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ABSTRACT

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The paper presents a model of educational production which tries to make sense of recent evidence on effects of institutional arrangements on student performance. In a simple principal-agent framework, students choose their learning effort to maximize their net benefits, while the government chooses educational spending to maximize its net benefits. In the jointly determined equilibrium, schooling quality is shown to depend on several institutionally determined parameters. The impact on student performance of institutions such as central examinations, centralization versus school autonomy, teachers' influence, parental influence, and competition from private schools is analyzed. Furthermore, the model can rationalize why positive resource effects may be lacking in educational production.

JEL Classification: I20, L32, H52

Keywords: educational production, principal-agent model, institutions of the education system

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1 Introduction

The determination of schooling quality as reflected in students' educational performance is the topic of a wide empirical literature. On the one hand, a standard finding of this literature is that additional resources such as smaller class sizes do not generally seem to improve student performance (cf. Hanushek 1999; Hoxby 2000b; Gundlach et al. 2001).[1] On the other hand, there is increasing evidence that institutions of the education system exert important effects in educational production. Institutions which have been shown to influence student performance considerably are central examination systems (Bishop 1997, 1999); centralized decision-making versus school autonomy (Wößmann 2001); the degree of teacher unionization (Hoxby 1996); parental choice (Rouse 1998); and competition in the education system (Hoxby 1994, 2000a; Rouse 1998). However, the theoretical literature on institutional effects lags considerably behind this empirical development. This paper develops an economic model of educational production which tries to make sense of the impact of institutional arrangements of the education system on the quality of schooling.

One reason why the institutional system plays such a crucial role especially in educational production may be that public schools dominate the production of basic education all over the world. As the Economist (1999, p. 21) put it, "[i]n most countries the business of running schools is as firmly in the grip of the state as was the economy of Brezhnev's Russia." Like other command and control systems, public schooling systems may arguably not set suitable incentives for improving students' educational performance or for containing costs. It is usually assumed that a performance-maximizing behavior ensues in private sectors because market competition imposes penalties on firms which fail to use their resources effectively. Inefficiency leads to higher costs and higher prices – practically an invitation for competitors to lure away customers. Such a loss of customers has a negative effect on firms' profits, the objective which firms usually strive to maximize, so that they have an incentive to make an efficient use of their resources.

[1] This general finding holds notwithstanding individual studies which report positive effects in some circumstances, such as Krueger (1999) or Angrist and Lavy (1999).

This may be different in the education market, however, because schools may not face rigorous objectives to maximize performance (Hoxby 2000b). The relative lack of competition in the schooling sector tends to dull the incentives to improve quality while holding down costs. Moreover, in the public system, the ability of parents and students to ensure that they receive a high-quality education is constrained by a large number of obstacles to "opting out by feet," that is to leaving a bad school. They have to rely almost exclusively on the government, school administrators, and school personnel to monitor one another's behavior and to create appropriate quality-control measures.

In developing a theoretical model of institutional effects in educational production, this paper starts with an application of the theory of institutional economics to the schooling sector in general terms (Section 2). Institutions allocate the rights of decision-making in a system and determine the incentives faced by the actors. In the education process, a network of principal-agent relationships exists which entail conflicts between the interests of different groups and serious problems of monitoring due to informational advantages of self-interested agents. This can create adverse incentives and leeway for the agents to act opportunistically, leading to an inefficient use of given resources and to misallocations of resources across different uses. By determining decision-making rules and incentives, the institutional structure of the schooling system can thus influence the quality of the education which is ultimately produced.

The few economic models of the schooling system available in the literature which deal with the influence of institutions on the production of education are scattered among several approaches which are restricted to specific effects. Among those models which do include institutional effects, Costrell (1994) and Betts (1998) model education as a principal-agent problem where a policy maker sets educational standards and students choose their effort in response to these standards. They restrain the model to the optimal setting of educational standards and come to conflicting conclusions for an egalitarian policy maker. Hoxby (1999) analyzes the effects of central versus local school financing on schooling productivity in an agency model where schools are producers of local public goods facing decentralized Tiebout choices by households. She finds favorable effects of local financing on the productivity of schooling producers. Epple and Romano (1998) restrict their schooling model to the analysis of the sorting of students into public and private schools by ability and income. Lazear (2001) presents a model of educational

production where classroom learning is a public good which can be disrupted by individual students and where schools choose class sizes according to students' behavior. He shows that private schools may produce higher student achievement by setting higher disciplinary incentives for students. In essence, the few existing models of schooling which deal with institutional features limit themselves to special issues. They fall short of being capable of predicting the effects which a broad range of potential institutional features might have on the quality of the education produced by schools.

