

CENTRAL EXAMS AS THE “CURRENCY” OF SCHOOL SYSTEMS: INTERNATIONAL EVIDENCE ON THE COMPLEMENTARITY OF SCHOOL AUTONOMY AND CENTRAL EXAMS†

LUDGER WÖßMANN*

Just as currencies serve as a unit of value in the economic system, central exams can act as a measure of value in education systems, thereby mitigating informational asymmetries and preventing opportunistic behaviour in decentralised decision-making. Central exams are thus a precondition for decentralised education systems to achieve high student performance. This article first outlines this complementarity between central exams and school autonomy in a principal-agent model of educational provision, and then tests it empirically using the TIMSS international student achievement tests as a basis for a cross-country institutional comparison of education systems. Micro-econometric estimations reveal large positive effects of central exams on student performance. In education systems without central exams, school autonomy often has a negative impact on student performance. Central exams remove these negative effects of autonomy and convert them into positive effects in the case of school autonomy in salary decisions. Efficient education policies would thus combine central exams with school autonomy, setting and testing standards externally but leaving it up to schools how to pursue them.

Introduction

A high quality of the education learnt in schools leads to higher productivity and a more balanced income distribution of an economy (Wößmann 2003a, 2003b; Grundlach, Navarro de Pablo and

Weisert 2003). It is thus critical (not only) from an economic perspective to determine how the quality of educational performance may be improved. Extensive empirical evidence suggests that this cannot be done merely by spending more on education. In most cases, additional resources do not seem to improve student performance either over time or in a cross-sectional comparison (Grundlach, Wößmann and Gmelin 2001; Hanushek 2002, 2003; Wößmann and West 2002). In contrast, an institutional structure of the education system which sets appropriate incentives is associated with better student performance (Wößmann 2003c).

Central or external exams have been identified as such a performance-promoting institution (Bishop 1997; Wößmann 2003c). Instead of leaving the organization, implementation and marking of the examination of educational performance to individual teachers or schools, central exams are run by an external agency. The comparable information on student performance generated in this way changes the information status in the education system. Central exams thus change the incentives affecting all those involved in the educational process: the performance achieved by students, teachers and schools becomes objectified, thus providing the basis for appropriate consequences. The result is the creation of performance-promoting incentives for everyone concerned (Bishop and Wößmann 2004). It is not crucial whether the “central” exams are run by a national authority, regional authorities or in a standardised way by private service providers; the important thing is that they are organized “externally” with respect to the individual school.

This article examines the impact of the incentives created by central exams on the relative effectiveness of decentralised school systems. Its core message is that central exams – despite their apparent implication of a centralisation – need by no means be part of a centrally regulated education system. Indeed, they are really a precondition for the efficient functioning of otherwise decentralised school systems. This is because the education system often creates strong incentives for opportunistic behaviour due to its unbalanced information distribution and the divergent interests of its principals and agents. As long as local decision-makers cannot be held accountable for their behaviour in these cases because no information on performance is available, a school’s local decision-making autonomy

* Ludger Wößmann is senior researcher at the Ifo Institute for Economic Research at the University of Munich.

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will have a negative impact on student performance. However, as soon as central exams correct this information imbalance and reveal opportunistic behaviour so that decentralised schools are accountable for their performance, the negative effects of autonomy can be transformed into positive ones as the benefits of superior local knowledge come into play.

In this sense, therefore, school autonomy and central exams are complementary to each other: school autonomy leads to better educational performance only thanks to the performance-promoting incentives created by central exams. Conversely, central exams can contribute to assuring particularly good educational performance by exploiting the benefits of local knowledge made possible by this autonomy. This also means that the frequently urged decentralisation of the school system (for instance Weiß 1998; World Bank 1999, pp. 49–50) can enhance performance only if it is ensured, for instance by central exams, that the local decision-makers have incentives to act in a manner which promotes performance.¹

To this extent, central exams can perform a role in the school system similar to that played by currencies (which are also centrally supplied) in the economic system: just as money plays the role of a “unit of calculation” in the economic system (see any textbook on the theory of money, for example Issing 1998), standardised performance tests can assume the function of a “unit of calculation” in the education system. By acting as a unit of calculation or “measure of value”, money allows estimates of the practical value of an object to be precisely quantified and thus to be compared with its alternatives (for instance Schumpeter 1970, pp. 25–35). Such quantitative measures of performance and evaluation are “obviously of the very greatest importance for the rationalisation of behaviour, of similar importance to language and writing” (Schumpeter 1970, p. 27).² In a similar way, central exams can play a decisive role as a measure of performance and evaluation in the education system.

Beyond this, the monetary theory of Brunner and Meltzer (1971) stresses the role played by a cur-

rency in helping to overcome information imbalances in a barter economy. In such economies, information on market prices and commodity values is not available free of charge. Money reduces the costs of gaining information, and “it is the uneven distribution of information ... that induces individuals to search for, and social groups to accept, alternatives to barter” – namely money (Brunner and Meltzer 1971, p. 786). Just as it is a critical function of money to reduce transaction costs in the case of an uneven distribution of information, central exams can help to overcome information imbalances between the supply and demand side by acting as a standardised unit of measure in the education system. Like the central money supply in the economic system, central exams are the precondition for the effective functioning of a decentralised education system of autonomous agents.³

This article will examine the function of central exams as the “currency unit of the education system” first theoretically and then empirically. The theoretical analysis maps central exams as a monitoring tool in a principal-agent theory of the education system. The framework of the principal-agent model considers the dangers of local opportunistic behaviour in addition to the advantages of superior local knowledge. The effects of local autonomy thus depend on the relevant scope for opportunistic behaviour. When decisions are made on questions of budgets or salaries in which diverging interests create strong incentives for opportunistic behaviour, central exams become critical. This is because they make local decision-makers accountable for their behaviour thanks to the information they provide. Depending on whether the education system uses central exams or not, the positive performance effects of school autonomy created by the exploitation of local knowledge will either exceed the negative effects of local opportunistic behaviour or will fail to do so.

