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Article

Better schools for Europe

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First Prize

Erich Gundlach and Ludger Wößmann

Time-series evidence for a number of European countries shows that rising educational expenditures have not improved student performance. We speculate that the apparent decline in European schooling productivity reflects inefficient schooling institutions. International cross-section evidence suggests that the performance of students in many European countries could be vastly improved by changing the institutions which govern the incentives of students, teachers and the school administration. For instance, we find that centralised exams, school autonomy in personnel decisions, and competition from private schools boost student performance. Hence educational policies in Europe should focus on institutional reform rather than on additional spending.



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Ludger Wößmann is a researcher at the Kiel Institute of World Economics, where he specialises in the efficiency of schooling systems and the effect of human capital on economic growth. He holds degrees in economics from the University of Kent at Canterbury, the Philipps University, Marburg, and the Advanced Studies Program at the Kiel Institute. Last year he was awarded the Friedrich Bruckhaus Prize of the Hanns Martin Schleyer Foundation for his master thesis. He has recently submitted his Ph.D. thesis to the Christian Albrechts University, Kiel.

Better schools for Europe

1. Introduction

Parents, students, teachers and governments in many European countries were not amused by the findings of the latest international evaluation of student performance in mathematics and science. British, French and German students did not perform significantly better than their peers in the United States - a country where the public has become deeply alarmed over the state of the schooling system - and they performed much worse than students from several Asian countries. Up to now, convincing explanations are largely missing for the poor educational performance of European students. Research on the economics of education in Europe lags considerably behind research in the United States and even in developing countries. But understanding the striking international differences in student performance may hold the key for future economic prosperity because a well-educated labour force will provide a competitive edge in tomorrow's knowledge-based society.

We try to identify the economic factors that might be responsible for the large international differences in student performance. We present time-series evidence for a number of European countries that suggests that rising educational expenditures did not improve student performance. This finding is largely in line with the international literature on the effectiveness of schooling expenditures and implies that schooling is often provided inefficiently in Europe. Therefore, we speculate that a reform of institutions may be needed to achieve improved student performance.

To test this hypothesis, we use cross-country data to identify the impact of institutional differences across national schooling systems. We find that for a given amount of schooling resources, the performance of students in many European countries could be vastly improved by changing the institutions that govern the incentives of students, teachers and the school administration. Among the institutional features that appear to be most conducive to student performance are nationwide examinations, administrative control mechanisms in curricular and budgetary matters, school autonomy in process and personnel decisions, choice of teaching methods by individual teachers, limited influence of teacher unions and competition from private educational institutions.

Overall, our results show that the effectiveness of resource use in the schooling sector has declined more rapidly in many European countries than in the United States. What has been called a "productivity collapse" of US schools (Hanushek, 1997) appears to be a small problem when compared with the situation in countries like France, Germany, Italy and the United Kingdom. Given past experience, more educational expenditures will not necessarily suffice to turn failing European schooling around. Rather than throwing money at the problem, a reform of schooling institutions is needed to get better schools for Europe.

2. Educational expenditures and student performance: Schooling productivity (1)

In the average EU country, schooling accounts for a larger fraction of Gross Domestic Product (GDP) and employment than many manufacturing industries. Nevertheless, very little is known about

1) This section mainly draws on Gundlach et al., (2001).

Schooling is labour intensive and the methods used may not have changed much over the past quarter century.

changes in the productivity of schooling. Like other services, schooling is most likely a sector with stagnant productivity. Similar to performing a symphony or a haircut, schooling is labour intensive and the methods used may not have changed much over the past quarter century. This is in stark contrast to technological developments in manufacturing industries. The labour input required to produce an automobile has declined significantly, but performing a symphony or a haircut requires the same amount of labour input as ever. Schooling may not be very different.

The productivity of schooling can be measured as units of schooling output per units of schooling input. Schooling output is the number of students taught and schooling input is spending on education at the primary and secondary level. A plausible first guess would be that schooling productivity, like haircut productivity or symphony productivity, does not change by much over time: in all cases, the consumer is part of the product, production is labour intensive, and the technology is tried and tested. What hinders productivity growth is the combination of these features. Hence in theory, schooling should be a sector with stagnant productivity, where the same amount of input resources always produces the same amount of output.

Abstracting from detail, it is instructive to consider what would happen in a perfectly flexible economy, if schooling actually displayed stagnant productivity while all other sectors faced a constant positive rate of productivity growth. The outcome would be what Baumol (1967) has called the cost disease of services. With a functioning labour market, the wages of workers in the stagnant-productivity sector would have to increase in line with those of workers in the other sectors where labour productivity increases. Given an efficient allocation of resources, the price per unit of output of the stagnant-productivity sector would rise with the average rate of productivity growth of the other dynamic sectors. Applying this insight to the case of schooling suggests that a constant-quality unit of schooling output should become more costly over time.

