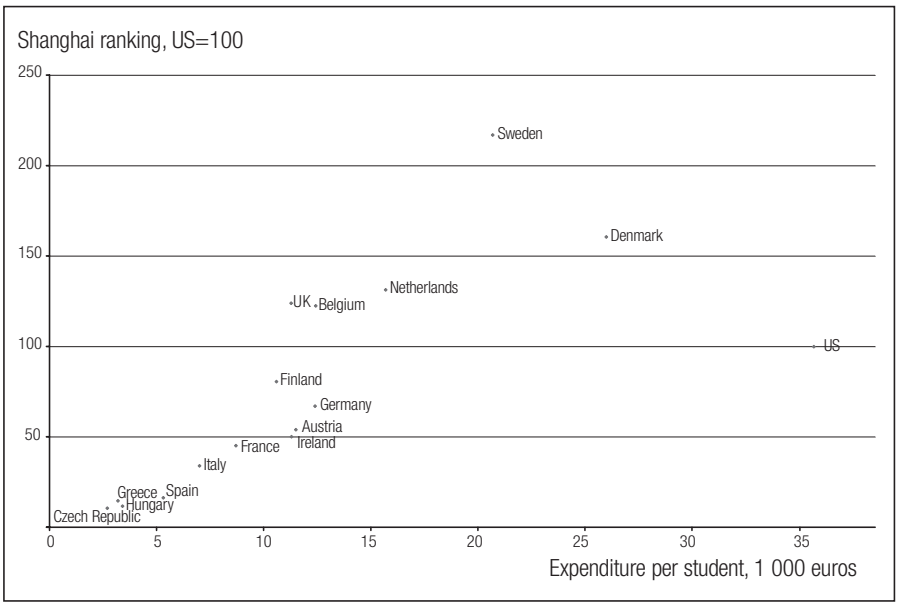
Source: European Commission, DG Research; *: not available. Note: not PPP converted.

— 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.
— Scandinavia also spends a lot, with most of the money coming from public sources.
— The UK spends surprisingly little (more on this later).

Figure 1 shows that there is a strong positive correlation between expenditure per student (from Table 2) and country performance (measured by the Top 500 performance values in Table 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.

**Figure 1** Relationship between expenditure per student and country performance




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

### *A. A survey of European universities*

A survey questionnaire was sent to the European universities in the 2006 Top 500 Shanghai ranking[3]. We received 71 responses, an overall response rate of 36 %, which can be considered very satisfactory. We decided to focus on the ten countries for which the response rate was at least 25 % and the number of respondents at least two[4]. This left us with a total sample of 66 universities, with an average response rate of 41 % for the ten countries considered. We were able to check that, for each country, respondent universities have an average Shanghai 500 rank pretty close to that of the whole population of universities from that country, so that we could be satisfied of the representativity of our sample[5].

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

[4] 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.

[5] In fact, respondents had a somewhat higher rank for all countries except for Spain.

**Table 3** Characteristics of the universities in the sample (averages)

| | *Age (in years)* | *Number of students (in thousands)* | *Budget per student (in thousand Euros)** | *Public status (1 if public, 0 if private)* | *Budget autonomy (1 if yes, 0 if no)* | *Building ownership (1 if yes, 0 if no)* | *Hiring autonomy (1 if yes, 0 if no)* | *Wage-setting autonomy (1 if yes, 0 if no)* | *% of Faculty with in-house PhD degree* |
|---|---|---|---|---|---|---|---|---|---|
| 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 | 8 |
| 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 | 0.75 | 0.55 | 0.76 | 0.8 | 0.31 | 29 |

*: PPP adjusted.

Table 3 provides country averages on a variety of dimensions[6]. It confirms the high degree of heterogeneity between countries for the universities in the Top 500:

— Southern European (Italy and Spain) countries 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) 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 foremost exceptions.
— Building ownership by the university is commonplace (except in Scandinavia and Switzerland).
— Hiring autonomy is prevalent, except in Southern Europe.

[6] We obtain very similar results when looking at medians rather than averages.

— Endogamy (measured as the percentage of faculty trained in-house at the 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 a lot of accumulated knowledge, but may also be complicated to reform.

### *B. Preliminary evidence*

Our survey allows us to examine how budget per student and various measures of university governance correlate with research performance 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 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 endogamy 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 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.

### *C. 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 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. As Box 1 clearly indicates, other things 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. Box 1 also indicates that, other things 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.