Thus, in Section 3 we develop a basic model of educational production which is drawn up to reflect the principal-agent structure of the education process and which allows us to analyze the impact of institutional features on students' educational performance. In this model, we strip down the network of principal-agent relationships in schooling as described in Section 2 to only two actors: The government chooses the level of educational spending which maximizes its net benefits, given students' efforts, and the students choose the level of their effort which maximizes their net benefits, given the government's spending choice. In the jointly determined equilibrium, the quality of the education produced in schools is shown to depend on several parameters which are given by the institutional structure of the schooling system. While this model is quite parsimonious, it contains the essential features necessary to understand the influence of institutions in the educational process.

The model is applied to assess the impact of different institutional features of the schooling system on the quality of schooling output (Section 4). It is argued that central examinations favor students' educational performance by increasing the rewards for learning, decreasing peer pressure against learning, and improving the monitoring of the education process. School autonomy on standard setting and performance control is detrimental to educational performance because it increases the scope for diverting resources from teaching, whereas school autonomy in process operations and personnel-management decisions is conducive to educational performance because it increases the informational content and effectiveness of teaching. As regards the level of administrative decision-making, both local and central administrative levels render negative effects on schooling quality. Teachers' influence on teaching methods, teachers' scrutiny of their students' performance, parents' influence in the education process, and competition from private schools increase the quality of schooling, because they favor schooling

effectiveness, increase the rewards for learning and the political priority given to schooling quality, and limit the scope for resource diversion. By contrast, teachers' influence on their salary levels and work-load and a high degree of political leverage of teacher unions decrease the quality of schooling, because they favor resource diversion to the furthering of vested interests and lower the priority given to schooling quality in the political process.

2 Institutional Economics Applied to the Schooling Sector

2.1 The Role of Institutions and Incentives in the Schooling System

In studying the economic forces at work in the schooling sector, one is easily led to the simple production-function argumentation that more inputs such as smaller classes, higher teacher salaries, or more teaching material should lead to higher schooling output in the form of improved educational performance of students. However, this would require an efficient use of resources in the sense that inputs are used in a performance-maximizing way. Because the incentives elicited by competition and the price system which tend to create the efficient input-output link in other sectors of the economy are usually not at work in the public schooling sector, we cannot simply presuppose that the educational input-output relation in schools is efficient. Instead, we have to look at the institutional structures which prevail in the schooling system and at the monetary and intrinsic incentives they create for the different groups involved in educational production. As Landsburg (1993, p. 3) put it, "[m]ost of economics can be summarized in four words: 'People respond to incentives.'" Therefore, to understand the economic forces at work in the schooling sector, we analyze the incentives influencing the different actors involved in the production of education and the different institutional structures which create these incentives.

Generally speaking, institutions are constraints devised by human beings which constitute the rules of the game in a society, thereby structuring human interactions (North 1994). Institutions enclose formal and informal rules and their enforcement instruments. Within the schooling system, relevant institutions govern the distribution of decision-making powers between the different actors involved. The set of given institutions creates a system of property rights, i.e. rights of actors to use resources and to limit competition

for resources as well as entitlement rights. That is, institutions determine who is eligible to make decisions on the use of resources in different areas. Furthermore, institutions determine the provision of information in the system and the rewards and penalties which the actors get in response to their actions (Furubotn and Richter 1997). Thereby, institutions define and limit the set of possible choices of all actors involved and thereby form the prevailing incentive structure.

While institutions are the rules of the game, the people who are the players in this game act within this system of rules. Assuming that individual actors behave rationally, they maximize their objective functions subject to the constraints set by the institutions. Therefore, they respond to the incentives created by the set of given institutions. The behavior of the people involved in educational production is reflected in their decisions on the allocation of resources across different functional categories (e.g., number of teachers, teachers' salaries, instructional material) and on the effectiveness of the use of these resources. This in turn affects the outcome of the education process, namely the performance of the students.

Consequently, institutions influence student performance by creating a system of rights to decide on resource allocation which establishes the incentives which steer actors' behavior in a particular direction. In North's (1994, p. 359) explanation of economic performance, "[i]nstitutions form the incentive structure of a society, and the political and economic institutions, in consequence, are the underlying determinants of economic performance." In the same consequence, political and educational institutions are the underlying determinants of educational performance.

2.2 Agency Problems and Inefficiencies in Schooling

Institutions are not per se created in ways which ensure efficiency. Quite to the contrary, in the schooling system, there are a lot of problems of agency, incomplete contracts, and adverse incentives which work against an efficient use of resources. The institutions governing the education process can be viewed as a network of principal-agent relationships. Within these relationships, a principal has an (explicit or implicit) contract with an agent to act on his behalf. The agent is self-interested, and he enjoys some informational advantage over the principal (asymmetric information). The self-interest of

the agent might conflict with the principal's interest, and the informational advantage will make it costly (or even impossible) for the principal to monitor the actions of the agent completely. This leads to adverse incentives, giving the agent some leeway to act opportunistically - i.e. selfishly in his own interest instead of the principal's interest - without being penalized. While it might be in the interest of the "ultimate" principal in the education process to maximize student performance with given resources - parents are probably the actors which come nearest to something like an "ultimate" principal in schooling -, the vested interests of the different agents will lead to a misallocation across different inputs and an inefficient use of the inputs.