In addition, one could even predict the efficient size of the expected cost increase of schooling if the average rate of productivity growth of the dynamic sectors of the economy were known. If average economy-wide productivity grew by 2 percent per year and efficiency conditions prevailed, then the GDP-deflated price of schooling (and of all other stagnant-productivity sectors) should grow by 2 percent as well (Gundlach et al., 2001). That is, public expenditures per student should rise by 2 percent in an economy which grows by 2 percent if schooling productivity had remained constant. However, if public expenditures per student grew by more than average productivity growth, then either schooling productivity should have declined or the quality of schooling output in the form of student performance should have increased. We begin with the latter possibility.

The main problem with an empirical analysis is exactly the difficulty of correctly measuring potential changes in the quality of schooling output. In principle, changes in the quality of schooling output can be measured by the results of standardized student achievement tests at various points in time. However, consistent time-series data on the cognitive achievement of students are available only for the United States (2). These tests suggest that there has been no substantial change in the average performance of US students between 1970 and 1994 (Hanushek, 1997).

2) The National Assessment of Educational Progress (NAEP) began to monitor the performance of students aged 9, 13 and 17 years, in mathematics and science in the early 1970s. The NAEP used the same assessment content and the same administration procedures over time, so the reported average test scores of US students are comparable intertemporally.

In addition to this US data, there is cross-country evidence on student performance for selected years. The International Association for the Evaluation of Educational Achievement (IEA) conducted cross-country science studies in 1970/71 and in 1983/84, and cross-country mathematics studies in 1964 and in 1980-82. The IEA's Third International Mathematics and Science Study (TIMSS), which integrated the two subjects, was conducted in 1994/95. All these studies include achievement tests for students in the middle and final school years, and except for the two mathematics studies, students were also tested in the primary school years.

We focus on a comparison of the results for the early 1970s with the mid-1990s. A direct comparison of the results is not possible because the sample of participating countries, the design of test questions, the distribution of difficult and easy questions within a test, and the format in which test results are reported have all changed. Nevertheless, it is possible to calculate changes in the performance of students for each country over time subject to specific assumptions about the mean and the standard deviation of the reported test results. This is possible at least as a rough approximation because independently of the test actually conducted, we also know the performance of students from any single country relative to the constant performance of US students - this can serve as an inter-temporal benchmark.

To make the different test results comparable over time, the sample distributions and sample means have to be converted to a common scale. We use alternative statistical hypotheses to define such a common scale for a sample of OECD countries. Our hypotheses centre around the idea that the performance of US students has remained constant and that the distribution of results among the relatively homogenous group of OECD countries should not have changed substantially between the early 1970s and the mid-1990s. In Gundlach et al., (2001) we explain in detail how we transform the original test scores subject to three different statistical assumptions about the sample distributions and sample means.

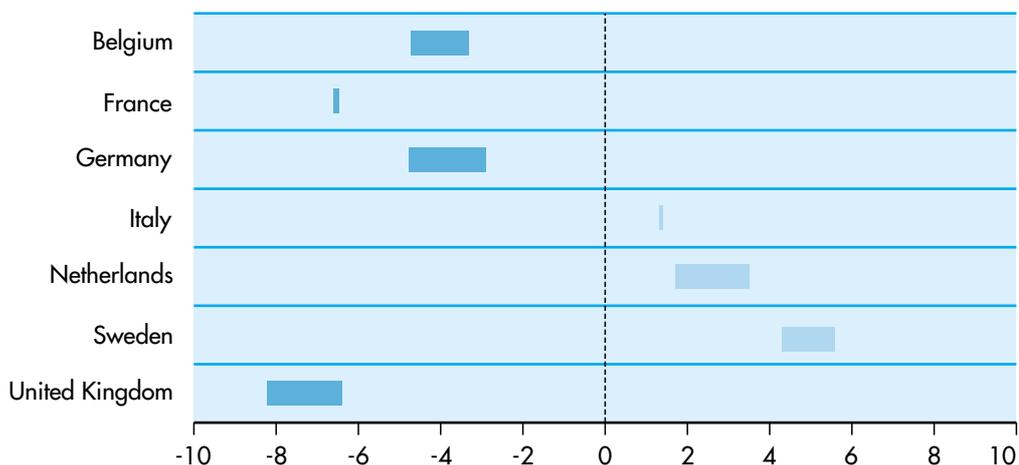
Figure 1 presents our results for the calculated changes in the average performance of students from selected European countries in science and mathematics relative to the constant performance of US students, which is shown as the vertical line. Bars on the left side of the vertical line show a decline in the performance of students relative to the performance of US students, bars on the right side of the vertical line show a relative improvement. The size of the bars reflects the range of our estimates derived under three statistical assumptions regarding the mean and the standard deviation of the various subtests. A bar further away from the vertical line indicates a larger estimated change in relative student performance. However, since all bars are close to the vertical line we interpret our findings as suggesting that the relative performance of students in the selected European countries did not change by much. And since all bars are relatively small, our results appear to be robust with regard to alternative statistical assumptions.