The following empirical analysis confirms this complementary relationship between school autonomy and central exams empirically on the basis of the international micro-database of the TIMSS and TIMSS-Repeat student performance

¹ In this light, it is also hardly surprising that Summers and Johnson (1996), in their overview of decentralizing reforms in the United States, found that decentralization does not always have a positive impact.

² Author’s translation.

³ However, the parallels between central exams in the education system and currencies in the economic system should not be taken too far: currencies also perform other functions in the economic system, for instance by acting as a medium of exchange and payment and as a means for storing value, and the measure of value produced by central exams can only to a limited degree be viewed as an *exchange value*.

tests. These cover almost half a million students in the middle school years from 54 countries. Interaction effects between school autonomy and central exams are introduced into estimates of international education production functions for this purpose. For instance, it is found that school autonomy in setting salaries has a statistically significant negative effect on student performance in the absence of central exams, but this is converted into a statistically significant positive effect where central exams do exist. Thus the international evidence in various decision-making areas reveals a complementarity between central exams and local decision-making. In general, those education systems do best which combine central exams with school autonomy, i.e. which specify standards and monitor their attainment but simultaneously leave it up to the individual schools *how* the externally set standards should be reached.

Opportunism, local knowledge, central exams and school autonomy

A principal-agent approach to educational production

From a theoretical viewpoint, education provision can be understood as a network of principal-agent relationships in which a principal (e.g. the parents) commissions an agent (e.g. a school director) to perform a service (the education of the child) on behalf of the principal. Laffont and Martimort (2002, p. 2) describe decentralised information and a constellation of opposing interests as the two essential components of incentive effects which make such principal-agent relationships a problem: "Delegation of a task to an agent who has different objectives than the principal who delegates this task is problematic when information about the agent is imperfect." For if the agent's interests diverge from those of the principal and if the information on the agent's real performance is asymmetrical, then the agent may pursue his own interests instead of those of the principal, without the latter becoming aware of this behaviour and thus being able to sanction it.

Central exams can help to resolve the problem of incomplete monitoring of the actions of the agents in the education system by supplying information about the performance of individual students relative to the national (or regional) student popula-

tion. By mitigating the monitoring problems inherent in principal-agent relationships, they harmonise the incentives of the agents more strongly with the interests of the principal and thus with the objectives of the education system (Wößmann 2002b). They make the performance status of the students visible and comparable for parents, teachers, potential employers and advanced educational institutions, so that better performance can be rewarded. They also prevent that entire areas of knowledge can be omitted in individual classes without any consequences for marking, and they reveal to parents and school directors whether the teachers are effective in passing knowledge on to their students.

School autonomy with and without monitoring

School autonomy or the decentralisation of decision-making power can be understood as such delegation of a task by a principal who wishes to implement the provision of knowledge in the education system, to agents, namely the schools. This need not always be a "problem": as long as no divergent interests or asymmetrical information exist, the agents can be expected to behave in conformity with the objectives. Only where both are present, do incentives and possibilities exist for the agents to act in an opportunistic way without incurring the risk that such behaviour will be noticed and sanctioned.

The danger of opportunism by decentralised decision-makers is thus limited to those decision areas in which their interests diverge from the objective to enhance the students' knowledge. This is, for instance, imaginable whenever the decision concerns the financial position or the workload to be fulfilled by the schools: in such cases it is rational for the school decision-makers to favour their own interests over promotion of student performance as long as possible monitoring agencies such as the school governors or the parents have no information about the actual behaviour of the schools. In view of the decentralised character of educational provision, there is almost always a high degree of information asymmetry about school behaviour. Nevertheless, it can be at least partially overcome by central exams which supply information about actual performance. Thus central exams have a considerable impact on the efficiency of educational provision whenever divergent interests in a decision-making situation make opportunistic behaviour probable.

In considering school autonomy in the education system, another important point must be added: in many decision-making areas, local decision-makers know much better than a central agency ever could how education services can be most efficiently provided. Thus teachers usually have a local knowledge lead as regards the best way of teaching their specific students a specific subject. This is only one example of the widespread “knowledge of the particular circumstances of time and place” (Hayek 1945, p. 522) which can make provision by a local agent much more efficient than by a central planning authority. But the decisive factor is whether these decision-makers also have the incentive to exploit their local knowledge lead in providing educational services. This will be the case only when others become aware of whether they have made the effort to utilise their local knowledge – i.e. only when information asymmetries are bridged, for instance by central exams.