A (still hugely simplifying) picture of the network of principal-agent relationships in educational production looks as follows: Voters (including parents) entrust the government with the task of ensuring schooling for the children. The government hands the implementation over to the administration. The administration transfers the task of schooling provision to school management (usually exercised by heads of school or school governing boards). School management employs teachers and teaching aides for tuition of the children. And ultimately it is the students who have to do the learning. Each of these contracts is laden with problems of monitoring. There is no clear-cut property right of students or parents to decide how the money for their schooling is spent. Instead, all the agents involved respond to the incentives set by the institutions: They can use the room created by imperfectly monitored contracts to advance their own interests. They can divert resources from the use of maximizing the educational performance of the students to the use of advancing their own objectives.

It would be a vast simplification of reality to assume that the different groups of agents maximize a single objective each. In reality, each group of agents faces multifarious interests, and the institutional structure can change the relative costs and benefits of advancing one objective or the other. While teachers have a genuine interest in increasing their income at a given work-load or decreasing their work-load at a given income, no one will deny that most teachers also get satisfaction from seeing their students progressing, thereby raising their welfare level. Furthermore, teachers might face negative consequences from their heads of school or from parents when they are doing a bad job. Thus, teachers often face conflicting interests, and their relative advancement may be easier or harder in different institutional surroundings. If the performance of

students is observed, the achievement of higher student performance will have a higher pay-off for teachers than if it is not. Likewise, if teachers have a lot of leeway to decrease their work-load without facing negative consequences, this will have adverse effects on student performance relative to a situation where they have less leeway.

Parents are probably the actors with the clearest unidimensional interest in a high level of their children's educational performance. While the students themselves certainly have an interest in their own performance, they will weigh this objective against other objectives such as the amount of leisure time and the possibility of making and losing friends through studying less or more. In the same way as with teachers and students, the school management and the administration will face a trade-off between advancing the educational performance of students' and reducing their own work-load, while they also care for their own monetary pay-off and for their school's or district's reputation. Finally, in the public-choice view, the government's interest lies in its re-election, so that it will do whatever it has to do to increase the likelihood of being re-elected. This in turn will be influenced by the ability of the different interest groups to lobby for their objectives.

The advancement of their own interests by the different groups of agents may lead to two kinds of inefficiencies in the allocation and use of schooling resources. First, it may be in the interest of some agents to make inefficient use of given resources (although resources may be allocated efficiently across different inputs). E.g., a teacher may be inclined to use part of a lesson for more pleasant things than stressful teaching of mathematics, as long as this lack of mathematical tuition is not monitored. Second, the agents' interest may lead to a misallocation of resources across functional categories (causing inefficiency even if these resources were then used effectively). If it is in the interest of a group of agents with decision power over resource allocation to over-spend on one input relative to others, the marginal productivity of this input would be lower than that of the other inputs (given decreasing returns to each individual input), leading to a student performance level inferior to a situation of efficient spending. E.g., if teachers have a say in budgetary matters, they may want to increase spending on teachers at the expense of spending on instructional material, so that the marginal product of material inputs is higher than the marginal product of teacher inputs and schooling output could be higher at the given expenditure level.

Therefore, "there is an enormous gap between children sitting in a classroom and an increase in human capital" (Pritchett and Filmer 1999, p. 223). An increase in educational expenditure does not necessarily have to lead to increased student performance. Likewise, lower class sizes do not necessarily have to go hand in hand with better schooling quality. The classes may already be so small that the marginal productivity of a reduction in class size is negligible. Even more, the input "teacher per student" may not be used with the same effectiveness everywhere. If a more productive way of using resources in bigger classes outweighs any potential positive effect of smaller classes, class size could even be positively related to student performance.

3 A Basic Model of Educational Production in Schools

In the following, the arguments of the economics of institutions as applied to the schooling sector are crystallized into a model of the production of educational quality in the schooling system. This model is very parsimonious, stripped down to the bare necessities to be able to demonstrate the point of focus, namely the effects of institutions on actors' incentives and thus on the quality of educational production. It contains only one principal-agent relationship. The principal is represented by the government, which reflects the public interest and decides on the level of school spending. The only agent in the model is the student, whose effort is an input into the educational production process and who has interests which diverge from those of the public. The incentives faced by both the government and the students are influenced by the prevailing institutional structure of the schooling system. The choices of other actors in the schooling system - such as teachers, parents, heads of school, and the administration - are exogenous to the model. They come in as determinants of the effectiveness of resource use in the education production function and of the priority given to a high-quality education in the political process.