As student performance has not changed much, school expenditures rising faster than productivity growth cannot be justified by an improved quality of schooling.

Given that student performance actually did not change by much, and especially not for the better in Belgium, France, Germany and the United Kingdom, schooling expenditures rising faster than the benchmark figure suggested by average productivity growth cannot be justified by pointing to an improved quality of schooling output. Therefore, it remains to be seen what the actual rise in the price of schooling in these European countries implies about changes in the productivity of

schooling. As outlined above, schooling productivity would have remained constant if the average rate of economy-wide productivity growth matched the rise in the price of schooling.

Figure 1. Changes in an index of the quality of schooling output in selected European countries between 1970 and 1995; the index in 1970 equals 100.



Note: The figure shows the estimated range of the change in the average performance of students in standardised achievement tests in science and mathematics, relative to the constant performance of US students (zero means constant performance). The estimated range reflects the impact of alternative assumptions about the mean and the standard deviation of the test distributions.

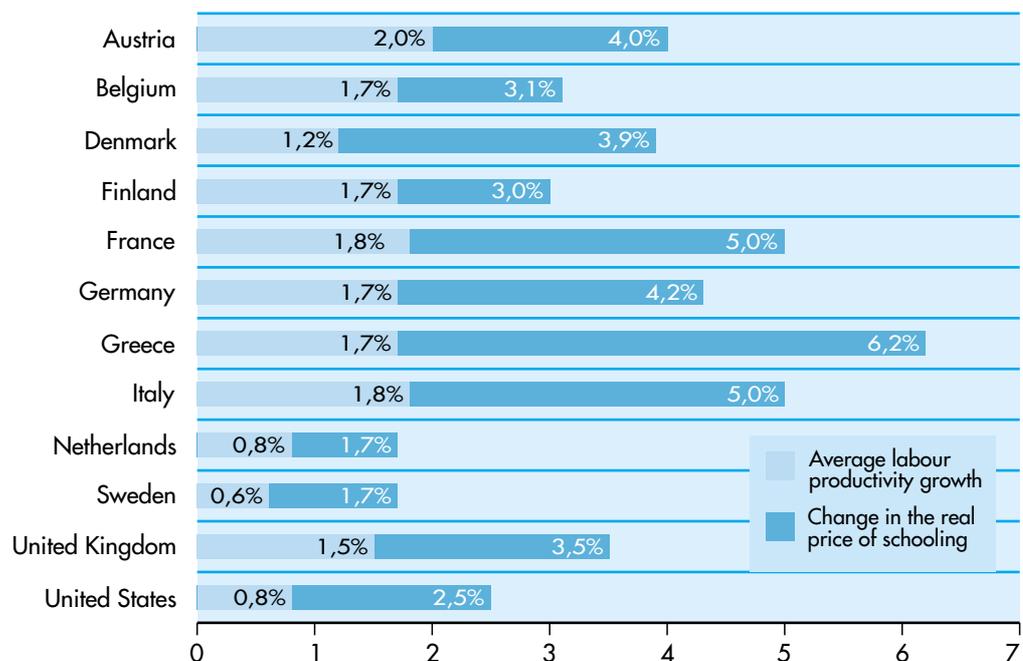
Unlike many other service sectors, there is a straightforward way to calculate the price of schooling. While it is somewhat difficult to disentangle the price component from the quantity component in services such as banking, insurance, or government, the case of schooling can be settled more easily because a direct measure of quantity is available in the form of students enrolled. Since total expenditure is defined as price times quantity, the price of a unit of schooling output with constant quality follows as total expenditure on primary and secondary education divided by the number of students enrolled in primary and secondary education. Based on UNESCO data, we measure schooling expenditure as current expenditure on education, which mainly consists of remuneration for administrative staff and teaching staff. That is, we exclude capital expenditure from our measure to avoid an influence of possible cycles in spending on school buildings.