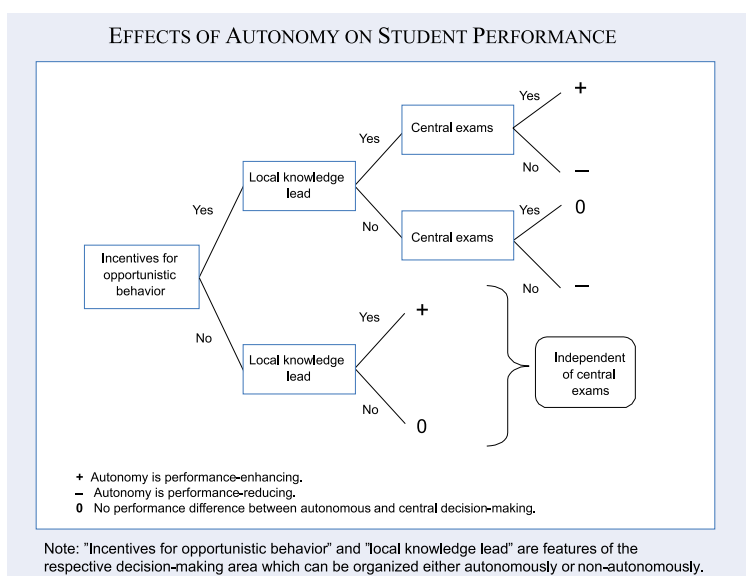
Figure 1 represents the corresponding effects on performance by school autonomy for various decision-making areas which may be characterized by the presence or absence of incentives for opportunistic behaviour and of local knowledge leads. In those areas where no incentives for opportunistic behaviour exist because the interests of agents and principal do not diverge, the effects of school autonomy on performance may be very simply determined: if local decision-makers have a knowledge lead in such areas, then school autonomy has a positive effect on educational performance. This is because the advantages of local decision-making (local knowledge lead) exist, while the disadvantages (opportunistic behaviour) do not. If local decision-makers have no knowledge lead in these areas, there will be no difference between decentralised and centralised decision-making. In both cases, it makes no difference on the effect of school autonomy on student performance whether the education system uses central exams or not: there is by definition no risk of any opportunistic behaviour which would have to be averted.

Central exams are of importance for the effect of school autonomy on performance only in decision-making areas offering incentives for opportunistic behaviour due to the diverging interests of the agents and the principal. Let us first consider those areas without a local knowledge lead and consequently with no benefits of decentralised decision-making. If the education system has no central exams, then school autonomy has a negative impact on student performance in these areas because decentralised decision-making – unlike centralised decision-making – leads to opportunistic behaviour. But if central exams do exist, the risks of local opportunistic behaviour and thus of negative performance effects are averted even in the case of decentralised decision-making. There are consequently no differences in performance between autonomous and central decision-making.

Finally, if a decision-making area contains both incentives for opportunistic behaviour and benefits of superior local knowledge, then the performance effects of decentralised decisions again depend on the existence of central exams. If such exams do exist, then the disadvantages of opportunistic behaviour are averted, so that the local knowledge lead is likely to produce an overall positive effect of school autonomy on performance. Without such exams, however, the advantage of superior local knowledge must be weighed against the disadvantages of opportunistic behaviour, and the overall effect of school autonomy depends on the relative size of these two partial effects. So it is not obvious whether these decision-making areas yield a slightly positive effect, no effect or an overall negative effect of school

Autonomy is performance-enhancing.
 - Autonomy is performance-reducing.
 0 No performance difference between autonomous and central decision-making.

Figure 1



autonomy. On the basis of the empirical results reported in the next section, in which the negative effect of opportunism generally appears to outweigh the positive effect of superior knowledge, an overall negative effect is shown in Figure 1. In this case, central exams turn an originally negative effect of school autonomy on performance completely round to become a positive effect.

The international evidence

The TIMSS datasets

In order to test these theoretically derived hypotheses empirically, I use the data of the two international comparative tests of student performance of the Third International Mathematics and Science Study (TIMSS). The TIMS study was initially carried out in 1995 (“TIMSS-95”) and repeated in 1999 (“TIMSS-Repeat”). Whereas TIMSS-95 has internationally comparable data for 266,545 students from 6,107 schools in 39 countries, TIMSS-Repeat covers 180,544 students from 6,068 schools in 38 countries. The pooled database thus contains a total of 447,089 student and 77 country observations, and as only 23 countries took part in both tests, the pooled database contains 54 different countries.⁴

Both TIMS studies were carried out by the International Association for the Evaluation of Educational Achievement (IEA). In the middle-school years, TIMSS-95 tested the two grades with the largest proportion of thirteen-year-olds, which correspond in most countries to seventh and eighth grades, whereas TIMSS-Repeat tested only the upper of these two grades. A representative random sample of around 150 schools was taken within each country, and one (randomly selected) eighth class as well as – in TIMSS-95 – one seventh class were completely tested in each school.

This article uses the individual student data of the pooled database, so that as many different education systems with and without central exams as possible can be considered, as well as local differences in the degree of school autonomy within these systems. In addition to the performance data

on math and science of the individual students, the TIMSS database contains extensive background information obtained via various questionnaires. Thus data from student questionnaires allow the control of extensive influences resulting from the personal and family background of the students. Teacher questionnaires contain data on both teacher characteristics and class resources as well as on the influence of teachers in various decision-making areas. Finally, questionnaires of school directors in particular provide information about the degree of school autonomy in various decision-making areas.