The basic idea of this economic model of the schooling sector is that rational actors maximize the difference between their individual benefits and their individual costs, i.e. their net benefits. Schooling quality is a function of educational spending and the effort of the student. The government chooses the level of educational spending which maximizes its net benefits given the level of student effort. The student acts to maximize his own net

benefits given the level of educational spending. All choices are made for given institutions of the schooling system, and they respond to changes in the institutional structure. In effect, rational choices of students and the government determine the level of schooling quality, and institutions influence these choices by altering the incentives for the actors.

3.1 The Education Production Function

For ease of presentation, the education production function which depicts what is happening in schools is taken to be of the Cobb-Douglas form. While this functional choice is more specific than would be necessary to reach the conclusions of the model, the main intuition and results of the model can readily be followed in this specific functional form.[2] Thus, schooling quality *Q*, as reflected in students' educational performance, is produced in the schooling system according to

$$Q = AE^{a}(IR)^{b}, \qquad a + b < 1 \quad . \tag{1}$$

Students are assumed to be perfectly homogenous, so that student subscripts are omitted in all equations. In effect, all student-related variables may be viewed as aggregations for a whole population of students. Three inputs go into the production process: learning ability *A*, student effort *E*, and effectively employed resources, combined into the term *IR*.

The student's learning ability *A* is exogenous to the model. It combines all effects which determine the readiness of students to learn when they are in school. This is not only the students' innate ability, but also his family background and prior learning experience. By contrast, student effort *E* is controlled by the student himself. It reflects the student's motivation, time, and engagement devoted to learning. Student effort is probably the most important input in the education process, given that with student-teacher ratios of, e.g., 20 to 1, students spend about 20 times as many hours learning as teachers spend teaching.

The term *IR* combines the amount of resources going into teaching (given by *R*) with the effectiveness with which these resources are used (given by *I*). The effectiveness *I* of

[2] The main necessary features of a more general model are that there is complementarity between student effort and resource input in educational production and that certain institutional features enhance the productivity of resource usage.

resource use in the education process is determined by the amount of information necessary for an efficient education which is available to those who make the educational decisions. *I* is the information on how to teach effectively at the local level. It reflects whether allocation choices, hiring decisions, teaching methods, and similar decisions are made in the most effective way to further the learning of the specific students in a given school at a given time. Hence it measures how knowledgeable the educational choices are, standing for the effectiveness with which educational spending is used to produce schooling quality. It combines the effectiveness of the allocation of resources across different functional categories of inputs and the effectiveness of the use of these resources. In effect, *I* is a school effectiveness index, exogenous to the model. It is given by the institutional decision-making structure of the schooling system which lays down who is allowed to decide on educational tasks. Hence it is a technical parameter imposed on teachers and schools, not something chosen by teachers or schools.

R is the amount of educational resources employed in teaching. This is not necessarily the same as the total amount of educational expenditure *X* spent in the schooling system, which is chosen by the government. *R* and *X* may differ from one another because part of the original government spending may be diverted to further objectives different from schooling quality *Q* before being used in the schooling process at all:

$$R = (1 - d)X \quad , \tag{2}$$

where d is the share of original spending diverted for other objectives, which is exogenous to the model. The government can directly control *X*. Thus, the total amount of expenditure spent on schooling in the model is based on governmental choices endogenous to the schooling process, as argued in Section 3.1.3. However, the government cannot directly determine *R*. Note that if $d = 1$ at the margin, any additional educational expenditure by the government will have no effect at all on students' educational performance.

The parameter d is a measure of how much the institutional setting of the schooling system allows self-interested producers of schooling to divert resources from teaching students. It thus reflects how much actors in the administration, in school management, and in the teaching force are allowed to or prevented from using administrative funds, school funds, and teacher time for objectives which do not increase schooling quality. In contrast

to the parameter *I*, the parameter *d* may be thought of as being influenced by the intentional behavior of local schools and teachers. In the model, the parameters *d* and *I* are thought of as being independent from each other.

The parameters a and b are the elasticities of schooling quality Q with respect to student effort E and effective spending IR, respectively. The Cobb-Douglas form of the education production function ensures that student effort and educational spending interact positively. An improvement in resource endowment enhances the effect of greater student effort, and vice versa. Furthermore, the function has decreasing returns to scale as $a + b < 1$.[3] A proportionate increase in both student effort and effective spending causes a less than proportionate increase in schooling quality, which should be a realistic feature because additions to students' educational achievement are increasingly hard to produce.