Alternative deflators can be used to derive a measure of the change in the price of schooling with constant quality. One possibility to assess changes in the productivity of schooling is to compare the GDP-deflated increase in the price of schooling with the average economy-wide growth rate of labour productivity. Our general finding is that the increase in the GDP-deflated price of schooling in the four large European countries exceeds the average annual growth rate of labour productivity by an order of magnitude (see Figure 2) (3). This finding does not fit with the assumption of a more-

3) Another possibility is to compare the GDP-deflated increase in the price of schooling with total factor productivity (TFP) growth. Using consistent estimates of TFP growth for G7 countries from Dougherty and Jorgenson (1997) that match the relevant time period as closely as possible, we also find that the increase in the GDP-deflated price of schooling exceeds the TFP growth rates in the four large European countries by an order of magnitude.

or-less efficient allocation of schooling resources, with Sweden and the Netherlands as possible exceptions. In all other cases, our results point to a substantial decline in schooling productivity in Europe that is larger than in the United States.

Figure 2. Changes in the real price of schooling and average labour productivity growth between 1970 and 1994



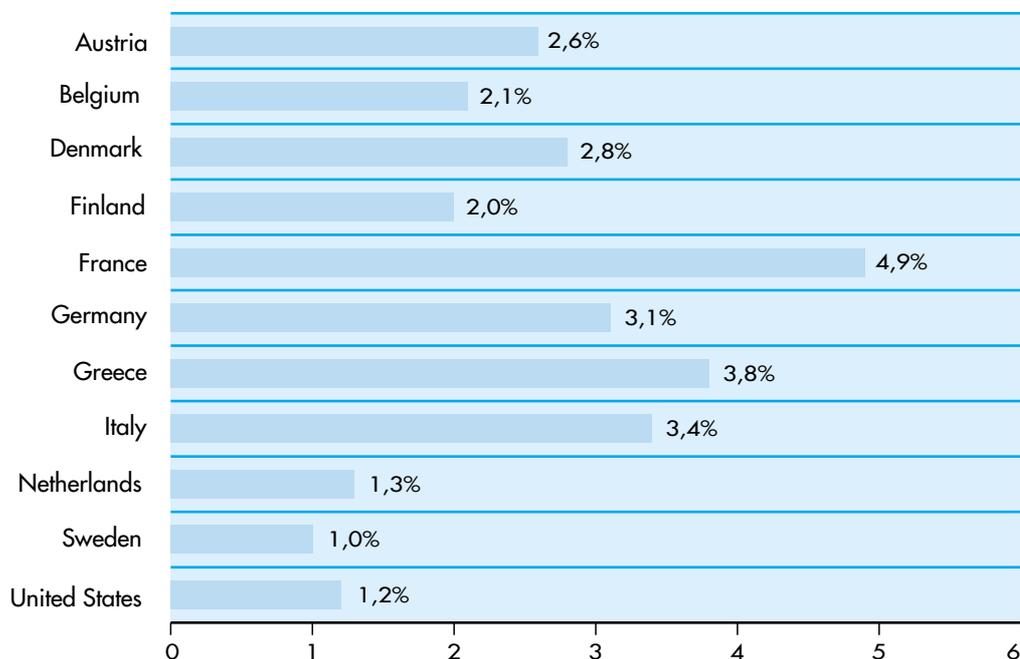
Note: The change in the real price of schooling equals average annual change in public current expenditures per student enrolled in primary and secondary education (UNESCO data), deflated with the GDP deflator (UN data). The average annual rate of change of real GDP per worker comes from World Bank data.

The same result reappears if changes in the productivity of schooling are proxied by comparing the increase in the (nominal) price of schooling with the increase in the price of labour-intensive service categories such as “producers of government services” and “community, social and personal services” as reported in National Accounts data (4). Assuming that these two service categories exhibit stagnant productivity, any positive change in the price of schooling relative to these service-sector deflators should indicate a relative decline in schooling productivity. Figure 3 does indeed show relatively large positive changes in the price of schooling relative to other labour-intensive services for all European countries. In most cases, the amount of the implied productivity decline is again larger than in the United States, and it is larger than in Figure 2. As before, the two less dramatic cases are Sweden and the Netherlands.

Whatever the benchmark, there is a huge decline in schooling productivity in most European countries.

4) Given that labour markets in Europe are not as flexible as assumed in the Baumol-model, it may be useful to compare the estimated change in the price of schooling with the change in the price of government services only, since developments in teacher wages could be expected to match those of other public sector workers. However, for some countries there is no difference in the two service deflators that we employ (Belgium, Sweden and the United States), and in some countries the deflator for government services actually increased by less than the deflator for community, social and personal services (Denmark, Germany, Greece and the Netherlands). A larger difference between the two deflators does occur for France and Italy. Nevertheless, the comparison of the change in the price of schooling with the deflator for government services would still imply an annual decline of schooling productivity of 2.6 percent in France and 2.9 percent in Italy. For details of the data, see Gundlach et al., (2001).

Figure 3. Changes in the price of schooling relative to other labour-intensive service sectors between 1970 and 1994.