In addition to this TIMSS data, the database used here contains information about whether central exit exams are held at the end of secondary schooling in the countries concerned (or in regions within these countries). All forms of “curriculum-based external exit exam systems” (Bishop 1997) are considered here, but not university entrance exams which are not taken by all students and thus do not represent an integral part of the education system. The information about central exams is taken from comparative educational studies, educational encyclopaedias, interviews with representatives of the various national education systems, government documents and background documentation. In cases in which central exams are taken in only some regions of a country, the data used specifies the proportion of students who take them.

Central exams and student performance

Before examining the difference between autonomy effects in education systems with and without central exams in the next section, the general impact of central exams on student performance will initially be estimated by means of an international comparison of student performance in systems with and without central exams. The effect α of central exams E is estimated with the aid of the following equation:

(1)

$$T_{ilsc} = \alpha E_c + A_{lsc}\beta + C_{ilsc}\gamma + \mu_c + \eta_{il} + \nu_j + \varepsilon_{ij}$$

where E_c is the proportion of students in country c who take part in central exams.⁵ T_{ilsc} is the test

⁴ For more information on these two TIMS studies, see for instance Gonzalez and Smith (1997) and Gonzalez and Miles (2001). Wößmann (2003c, 2002b) contains more detailed information and notes on the specific database used in this paper.

⁵ As these involve national central-exam systems in most cases, E is usually assigned the dummy values 0 or 1.

score of student i in class l in school s in country c . The TIMSS test scores are scaled so that each discipline has an international mean of 500 and an international standard deviation of 100. In addition to twelve indicators of school autonomy A in various decision-making areas, the estimate also controls for an extensive control-variable vector C , which contains 17 variables for the student's personal and family background, 13 variables for school resources and teacher characteristics and six variables for other institutional features of the education system such as the centralisation of curricula and textbooks.⁶ The error term has several components at various levels: μ is a country-specific, η a school-specific, ν a class-specific and ε a student-specific component.⁷

The estimation results reported in Table 1 for the effect of central exams confirm that students in schools with such exams show a statistically significant better performance than those in schools without them. This applies both to math and science, and both for TIMSS and TIMSS-Repeat. In the pooled database, the effect of central exams is equal to 42.7 percent of an international standard deviation in math and 35.9 percent in science. This corresponds approximately to the difference in performance between students of the seventh and eighth classes, i.e. the knowledge learnt in an entire school year. The results of TIMSS-Repeat thus corroborate previous results obtained exclusively on the basis of TIMSS (Bishop 1997; Wößmann 2002a), namely that students perform better in education systems with central exams. Moreover, the magnitude of the effect estimated for TIMSS-Repeat is not statistically significantly different from that estimated for TIMSS-95.

In principle, it is conceivable that these least-squares esti-

mates of the effect of central exams are biased by endogeneity problems (for instance Jürges et al. 2003). Thus, there may be omitted variables at the country level which are correlated with the existence of central-exam systems and which cause the correlation with student performance. Four areas of possibly distorting country characteristics are particularly conceivable: firstly other institutional circumstances of the education system; secondly the general level of centralisation of a country; thirdly the homogeneity of the population; and fourthly cultural differences between countries. Because the use of central exams is not randomly distributed between countries but occurs most often in centralised or homogeneous countries or is associated with other institutions or cultural characteristics, and because these other country characteristics lead to differences in student performance, a simple least-squares estimate of the effect of central exams would be biased by such effects.

In the first three cases, it should be possible to eliminate at least most of this distortion by considering additional corresponding control variables. Thus the reported specification already contains a large number of institutional control variables (including the centralisation of the curriculum and of textbook approval), and tests show that their inclusion has no significant impact on the estimated effect of central exams. To control for the general centralisation of the education system and the homogeneity of the population, the share of the educational budget controlled by the central government as well as a measure of ethno-linguistic fractionalisation of the population were additionally included in the specification as control variables, without significantly changing the estimated effect of central exams.

Table 1
The effect of central exams on student performance

Estimates of the coefficient on central exams. – Dependent variable: TIMSS test score. – Control variables: 48 student, family, resource, teacher and institutional characteristics. – Clustering-robust standard errors (at country level) in parentheses.

	Math	Science	Students	Countries
TIMSS-95	40.9* (13.5)	39.7* (9.9)	266,545	39
TIMSS-Repeat	47.0* (13.5)	35.9* (12.9)	180,544	38
Both	42.7* (9.8)	35.9* (8.3)	447,089	77
Both, with regional dummies	28.6† (13.2)	41.7* (10.8)	447,089	77
Significance level (based on clustering-robust standard errors): * 1 percent; † 5 percent.				
Source: Wößmann (2003d).				

⁶ The individual control variables are reported in Table A1 in Wößmann (2002b).

⁷ The error components are implemented by clustering-robust linear regression (CRLR). In calculating the effect of central exams, CRLR considers possible interdependences of the error terms for students within a country – and, below, in calculating the effects of autonomy, within individual schools – in the calculation of the standard errors (Moulton 1986; Deaton 1997, pp. 74-78). The stratified random sampling in TIMSS is taken into account by weighting the observation of each student within his country with his survey probability (DuMouchel and Duncan 1983; Wooldridge 2001); at the same time all countries are weighted equally.