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

| *Characteristics* | *Correlation coefficient* |
|---|---|
| | |
| Budget per student | + 0.61 |
| | |
| University governance: | |
| Public status (1 = public; 0 = no) | – 0.35 |
| Budget autonomy (1 = yes; 0 = no) | + 0.16 |
| Building autonomy (1 = yes; 0 = no) | – 0.01 |
| Hiring autonomy (1 = yes; 0 = no) | + 0.20 |
| Wage-setting autonomy (1 = yes; 0 = no) | + 0.27 |
| Percent of faculty with internal PhD degree | – 0.08 |

* Measured by the (logarithm of the) Shanghai ranking.

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

| *Variable* | *Effect on research performance* |
|---|---|
| Size of the university (number of students) | + |
| Age of the university | + |
| Budget per student | + |
| Budget autonomy | + |
| Interaction between budget and autonomy | + |

* Measured by the (logarithm of the) Shanghai ranking.

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 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 the analysis of American universities presented in the next section.

## 4. 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. Specifically, for the US we have access to a rich data set across US states and across time on education spending and patenting. For each state, we have at our disposal yearly information on university funding and governance and on patenting. We are able, therefore, to examine the effect of university funding and governance directly on innovation activity, rather than solely on university 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)[1] 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 (e.g. 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 turns out that, like 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 the research education funding on innovation which is roughly twice as high as that enjoyed by states with less autonomous universities.

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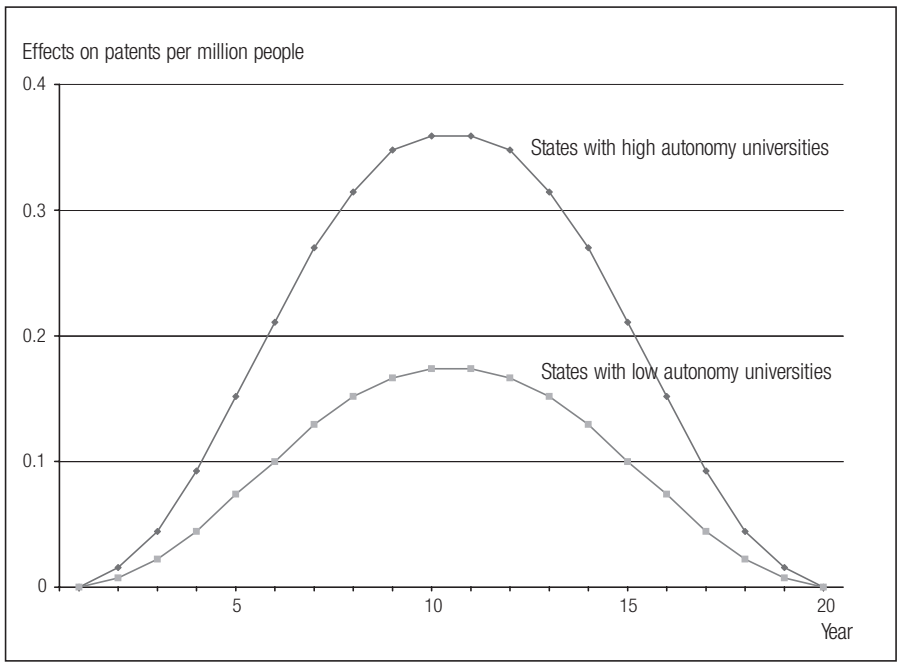
[1] P. Aghion, L. Boustan, C. Hoxby and J. Vandenbussche (2007), "Exploiting States' Mistakes to Evaluate the Impact of Higher Education on Growth", mimeo, Harvard.

Interestingly, 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 rather low autonomy on average, while their neighbours in Ohio enjoy instead 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 (e.g. 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 3.

**Figure 2** Effects on patents of an increase in higher education expenditure, states with high autonomy vs. low autonomy universities




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.

## 5. 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 most universities being public, 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 remaining of the Top 500. This is due to the fact that the UK heavily concentrates its less than average higher education budget (in terms of GDP) on top institutions.

Indeed, a fourth lesson is that money helps performance.

Fifth, autonomy is good for research performance.

Sixth, autonomy and funding are complementary inputs to performance: more autonomy increases the extent to which additional research funding improves performance measures at the university and at the national/state/regional levels.

### *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 % of their GDP on higher education, against 3.3 % in the US. European countries should increase funding for higher education by at least 1 percentage point over the next ten years. It remains an open question how the burden of this increase is to be shared between public budgets and private funding, including tuition fees.
2. For this effort to pay off, European universities should become more autonomous, in particular with regard to budgets, and also in hiring, remuneration, programme 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 budget has more impact with good governance and improving 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 our 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.