Note: The figure shows the difference between the average annual change in the price of schooling (UNESCO data) and the average annual change in the price of government services and community, social and personal services (UN data).

Our figures imply that it does not matter much in practice whether changes in the GDP-deflated price of schooling are compared with the average growth rate of labour productivity (or TFP) or whether changes in the nominal price of schooling are compared with changes in prices of other stagnant-productivity services. On both counts, there is a huge implied decline in schooling productivity in most European countries between 1970 and 1994. For instance, an average annual decline in schooling productivity of about 3 percent over a time span of 25 years, as in Germany, Italy and France, could only be regarded as irrelevant if the average performance of students in the 1994 achievement tests would have been more than twice as good as in 1970. But we do not find any evidence for such an outcome. By contrast, the countries where we find a slight improvement in student performance are those which report the lowest decline in schooling productivity, namely Sweden and the Netherlands.

In the other European countries, even substantial increases in schooling resources did not boost schooling quality. This finding confirms a large microeconomic literature, which has failed to identify a positive relation between additional schooling inputs and student performance (see, for example, Hanushek, 1996; Hoxby, 2000). A potential explanation for our finding is that the family background of the students might have worsened. Students coming to school today may lack many of the basic capabilities required for a successful education and may, therefore, be increasingly expensive to educate. Such effects may play a significant role in countries with a large inflow of immigrant families with school-aged children or in countries with rising levels of poverty. But

especially in Europe, there are also counterbalancing effects. On average, parents in the European countries considered enjoy higher incomes and are better educated than parents 25 years ago, and the number of children per family has declined. Hence children may actually start schooling with better basic capabilities than ever before. For European countries, the net effect of the trends in the different family background influences is not known. For the United States, Grissmer et al., (1994) estimate that the net effect has worked in the direction of making students better prepared for learning. In case such an outcome would also apply for European countries, the missing positive performance effects of increased educational spending would be even more severe than indicated by our calculations.

On balance, we conjecture that the schooling sector is inefficient in many European countries. Our interpretation of the evidence suggests that there is a need for institutional reform of European schooling systems because additional schooling resources apparently did not improve student performance. In the age of globalisation, countries with inefficient schooling systems are likely to face a loss of international competitiveness, which would limit the possibilities for further economic development. Therefore, it is important to understand which institutional reforms might work in order to increase the productivity of schooling.

3. Policies to increase the productivity of schooling: Institutions matter (5)

In most European countries (and worldwide), the great majority of schools are publicly financed and managed. The institutions and policies established by various levels of government create incentives for students, teachers and the school administration to use available resources in ways that maximize the individual utility of these actors, given the constraints they face. In many sectors of the economy, competition imposes penalties on actors who fail to use their resources efficiently. But schooling may be different: A lack of competition and the prevailing institutions may create incentives that are not conducive to student performance, but result in an inefficient allocation of schooling resources. This, in turn, would lead to rising costs and rising prices as reported in the previous section.

Within a country's educational system, various institutions determine the ways in which a society finances and manages its schools, how a society assesses student performance, and who is empowered to make basic educational decisions such as which curricula to follow, teachers to hire, and textbooks to purchase. The challenge of all these institutions is to create a set of incentives that encourages students, teachers, and the school administration to behave in ways that do not necessarily further their vested interests but instead further students' educational performance. For instance, without the right incentives, teachers may avoid using the most promising teaching techniques, but instead prefer to use the techniques most convenient to themselves. In terms of policy, one might speculate that if a country assesses the performance of students with some sort of national exam and uses this information to monitor teachers, teachers will focus more on raising student achievement than would otherwise be the case.

To find out which schooling institutions are most conducive to student performance, we turn to the international evidence on student achievement.

To find out which schooling institutions are most conducive to student performance, we turn to the international evidence on student achievement. This is because the institutions within a country do not vary enough and are relatively stable over time. So testing how different institutions may impact

5) This section draws on Wößmann (2001).

on student achievement is almost impossible on the basis of within-country studies. Only the international evidence, which encompasses many education systems with a wide variety of institutional structures, has the potential to show whether institutions heavily impact on student performance. Our working hypothesis is that differences in educational institutions explain more of the international variation in student performance than differences in the resources which countries devote to schooling.

We use data from the Third International Mathematics and Science Study (TIMSS) to analyse how various institutions impact on educational performance at the student level. As mentioned, TIMSS is the latest international student achievement test for which data is currently available, and it is the most extensive one ever conducted both in its coverage of countries and in the scope of its contents (6). Here, we focus on the middle school years, where students enrolled in the two adjacent grades containing the largest proportion of 13-year-old students were tested, which are 7th and 8th graders in most countries.