3.2 Student Maximization

As indicated before, the two actors in the model - the government and the student - have one choice variable each which they use to maximize their respective net benefits. The student *S* chooses his level of effort *E*, given the government's spending decision and given the exogenous institutional parameters. That is, he chooses how hard to study in order to maximize his expected benefits relative to his expected costs. The student's benefits B_S are given by

$$B_S = wQ = wAE^a (IR)^b \quad , \tag{3}$$

where *w* combines the extrinsic rewards for learning *l* and the intrinsic rewards *j*: $w = l + j$. The extrinsic rewards *l* reflect the impact of the absolute level of the student's educational performance *Q* on the present discounted value of lifetime earnings in the labor market, including any effects operating through admission to and completion of colleges and graduate programs. The intrinsic rewards *j* stand for the present discounted value of the non-pecuniary benefits of learning, including the joy of learning for its own

[3] Note that again, this is a sufficient assumption but not a necessary one because it is more specific than need be. Even in the given functional setting, the assumption that $a < (1-b)m$ would suffice to reach all the qualitative conclusions of the model.

sake and the honor and respect which parents, teachers, and others may give for educational performance.

The costs C_S of student's effort are given by

$$C_S = cE^m, \qquad m > 1 \quad , \tag{4}$$

where c is a constant. These costs combine the loss of control over one's in-class time, the additional time spent learning, the psychic energy of learning, and the money for tuition and books. In addition, the costs to the individual student may include the peer pressure against learning, e.g. of being called a "nerd" or "teacher's pet." Most of the costs will usually be the opportunity costs of the students' time, i.e. the cost of giving up other more pleasant activities. The elasticity m of cost with respect to effort is assumed to be greater than one because the marginal cost of effort rises as effort increases. Given that the total amount of time available per day is fixed, taking additional time of the day away from leisure activities to learning creates increasing costs.

The student chooses the effort level E which maximizes his net benefits, i.e. his benefits minus his costs:

$$S: \max_E \left(B_S - C_S \right) \tag{5}$$

$$\Rightarrow \frac{\partial \left(B_S - C_S \right)}{\partial E} = a w A E^{a-1} (IR)^b - mcE^{m-1} = 0 \quad .$$

This yields the optimal level of student effort E for any given level of spending X chosen by the government:

$$E = \left[\frac{a}{mc} wA \left(I(1-d)X \right)^b \right]^{\frac{1}{m-a}} \quad . \tag{6}$$

3.3 Government Maximization

To determine the government's choice of the level of spending X, we have to look at the benefits and costs of the government G. The government's benefits B_G are given by

$$B_G = PwQ = PwAE^a (IR)^b \quad . \tag{7}$$

Assuming for simplicity that there are no external benefits of education, the rewards for learning *w*, again including both extrinsic and intrinsic rewards, are equivalent for the individual student and for the general public. In addition to the benefits *wQ* which are thus equivalent to the student's benefits in equation (3), the benefits of the government are weighted by the parameter P which reflects the priority which the government gives to schooling quality. P characterizes the political power of supporters of high academic standards in the governance of schools, such as parents, relative to the political power of those whose objectives lie elsewhere. The latter may include voters whose main concern is keeping taxes down or teachers who place higher priority on decreasing their work-load by decreasing educational standards.

The cost C_G of school inputs to the government is equal to the government's overall educational expenditure:

(8) $$C_G = X \quad .$$

Note that total spending X - not effective resource use R - determines the government's cost.

Likewise, overall spending X - not R - is the choice variable under the control of the government. It chooses X in order to maximize its net benefits, given students' effort and the institutional setting:

(9) $$G\colon \max_X \left(B_G - C_G\right)$$

$$\Rightarrow \frac{\partial \left(B_G - C_G\right)}{\partial X} = bPwAE^a \left(I(1-d)\right)^b X^{b-1} - 1 = 0 \quad .$$

This determines the level of total educational spending X which is optimal to the government, given the level of effort E chosen by the students:

(10) $$X = \left[bPwAE^a \left(I(1-d)\right)^b\right]^{\frac{1}{1-b}} \quad .$$

3.4 Equilibrium

Equations (6) and (10), which determine the optimal levels of student effort E and government spending X, both contain the two endogenous variables E and X. This system

of equations can be solved to yield the levels of student effort *E*, government spending *X*, and schooling quality *Q* in equilibrium, where both the government's and the student's net benefits are maximized. Student effort *E* results as

$$E = \left[\left(\frac{a}{mc} \right)^{1-b} Aw\left(bPI(1-d) \right)^{b} \right]^{\frac{1}{\Delta}} \tag{11}$$

where

$$\begin{aligned} \Delta &\equiv m - bm - a \\ &= (1-b)m - a > am - a = a(m-1) > 0 \end{aligned} \tag{12}$$

.

Hence the student's effort is positively affected by his learning ability *A*, by the rewards *w* for learning, by the political priority *P* for high-quality schooling, and by school effectiveness *I*, while it is negatively affected by the cost factor *c* of effort to the student and by the share of diverted spending *d* in overall spending.