Finally, in order to test whether the effect of central exams captures other cultural differences between countries, regional (continental) dummies may be added as additional control variables. As a result, the effect of central exams is estimated exclusively on the basis of inter-regional variation. Thus inter-regional cultural differences such as those prevailing between Asian and European value systems no longer affect the estimate of central exams. As shown in Table 1, the estimations yield statistically significant effects of central exams even if all variations between the nine regions of Western Europe, Eastern Europe, North America, South America, Oceania, Asia, Middle East, North Africa and South Africa are ignored. Consequently, the estimated effect of central exams does not appear to be affected either by other institutional differences, nor by the general degree of a country's centralisation or homogeneity, nor by cultural differences, but to reflect the effect of external exams on student performance.

School autonomy and student performance with and without central exams

In order to examine whether – as derived above – the existence of central exams impacts the effect of school autonomy on student performance, additional interaction terms will be added between central exams E and the indicators of school autonomy A in equation (1):

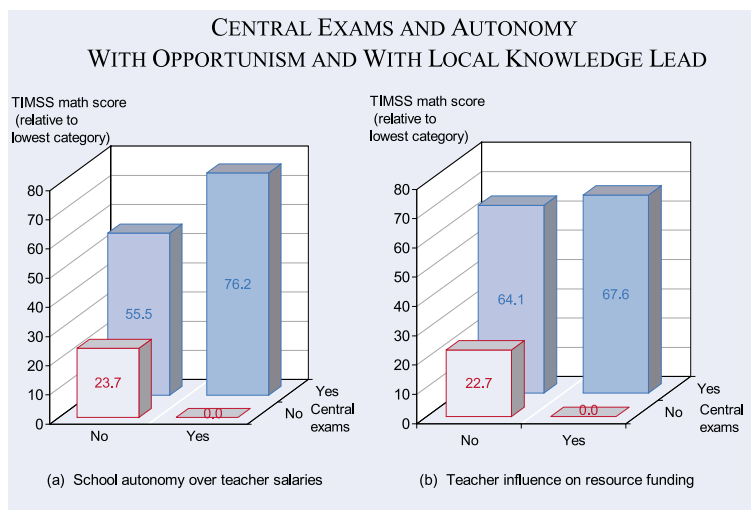
(2)

$$T_{itc} = \alpha E_c + A_{itc} \beta_1 + (E_c A_{itc}) \beta_2 + C_{itc} \gamma + \mu_c + \eta_{it} + \nu_j + \varepsilon_{it}$$

The estimated interaction effects show whether the effect of school autonomy in various decision-making areas differs between education systems with and without central exams. The complete results for the estimated effects of autonomy and interaction terms are listed in Table A1 in the appendix.⁸ The most striking findings will be discussed individually below on the basis of several diagrams.

⁸ The results reported here refer to math performance; similar results were found for science performance (Wößmann 2002b).

Figure 2



The following diagrams represent student performance under the four conditions resulting from the presence and absence of school autonomy and central exams for each of the various decision-making areas: the performance of students in schools without autonomy in systems without central exams; with autonomy but without central exams; without autonomy but with central exams; and with both autonomy and central exams. In each diagram, student performance is shown relative to the condition with the lowest performance.⁹

Figure 2a shows the case of whether schools are responsible for deciding on teacher salaries. In systems without central exams, school autonomy regarding teacher salaries has a *negative* effect on student performance. In systems with central exams, student performance is – as found before – generally higher than in systems without central exams, both in cases with and without school autonomy. In addition, however, it is striking that the effect of school autonomy on student performance in systems with central exams is turned completely around: salary autonomy of schools has *positive* effects on student performance in central-exam systems.¹⁰

Decisions on teacher salaries thus appear to involve both incentives for opportunistic behav-

⁹ The estimates on which these diagrams are based control for all the control variables of family, resources and institutions of equation (2), but – unlike the results reported in Table A1 – not for further interaction effects between central exams and family/institution variables. Otherwise, the specific effect of central exams would be estimated quite imprecisely and the bars for the effects in central-exam systems would consequently be based on imprecise estimates (Wößmann 2002b).

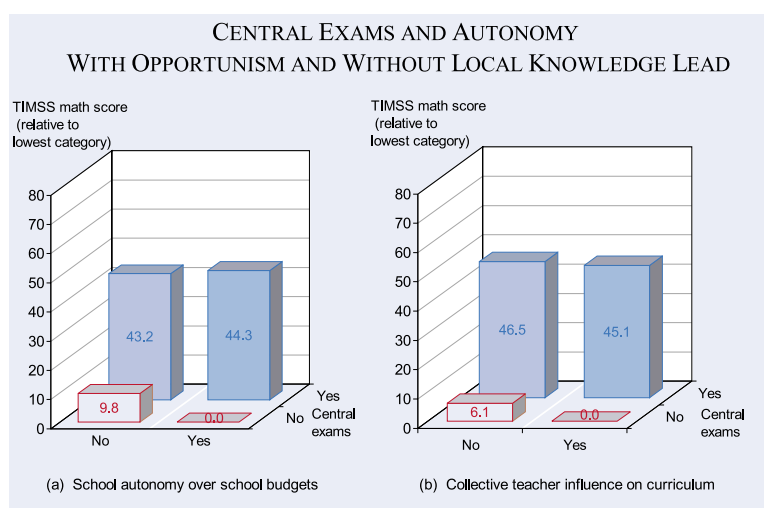
¹⁰ Unless otherwise reported, all the effects shown in Figures 2–4 are statistically significant.

ior and local knowledge leads (cf. Figure 1): without central exams, the negative performance effects of opportunistic decisions taken by the schools dominate, as this local opportunistic behaviour cannot be externally observed and thus cannot be sanctioned. Hence school decision-makers do not feel obliged to set teacher salaries so as to contribute to enhancing student performance, but can use their decision-making autonomy to promote other interests. In contrast, central exams provide information about whether the schools perform well or not, so that supervisory authorities and parents can draw possible consequences from that type of school behaviour which weakens performance. This creates incentives for the decision-makers in the schools not to exploit their autonomy in setting teacher salaries in an opportunistic way, but to use it in order to effectively promote student performance. The benefits of superior local knowledge then come into effect, as school decision-makers ought to know better than any central authority which teachers deserve to be rewarded for good work.