The students' achievement levels in mathematics and science were tested by a combination of multiple-choice and open-ended-response questions which covered a wide range of topics and capabilities in the two subjects. The test items were chosen to reflect most closely the current curricula of the students of all participating countries. A test-curriculum matching analysis conducted by TIMSS showed that omitting those items for each country which measure topics not addressed in the curriculum had little effect on the overall pattern of achievement results across all countries. All in all, the TIMSS test results are most probably the best one can currently get in measuring student achievement in mathematics and science (7).

Combining the performance in the different questions of a subject, proficiency was mapped onto an international scale with a mean of 500 and a standard deviation of 100 to yield the international achievement scores (Beaton et al., 1996). The top performer of the international sample in both mathematics and science was Singapore (with average test scores of 622 and 576 points), while South Africa was at the bottom of the list (with 351 and 322 points). As for Europe and the US, the scores were as follows (listed in order of the maths score):

	Mathematics	Science
Dutch students	529 points	539 points
French students	515 points	475 points
German students	497 points	515 points
British students	491 points	532 points
US students	488 points	521 points

Overall, the data set used in Wößmann (2000, 2001) includes data on more than 250 000 individual students, who form a representative sample of a population of more than 30 million students in the 39 countries considered. Roughly two thirds of these countries are in Europe.

6) TIMSS was conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA), which has gathered 40 years of experience with international comparative studies on educational achievement and learning contexts. More information about the design, development, implementation, and analyses of TIMSS is available on the internet homepage at <http://timss.bc.edu/>.

7) For more details regarding the TIMSS micro data, see Wößmann (2000).

TIMSS also contains student-level data on family background and school-level data on schooling resources, and it contains various institutional data: class-level data on teachers, and school- and country-level data on the distribution of decision-making powers within the education system. Further country-level data on institutional features of the education system are taken from the OECD educational indicators. Details of the various variables used for the empirical analysis are discussed in Wößmann (2000).

We deal with four main institutional features of a country's educational system: centralised exams; the distribution of decision-making power between schools and their governing bodies; the level of influence that teachers and teacher unions have on school policy; and the extent of competition from the private-school sector. But before we can test the empirical relevance of these factors, we must control for the possible effects of family background and schooling resources on student performance. Without giving detailed results here, we find that the educational level achieved by parents is strongly positively related to their children's educational performance and that there is no strong positive relationship between spending and student performance (8).

Centralised exams

Centralised exams
introduce transparency.

Of the 39 countries in the TIMSS sample, 15 have some kind of centralised exams, in the sense that an administrative body beyond the schooling level writes and administers the exams to all students. This can profoundly alter the incentive structure within the educational system by making performance comparable across classes and schools. It makes it easier to tell whether a given student's poor performance is an exception within a class or whether the whole class is doing poorly relative to the country as a whole. Centralised exams introduce transparency: parents can assess the performance of children, teachers and schools; heads of schools can assess the performance of teachers; and the government and administration can assess the performance of different schools. Hence we should expect centralised exams to boost student performance.

Our findings, presented in Table 1, support these considerations and confirm previous evidence based on country-level estimations (Bishop, 1997). All other things equal, students in countries with centralised exams scored 16 points higher in mathematics and 11 points higher in science, although the science finding is not statistically significant due to the small number of countries in the sample (9). Furthermore, students in schools where external exams or standardized tests heavily influence the curriculum scored 4 points higher in maths, though there appears to be no effect in science (10). This probably suggests that science tests may lend themselves less readily to standardisation.

8) Using previous cross-country achievement tests, Hanushek and Kimko (2000) also do not find evidence on resource effects.

9) The mathematics effect is statistically significant at the 15 percent level, and, when imputed data are excluded in a more robust specification (not reported in Table 1), it is statistically significant at the 10 percent level.

10) In contrast to the figure reported in Table 1, the science effect is statistically insignificantly positive in a more robust specification which excludes imputed data.

Table 1. Selected institutional effects on student performance

	Mathematics		Science	
	Coefficient	Robust S.E.	Coefficient	Robust S.E.
1. Centralised exams				
Central examinations	16.062	(10.574)	10.650	(8.743)
External exams influence curriculum	4.271‡	(2.199)	-4.364†	(1.881)
2. Decision-making between schools and their governing bodies				
Central curriculum	10.776	(11.440)	5.573	(10.105)
Central textbook approval	9.559	(11.411)	6.157	(10.102)
School responsibility				
School budget	-5.852†	(2.450)	-3.451	(2.356)
Purchasing supplies	0.538	(3.488)	2.867	(3.308)
Hiring teachers	12.723*	(1.772)	5.247*	(1.473)
Determining teacher salaries	10.588*	(2.112)	15.162*	(1.817)
3. The influence of teachers				
Teachers' responsibility				
School budget	-13.318*	(3.805)	-4.583	(3.025)
Subject matter	-0.830	(1.585)	-1.213	(1.186)
Purchasing supplies	14.148*	(2.576)	6.837*	(2.062)
Strong influence on curriculum				
Teacher individually	11.952*	(1.730)	10.768*	(1.536)
Subject teachers	-6.855*	(1.897)	-4.573*	(1.625)
School teachers collectively	-12.659*	(1.836)	-5.034*	(1.575)
Teacher unions	-32.329*	(5.979)	-18.395*	(5.533)
Observations	266545		266545	
Schools	6107		6107	
Countries	39		39	
R ² (adj.)	0.22		0.19	

* Significant at the 1 percent level based on robust standard errors.