Overall educational spending *X* in equilibrium is given by

$$X = \left[\left(\frac{a}{mc} \right)^{a} (Aw)^{m} (bP)^{m-a} \left(I(1-d) \right)^{bm} \right]^{\frac{1}{\Delta}} . \tag{13}$$

Note that government spending *X* is determined by the same exogenous parameters as student effort *E*, and in the same directions, only with different elasticities. Combining equations (11) and (13) into the educational production function (1) yields the equilibrium level of schooling quality *Q*:

$$Q = \left[\left(\frac{a}{mc} \right)^{a} A^{m} w^{a+bm} \left(bPI(1-d) \right)^{bm} \right]^{\frac{1}{\Delta}} . \tag{14}$$

Again, ability *A*, rewards *w*, political priority *P*, and school effectiveness *I* yield positive effects on schooling quality *Q*, while cost of effort *c* and diverted spending *d* have negative impacts.

The elasticities of the response of student effort *E*, government spending *X*, and schooling quality *Q* with respect to each of the exogenous variables, derived from

equations (11) to (14), are summarized in Table 1. The elasticities of student effort E and of government spending X with respect to the different parameters combine through the education production function to yield the elasticities of schooling quality Q, which is the ultimate focus in this study. All the elasticities depend solely on the parameters a, b, and m. The elasticity of schooling quality Q with respect to ability A is relatively large given that $m > 1$, whereas the elasticity of Q with respect to cost of effort c is relatively small since $a < 1 - b$. The elasticity of Q with respect to rewards w is larger than that with respect to political priority P, school effectiveness I, and share of non-diverted spending $(1-d)$.

4 Institutions, Incentives, and Schooling Quality

The parameters which influence the level of schooling quality achieved in the model of educational production are mainly driven by the institutional setting in the schooling system. The institutional setting determines the school effectiveness I, the scope for spending diversion d, the size of the rewards for learning w, the cost of effort c, and the political priority for high-quality schooling P. These shape the incentive structure with which the actors in the schooling process are faced. They thus influence the behavior of the actors, i.e. student effort and government spending in the model. And these actions in turn determine the quality of schooling produced in the system. In short, institutions influence the educational performance of the students.

Hence the model of educational production allows us to analyze the impact of educational institutions on schooling quality. We investigate the incentives created by different educational institutions and their probable consequences for the quality of schooling. We consider six main institutional features of the schooling system: centralized examinations; the distribution of decision-making power between schools and administration; the distribution of decision-making power between different levels of administration; teachers' influence in the schooling system; parents' influence; and the extent of competition from private educational institutions in the system.

4.1 Central Examinations

The institution of centrally and thus externally set examinations profoundly alters the incentive structure within the schooling system compared to school-based or teacher-based examinations. Central exams signal the achievement of a student relative to an external standard, thereby making students' performance comparable to the performance of students in other classes and schools.[4] As students get marks relative to the country mean, their level of educational quality is made observable and transparent, which simplifies the monitoring of the performance of students, teachers, and schools. Thereby, the incentives of all educational actors to further schooling quality differ between schooling systems which have central examinations and systems which do not have them. The influence of central examinations on the quality of schooling may run through three basic channels: increased external rewards for learning, decreased peer pressure against learning, and increased monitoring of teachers and schools.

First of all, central examinations change the students' incentive structure relative to autonomous local examinations. By creating comparability to an external standard, central examinations improve the signaling of academic performance to advanced educational institutions and to potential employers. These institutions will thus give greater weight to schooling quality when they make admissions and hiring decisions. In consequence, their decisions become less sensitive to other factors such as family connections, racial and religious stereotypes, the chemistry of a twenty-minute job interview, performance relative to the class mean, or aptitude tests which lean more to measuring innate ability than to measuring overall educational performance.

Hence, transition to the institution of central examinations *CenExa* should have a positive effect on the rewards for learning *w*, especially on the extrinsic part:

$$\frac{\partial w}{\partial CenExa} > 0 \quad . \tag{15}$$

As students' rewards for learning grow, anything which increases the quality of schooling becomes more worthwhile. Students respond to an increase in rewards *w* by increasing

[4] For a more detailed description of the characteristics of "curriculum-based external exit examination systems" see Bishop (1997, 1999).

their learning effort E, and governments respond by increasing educational spending X (cf. Table 1). The result is an increase in schooling quality Q. The elasticities in Table 1 show that the effect of an increase in w on schooling quality Q is relatively large compared to the effects of other institutional parameters.

The impact of rising rewards for learning w on schooling quality Q is largest when the elasticities of schooling quality with respect to student effort (a) and government spending (b) are substantial and when the marginal cost curve for student effort is flat (m close to 1):

$$(16) \qquad \frac{\partial h_{Qw}}{\partial a} = \frac{m}{\Delta^2} > 0, \quad \frac{\partial h_{Qw}}{\partial b} = \frac{m^2}{\Delta^2} > 0, \quad \frac{\partial h_{Qw}}{\partial m} = -\frac{a}{\Delta^2} < 0 \quad .$$

That is, central examinations should have the strongest impact on schooling quality when student effort and government spending have a strong impact on schooling quality and when the marginal cost of effort to the student is small.