The case is similar when decisions on school resources are decentralised in such a way that teachers have a say in the funds available for resources (Figure 2b). In this decision-making area too, decentralised decision-making autonomy has a negative effect on student performance in systems without central exams, whereas it has a positive effect in systems with central exams. However, the difference between schools with and without teacher influence on resource funding in systems with central exams is not statistically significant. This could be due either to the fact that opportunistic behaviour is not entirely prevented by central exams in such cases and consequently weakens the positive effects of local knowledge, or to the fact that no significant local knowledge lead exists here.

The same appears to be the case to an enhanced degree in the decision-making areas shown in Figure 3. In systems without central exams, school autonomy in budgeting has a negative impact on student performance (Figure 3a), which may be

Figure 3



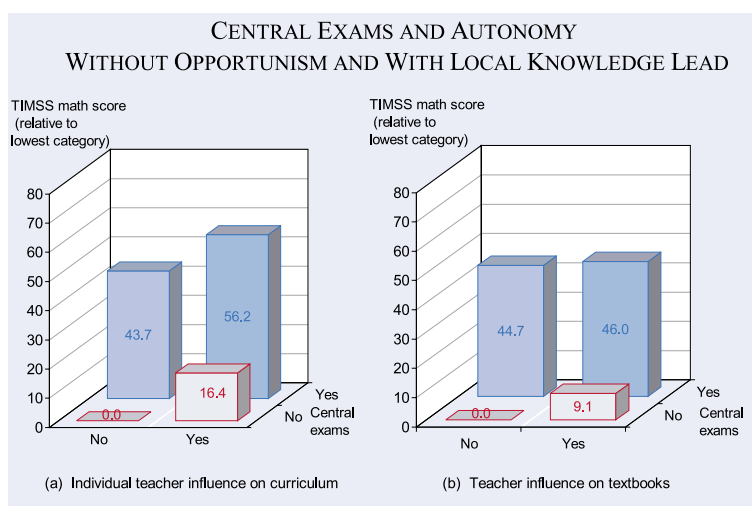
due to incentives for opportunistic behaviour in funding. In systems with central exams, this negative effect of school autonomy disappears, although without turning into a significant positive effect. This could be due to the fact that external agencies need by no means have a knowledge disadvantage in budget questions compared to individual schools which often lack the required specialist staff.

We see the same picture when we ask whether the teachers of a school collectively have a say in the curriculum to be taught (Figure 3b). Without monitoring by central exams, such collective teacher influence has a negative impact on student performance, which may be due to opportunistic interests of the teachers as regards the workload to be fulfilled. If a central-exam system does exist, then this negative performance effect is attenuated into an insignificant effect of teacher autonomy. This can be rationalised within the framework of the above model by assuming attenuated opportunistic behaviour with the simultaneous absence of local knowledge leads where decisions are taken collectively by the teachers.¹¹

Things look different when individual teachers rather than the teachers' collective can influence the curriculum (Figure 4a). In this case, a positive effect of teacher autonomy on student performance is observed in systems with and without central exams, showing no statistically significant difference between the two systems. In the model

¹¹ It should be noted that the underlying estimate controls for the influence of individual teachers on the curriculum, so that the individual knowledge benefits of the teachers are kept constant.

Figure 4



framework considered here, this would mean that the individual teachers are unable to push through opportunistic forms of behaviour in addition to their collective influence, but that they possess local knowledge advantages as individuals.

Finally, Figure 4b depicts a decision-making area in which the presence of central exams attenuates a positive autonomy effect: if individual teachers in systems without central exams have a say in the textbooks used, this has a positive effect on student performance. This is likely to be due to local knowledge leads which are not counteracted by opportunistic interests, as the teachers would do themselves a disservice if they were to select unsuitable books. This positive effect of teacher autonomy is smaller and statistically insignificant in systems with central exams. In contrast to the simplified presentation of Figure 1, therefore, a local knowledge lead can result in a difference in the autonomy effect on student performance between systems with and without central exams despite a lack of incentives for opportunistic behaviour. This weakening of the autonomy effect may be due to central exams inhibiting local decision-makers from fully exploiting their local knowledge. However, it should be noted that in this case too the overall performance of students in central-exam systems is still far superior to that in systems without central exams.