† Significant at the 5 percent level based on robust standard errors.

‡ Significant at the 10 percent level based on robust standard errors.

Note: The dependent variable is the TIMSS international test score, in mathematics and in science. Results are based on weighted least squares regressions using sampling weights for the stratified survey data. The reported results control for a host of variables including grade level, student characteristics, family background, parental educational level, educational resource measures, and teacher characteristics (for details, see Wößmann 2000). Robust standard errors based on robust linear regression are presented in parentheses, which account for the clustered data structure with countries as strata and schools as primary sampling units (PSUs). For the variables which are measured at the country level - central examinations, central curriculum, and central textbook approval - the reported robust standard errors are based on countries as PSUs.

Decision-making between schools and their governing bodies

Across countries in the TIMSS sample, some school systems are characterised by a high degree of administrative centralisation, so that decisions on a wide range of issues are taken out of the individual school's hands. Other school systems are highly decentralised; so most decisions are made at the local level. For instance, schools have a high degree of autonomy in the Netherlands, where almost three-quarters of the decisions are taken at the local level, according to the OECD (1998). By contrast, Greece, Norway and Portugal allow local school personnel to make less than one-quarter of the decisions.

More school autonomy may be good for student performance if, and only if, there are external standards and assessments.

Whether granting more autonomy to schools will boost student performance is hard to predict. On the one hand, the educators within a given school should know more than central administrators about the most effective teaching strategies tailored for their specific sample of students. Heads of schools should also have more knowledge than central administrators of which teachers to hire and of who deserves promotion or a raise in salary, given a fixed overall school budget. On the other hand, putting decisions on the size of the school budget in the hands of the school may make it easier for school personnel to reduce their workload. Hence more school autonomy may be good for student performance if, and only if, there are external standards and assessments which can control for school performance.

We begin by looking at the impact of a centrally designed curriculum and a centralised list of approved textbooks on student performance. These are essentially decisions about what schools are expected to cover. We find that students in countries with centralised curricula scored 11 points better in maths, 6 in science (see Table 1). Students in countries with centralised textbook approval scored 10 points better in maths, 6 in science. These findings are suggestive, even though the small number of independent observations causes statistically insignificant regression coefficients.

Moreover, students in schools that had primary responsibility for setting their own budget scored 6 points worse in mathematics and 3 in science (the science effect is again statistically insignificant). But giving schools autonomy in purchasing their supplies goes hand in hand with superior achievement. This is also true for decisions on hiring teachers. Students in schools that hire their own teachers scored 13 points higher in maths, 5 in science. Students in schools that determine their own structure of teacher salaries scored 11 points higher in maths, 15 in science. Taken together, it seems that centralised decision-making on curriculum issues prevents schools from allocating resources inefficiently and thus raises student achievement. In turn, an easing of process and management regulations may allow schools to tailor their instruction in ways that fit their students.

The influence of teachers

Besides a student's family, teachers probably have the largest impact on student achievement. Teachers often face conflicting interests. Like all other employees, they clearly have an interest in increasing their income at a given workload or decreasing their workload at a given income. But seeing their students learning also gives teachers pleasure, which encourages them to work harder no matter what their income may be. Furthermore, teachers who perform poorly may face negative consequences from their heads of school or from parents.

Since teachers account for a relatively large fraction of the workforce, they are also a potentially powerful political interest group when acting collectively. The very aim of teacher unions is to promote the interests of teachers, namely increasing their pay and decreasing their workload. Other things equal, strong teacher unions may result in weak student performance if they act to increase school resources but reduce the productivity with which these resources are used (Hoxby, 1996). By contrast, the predicted effect on student performance is uncertain when teachers act individually. A high degree of teacher leeway in making decisions about which textbooks to buy should be conducive to student learning, since they know best how to teach their students. But a high degree of influence in determining salary levels or the amount of subject matter to be covered should be detrimental to student performance.

Teachers' influence on the curriculum needs to be divided according to how they exercise it - whether individually or collectively via unions.