A second channel through which central examinations may impact on educational production is through their impact on peer behavior. Grading relative to class performance gives students an incentive to lower average class performance because this allows the students to receive the same grades at less effort. The cooperative solution of students to maximize their joint welfare is for everybody not to study very hard. Thus, with grades relative to the class level, students have an incentive to apply peer pressure on other students in the class not to be too studious and to distract teachers from teaching a high standard (Bishop 1999). With centralized external examinations, in contrast, these incentives are no longer given because inferior class work will only harm the students.

The peer denigration of studiousness is reflected in the cost of student effort c. By making the negative impact of a student's effort on his classmates' grades vanish, central examinations should lower peer pressure against learning and thus have a negative impact on c:

$$(17) \qquad \frac{\partial c}{\partial CenExa} < 0 \quad .$$

A smaller cost of effort c increases student effort E, government spending X, and schooling quality Q (cf. Table 1). The impact of central examinations on schooling quality

Q through reducing students' cost of effort will again be higher the higher the elasticities of production a and b and the smaller the elasticity m of students cost with respect to effort, since

$$(18) \quad \frac{\partial h_{Qc}}{\partial a} = \frac{(b-1)m}{\Delta^2} < 0, \quad \frac{\partial h_{Qc}}{\partial b} = -\frac{am}{\Delta^2} < 0, \quad \frac{\partial h_{Qc}}{\partial m} = \frac{a(1-b)}{\Delta^2} > 0$$

- the negative effect of c on Q is more negative, i.e. larger in absolute terms, the larger a, etc.

The distraction of teachers from teaching a high standard is reflected in the teaching effectiveness index *I*. By lowering the peer incentive to distract teachers relative to decentralized examinations, central examinations should increase *I*:

$$(19) \quad \frac{\partial I}{\partial CenExa} > 0 \quad .$$

As shown by the elasticities depicted in Table 1, an increase in teaching effectiveness *I* has a positive effect on student effort E, government spending *X*, and schooling quality *Q*. Thus, increased teaching effectiveness *I* is a further channel through which central examinations positively impact on the quality of schooling. Again, this effect will be the stronger the larger are the elasticities of schooling quality with respect to student effort and government spending and the smaller is the elasticity of the cost of learning with respect to student effort:

$$(20) \quad \frac{\partial h_{QI}}{\partial a} = \frac{bm}{\Delta^2} > 0, \quad \frac{\partial h_{QI}}{\partial b} = \frac{m(m-a)}{\Delta^2} > 0, \quad \frac{\partial h_{QI}}{\partial m} = -\frac{ab}{\Delta^2} < 0 \quad .$$

A third channel of positive impact of central examinations on schooling quality runs through the monitoring of teachers and schools. Given central examinations, it becomes evident whether the bad performance of an individual student in a subject is an exception within a class or whether the whole class taught by a teacher is doing badly relative to the country mean. Therefore, parents (and students) have the information they need to initiate action because they can observe whether the teacher (and/or the student) is accountable for the bad performance. If, by contrast, students get marks relative to the class mean only, the performance of the class relative to the country mean will be unobservable and

parents will have no information to intervene. As a consequence of the institutional setting, the agents' incentives are fundamentally altered. Given central examinations, the leeway of the teachers to act opportunistically is reduced and the incentives to use resources more effectively are increased. That is, the share d of total resources which teachers can divert from effective teaching is reduced. The same argument can be made for the monitoring of schools as a whole. Through central examinations, agents are made accountable to their principals: parents can assess the performance of their children, of the teachers, and of the schools; the head of a school can assess the performance of her teachers; and the government and administration can assess the performance of different schools.

In the model, the increase in the share $(1-d)$ of resources which are not diverted from teaching caused by a centralization of examinations -

$$\frac{\partial(1-d)}{\partial CenExa} > 0 \tag{21}$$

- is shown to positively impact on student effort E, government spending X, and schooling quality Q (cf. Table 1). Since the elasticities of the endogenous variables with respect to $(1-d)$ are the same as those with respect to I, the effect of the three parameters a, b, and m on these elasticities can again be derived from equation (20).