The last case illustrated in Figure 1, which contains neither incentives for opportunistic behaviour nor local knowledge leads, is of relatively little interest for a consideration of autonomy effects. This is because autonomy then has no influence on stu-

dent performance either with or without central exams. This could be the case for math in the decision-making area of teacher autonomy in decisions on the type of equipment, as reported in Table A1, where no significant autonomy effects are detected. However, in science there is a small but statistically significant positive autonomy effect which is slightly attenuated in central-exam systems, which would indicate the presence of local knowledge leads without opportunism. Table A1 reports the

same scheme for school autonomy in purchasing supplies. In contrast, teacher autonomy in the selection of subject areas is another example of a decision-making area offering incentives for opportunism but without a local knowledge lead: here, a negative autonomy effect in systems without central exams is largely eliminated by central exams.¹²

Concluding remarks

By overcoming information imbalances in the education system, central exams help otherwise decentralised school systems to benefit from local knowledge leads without suffering from local opportunistic behaviour. Thus central exams can act like a “currency” of the education system: as a centrally supplied measure of performance and evaluation, they reduce the transaction costs caused by incomplete contracts in the case of asymmetric information between principals and agents. They thus prove to be complementary to school autonomy: by reducing the opportunistic behaviour of local decision-makers, they become a precondition for the efficient operation of decentralised education systems.

Consequently, central-exam systems do not only change the behaviour of students but indeed of all agents involved in the education process. They re-

¹² The results for the case of school autonomy in teacher selection shown in Table A1 are hard to rationalize. They are restricted to the case of math; in science, systems without central exams do not produce an autonomy effect, and this is converted into a positive effect with central exams. This is the only case in which the science results diverge fundamentally from those in math. For a discussion of further institutional interaction effects with central exams, see Wößmann (2002b).

orient the incentives towards a promotion of scholastic performance. The change in the behaviour of the decision-makers in the schools will also affect the impact of schools' autonomy. This will consequently act as a mechanism via which central exams lead to improved student performance. An efficient education policy would consequently combine central exams with school autonomy, i.e. it would specify standards and monitor their attainment, but simultaneously leave it up to the schools as to how these standards should be realized.

In examining the role played by a currency, it has often been noted that the poorer sections of society tend to suffer disproportionately when the function of money as a measure of value is depleted – for instance as a result of inflation. In a similar way, one may ask whether central exams also show such distorted distribution effects. More detailed estimates which consider the interactions between central exams and indicators of a student's family background show that the impact of central exams really does differ considerably for students from various family backgrounds (Wößmann 2002b). Thus the effect of the level of parental education on children's performance in systems without central exams is far greater than in systems with such exams. This difference between the two systems is statistically highly significant, especially in math. The weaker scholastic performance of immigrant children of the first and second generations is also far less pronounced in systems with central exams than in systems without them. These findings suggest that central exams contribute to fairer educational opportunities for students from diverse family backgrounds – or in other words: the lack of the “currency” of central exams has negative distribution effects also in the education system.

Central exams need not eliminate all types of distinctions between schools. The performance effects examined here refer to the basic skills which should be possessed by all thirteen-year-old students in math. Supporters of homogeneous and differentiated school systems respectively ought to be able to agree that the acquisition of such basic skills should be a central objective of every school system. In this respect, it is of importance that the TIMSS test results used in the reported analyses are not based on the respective central exam of each country but on an independent test which has been accepted by all participating countries as corresponding to their respective math and science

curricula. Hence, central exams do not lead to a situation where teachers merely get their students to learn for the possible questions coming up in the respective central exams by heart and the students then “cram” for the test in question – for this would not affect their performance in the TIMSS tests. Instead, the reported estimates suggest that central exams really do lead to students acquiring a better basic knowledge in math and science. Beyond this, it should also be noted that in the case of external exams too, performance requirements can be differentiated and schools' focal interests can be reflected.

Beyond the reported empirical results relating to central exit exams at the end of secondary education, the theory presented here suggests that more regular central exams in the course of primary and secondary education could well yield further positive effects. Such regular external exams in various grades would improve the information status in the education system still further. Thanks to their early availability, in the case of unsatisfactory performance they would also allow countermeasures to be taken far ahead of the end of secondary education.

References

- Bishop, J.H. (1997), “The Effect of National Standards and Curriculum-Based Examinations on Achievement”, *American Economic Review* 87 (2), 260–64.
- Bishop, J.H. and L. Wößmann (2004), “Institutional Effects in a Simple Model of Educational Production”, *Education Economics*, forthcoming.
- Brunner, K. and A.H. Meltzer (1971), “The Use of Money: Money in the Theory of an Exchange Economy”, *American Economic Review* 61 (5), 784–805.
- Deaton, A. (1997), *The Analysis of Household Surveys: A Microeconomic Approach to Development Policy*, The Johns Hopkins University Press, Baltimore.
- DuMouchel, W.H. and G.J. Duncan (1983), “Using Sample Survey Weights in Multiple Regression Analyses of Stratified Samples”, *Journal of the American Statistical Association* 78 (383), 535–43.
- Gonzalez, E.J. and J.A. Miles, eds. (2001), *User Guide for the TIMSS 1999 International Database*, Boston College, Chestnut Hill, MA.
- Gonzalez, E.J. and T.A. Smith, eds. (1997), *User Guide for the TIMSS International Database: Primary and Middle School Years*, Boston College, Chestnut Hill, MA.
- Gundlach, E., L. Wößmann and J. Gmelin (2001), “The Decline of Schooling Productivity in OECD Countries”, *Economic Journal* 111 (471), C135–47.
- Gundlach, E., J. Navarro de Pablo and N. Weisert (2003), “Education Is Good for the Poor: A Note on Dollar and Kraay”, in A. Shorrocks and R. van der Hoeven, eds., *Growth, Inequality and Poverty*, Oxford University Press, Oxford.
- Hanushek, E.A. (2002), “Publicly Provided Education”, in A. J. Auerbach and M. S. Feldstein, eds., *Handbook of Public Economics*, vol. 4, Elsevier, Amsterdam, pp. 2045–141.
- Hanushek, E.A. (2003), “The Failure of Input-Based Schooling Policies”, *Economic Journal* 113 (485), F64–98.