Our empirical results come close to confirming the expected effects (see Table 1). Students in schools whose principals reported that teachers had primary responsibility for determining the school budget scored 13 points worse in maths, 5 in science. Likewise, students of class teachers who reported that they had a lot of influence on the subject matter to be taught performed worse in science, while the effect in mathematics was insignificant (11). But students scored 14 points better in mathematics and 7 points better in science if teachers had primary responsibility for buying supplies. As expected, teachers' influence on the curriculum needs to be divided according to how they exercise it. Students in schools where each teacher had a lot of influence on the curriculum performed 12 points better in maths, 11 points in science. But in schools where teachers acting collectively as a union had a lot of influence over the curriculum, students performed 32 points worse in maths, 18 points in science.

Competition from private schools

The level of competition that public schools face from private schools is another important institutional feature. Because the loss of students to private schools may harm the heads of public schools in terms of reputation and money income, increased competition from private schools should have a positive effect on the efficiency of resource use in public schools. As a result, aggregate student performance may increase if the share of privately managed educational institutions increases.

The degree of competition from private schools varies greatly worldwide (Robitaille, 1997). In Europe for instance, Austria, the Czech Republic, Denmark, France, Germany, Hungary, Iceland, Norway, Spain and Sweden have virtually no financially independent private schools in the sense that they receive less than half of their core funding from government agencies. Less than 1 percent of Dutch schools are financially independent. But the Netherlands has by far the highest share of students attending privately managed schools (76 percent), followed by the United Kingdom (36 percent). Our empirical results, based on OECD data, suggest that students in countries with larger shares of their enrolment in privately managed schools scored significantly higher in both mathematics and science (12). If the share of enrolment in privately managed schools was 14 percentage points (or 1 standard deviation) higher, students scored 10 points better in maths, 9 in science. The effect was even larger when only those private institutions that were financially independent were considered.

11) In the more robust specification excluding imputed data, the science effect is larger and statistically significant.

12) Since these results are based on a different sample of countries, namely OECD countries, they are only referred to in the text and not in Table 1.

Viewed from a different perspective, the Netherlands and Belgium are by far the countries with the largest share of public funds going to private educational institutions (75 percent and 63 percent). By contrast, less than half a percent of public funding goes to private schools in Austria, Greece and Ireland. We find that students from countries with a higher share of public-education spending going to private institutions performed better in mathematics and science (though the effect in science is statistically insignificant). The effect was even stronger when only those expenditures were counted which went to independent private institutions that received less than half of their core funding from government. Our empirical results imply that if the share of public funds going to independent private schools rose by 1 percentage point (or 1 standard deviation), there was a 10-point increase in mathematics achievement. This suggests that student performance is higher in educational systems where taxpayers' money is allocated by private schools rather than by the public schooling system.

Overall, our empirical results reveal that having centralised exams and a large private schooling sector seems to be conducive to student performance. Generally, school autonomy seems to have a positive impact - but only when schools are given extensive decision-making powers over the purchase of supplies, the hiring and rewarding of teachers within a given budget, and the choosing of instructional methods. Giving schools power over designing the curriculum syllabus, approving textbook lists, and determining the school budget seems to be detrimental to student performance. The effect of teachers' influence seems to depend on how it is exercised. Students seem to benefit from their teachers' having influence over the curriculum, but only when they act as individuals and not as part of a union.

4. Better schools for Europe

In the emerging knowledge economy, nothing seems to be more important for the wealth of nations than a skilled and well-educated workforce. If Europe wants to prosper in the future, it has to get its schools right. Since early learning begets later learning (Heckman, 2000), a sound basic education lays a lasting foundation on which specialized learning can build later on. And since specialized knowledge can quickly depreciate in the rapidly changing environments of a global economy, the basic knowledge learned in schools is the only enduring knowledge asset.

If Europe wants to increase the educational performance of its students, it must improve the institutional structure of its schooling systems.

An obvious problem for education policy is that spending more money on schools did not have any payoff in Europe over the last quarter of a century. If Europe wants to increase the educational performance of its students, it must improve on the institutional structure of its schooling systems. Our results show that differences in schooling institutions matter much more for international differences in student performance than differences in educational expenditures. For instance, a student who would face institutions that were all conducive to student performance would have scored more than 200 points higher on the TIMSS mathematics test and 150 points higher on the science test than a student who faced institutions that were all detrimental to student performance (Wößmann, 2000). Such a test-score difference is five times as large as the difference produced by one year of schooling.

Our results suggest that educational policy in Europe should not focus on providing more resources to schools. Rather, educational policy should focus on improving the institutional environment in which schools function. Spending more money within an institutional system that sets poor incentives will not improve student performance. More attention should be paid on how effective schooling systems can be organised. Educational policies will only be successful if they generate incentives within schooling systems to improve on performance and save on cost.

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