Hayek, F.A. (1945), "The Use of Knowledge in Society", *American Economic Review* 35 (4), 519–30.

Issing, Ottmar (1998), *Einführung in die Geldtheorie*, 11th ed., Vahlen, Munich.

Jürges, H., K. Schneider and F. Büchel (2003), "The Effect of Central Exit Examinations on Student Achievement: Quasi-Experimental Evidence from TIMSS Germany", *CESifo Working Paper* 939.

Laffont, J.-J. and D. Martimort (2002), *The Theory of Incentives: The Principal-Agent Model*, Princeton University Press, Princeton.

Moulton, B.R. (1986), "Random Group Effects and the Precision of Regression Estimates", *Journal of Econometrics* 32 (3), 385–97.

Schumpeter, J.A. (1970), *Das Wesen des Geldes*, Vandenhoeck & Ruprecht, Göttingen.

Summers, A.A. and A.W. Johnson (1996), "The Effects of School-Based Management Plans", in E. A. Hanushek and D. W. Jorgenson, eds., *Improving America's Schools: The Role of Incentives*, National Academy Press, Washington DC, pp. 75–96.

Weiß, M. (1998), "Schulautonomie im Licht mikroökonomischer Bildungsforschung", in R. K. von Weizsäcker, ed., *Deregulierung und Finanzierung des Bildungswesens*, Schriften des Vereins für Socialpolitik, vol. 262, Duncker & Humblot, Berlin, pp.15–47.

Wooldridge, J.M. (2001), "Asymptotic Properties of Weighted M-Estimators for Standard Stratified Samples", *Econometric Theory* 17 (2), 451–70.

World Bank (1999), *World Development Report 1998/99: Knowledge for Development*, Oxford University Press, Oxford.

Wößmann, L. (2002a), *Schooling and the Quality of Human Capital*, Springer, Berlin.

Wößmann, L. (2002b), *Central Examinations Improve Educational Performance: International Evidence*, Kiel Discussion Papers 397, Institute for World Economics, Kiel.

Wößmann, L. (2003a), "Specifying Human Capital: A Review and Some Extensions", *Journal of Economic Surveys* 17 (3), 239–70.

Wößmann, L. (2003b), "Returns to Education in Europe (Review Essay)", *Review of World Economics – Weltwirtschaftliches Archiv* 139 (2), 348–76.

Wößmann, L. (2003c), "Schooling Resources, Educational Institutions, and Student Performance: The International Evidence", *Oxford Bulletin of Economics and Statistics* 65 (2), 117–70.

Wößmann, L. (2003d), "Central Exit Exams and Student Achievement: International Evidence", in P. E. Peterson and M. R. West, eds., *No Child Left Behind? The Politics and Practice of School Accountability*, Brookings Institution Press, Washington DC, forthcoming.

Wößmann, L. and M.R. West (2002), "Class-Size Effects in School Systems Around the World: Evidence from Between-Grade Variation in TIMSS", *Program on Education Policy and Governance Research Paper, PEPG/02-02*, Harvard University.

Appendix

Table A1

Interaction effects of central exams and school autonomy

Estimates of the respective autonomy coefficient and of the interaction coefficient with central exams. – Dependent variable: TIMSS math test score. – Control variables: 36 student, family, resource, teacher and institutional characteristics as well as 17 interaction effects of student, family and institutional characteristics with central exams. – Clustering-robust standard errors (at school level) in parentheses.

	In systems without central exams ^a	Change in systems with central exams ^b
<i>School autonomy</i>		
School budget	- 6.9 [†] (2.8)	7.7 [†] (3.5)
Purchase of supplies	7.1 [†] (3.2)	- 5.7 (5.0)
Selection of teachers	21.6* (2.6)	- 20.2* (3.1)
Teacher salaries	- 28.3* (3.6)	50.2* (4.1)
<i>Teacher influence</i>		
Funds for resources	- 24.7* (5.1)	29.1* (6.3)
Type of resources	3.0 (2.8)	- 3.5 (3.8)
Subject areas	- 12.3* (2.3)	8.7* (2.8)
Textbooks	11.6* (3.1)	- 11.7* (3.6)
Curriculum		
Individual teachers	14.6* (2.1)	- 3.9 (2.7)
Subject teachers collectively	- 5.0 [†] (2.4)	2.8 (3.1)
School teachers collectively	- 14.7* (2.1)	6.5 [†] (2.8)
Teacher unions	- 8.5 (5.4)	- 29.5* (8.7)
Students (unit of observation)	447,089	
Schools (primary sampling unit)	12,175	
Countries	77	
R ²	0.296	
Significance level (based on clustering-robust standard errors): * 1 percent; † 5 percent.		
^a Coefficient of the respective autonomy variable (β_1 in equation [2]).		
^b Coefficient of the interaction term between central exams and the respective autonomy variable (β_2 in equation [2]).		
Source: Wößmann (2002b).		