4.2 Distribution of Responsibilities between Schools and Administration

A second institutional feature of the schooling system is the division of decision-making authority between administration and schools. The structure of the institutional system of schooling determines who has the power to decide on which task, which should impact on the effectiveness of resource use in schools. There are two conflicting potential effects of increased decision-making power at the school level. On the one hand, school autonomy establishes freedom to decide within schools, which is a pre-requisite for competition and for the possibility to respond to demands from parents. The actors within the schools should have the decentralized knowledge to choose the best way of teaching for their students (if they have incentives to do so), a kind of knowledge probably not given at the administrative level. Thus, schools autonomy *Aut* should increase the informational

content of the decisions and thus school effectiveness I relative to external decision-making by the administration:

$$\frac{\partial I}{\partial Aut} > 0 \quad , \tag{22}$$

with the ensuing improvements in teaching effectiveness due to the use of local knowledge. As shown by the model of educational production, this is conducive to the levels of student effort E, government spending X, and schooling quality Q (cf. Table 1).

On the other hand, increased school autonomy increases the schools' leeway to act opportunistically, unless decisions can be fully monitored and the extent to which educational objectives are met can be fully evaluated, and unless there is a credible threat of penalties for opportunistic behavior. In addition to leading to more effective teaching, decentralized decision-making might thus also lead to a diversion of schooling resources from teaching students to other objectives of the self-interested producers of education. Hence schools autonomy may also increase the share of original educational spending which is diverted from teaching activities:

$$\frac{\partial d}{\partial Aut} > 0 \qquad \text{, i.e.} \qquad \frac{\partial (1-d)}{\partial Aut} < 0 \quad . \tag{23}$$

This has detrimental consequences for student effort E, government spending X, and schooling quality Q (cf. Table 1).

To assess the combined effect of decision-making autonomy of schools on schooling quality, the two tendencies invoked by increased school autonomy - better use of decentralized knowledge and increased scope for resource diversion - have to be compared. Since the elasticity h_{QI} of schooling quality Q with respect to school effectiveness I and the elasticity $h_{Q(1-d)}$ of schooling quality Q with respect to the share of non-diverted spending $(1-d)$ are equal (Table 1), the net effect of school autonomy on the quality of schooling depends on the relative size of the effects on school effectiveness and on resource diversion in equations (22) and (23). Which direction of impact is the superior one should depend on the area of decision-making. There are decisions where centralization (decreased school autonomy) may plausibly have positive net effects on

student performance, and there are decisions where it is likely to have negative net effects.

If decisions on standard setting and performance control are centralized, a lowering in a school's tuition standards will become easily transparent to parents and administration. This helps in the monitoring of schools' actions, thereby changing the schools' incentives against a misuse of resources. Through a centralized basic curriculum, the amount of what schools should teach is fixed and cannot easily be watered down by the interests of the agents at the school level as long as an external performance control is in place. Thus, the increase in resource diversion *d* caused by school autonomy can be thought to be substantial in these areas of decision-making. Furthermore, the informational advantage, reflected in the teaching effectiveness index *I*, of local school personnel on the best curriculum and on the best way to measure performance may be limited. Therefore, the detrimental effect of school autonomy *Aut* of diverted resources should be larger in percentage terms than the conducive effect of local knowledge in the decision-making areas of standard setting and performance control *Sta*:

$$\left|\frac{\partial \ln I}{\partial Aut\,Sta}\right| < \left|\frac{\partial \ln(1-d)}{\partial Aut\,Sta}\right| \quad . \tag{24}$$

The net effect on schooling quality of school autonomy in standard and control decisions should thus be negative.[5] It may even be argued that knowledge on what students should be taught and on how their achievement should be measured may be equivalent or even superior at the central level relative to the school level. In this setting, $\partial \ln I / \partial Aut\,Sta \leq 0$, and the detrimental effect on schooling quality is even larger. Likewise, centralized decisions on the size of the school budget should benefit the overall effectiveness of resource use and thus schooling quality, since actors at the school level have large adverse incentives when it comes to the amount of resources available. It is clearly in the self-interest of decision-makers at the school level to collect additional funds for themselves or for resources which lighten their work-load.

[5] Additionally, as shown by Costrell (1994), a centralized system of standard-setting will result in higher educational standards than a decentralized system because decentralization reduces a district's marginal benefit of a higher standard and raises its marginal cost.

In contrast, knowledge on which process and personnel-management decisions are favorable to students' learning should be superior at the school level. Heads of school will have better knowledge than the administration on which tuition structures are best for their schools, which teacher deserves a pay rise or a promotion, and which teacher is the right one to hire for the school. Likewise, individual teachers should be best in choosing the right textbooks and other supplies and in organizing instruction. School autonomy should increase the effectiveness I of teaching in these decision areas. Furthermore, school autonomy in process and personnel decisions does not generate much leeway to act opportunistically because hiring bad teachers or choosing bad textbooks is not in the interest of school personnel. That is, there is not much room or incentive for local decision-makers to divert resources d in these decisions. Since the local advantage of information and thus effectiveness I is large and the scope for resource diversion d is small, school autonomy in process and personnel decisions *AutPro* should plausibly have a positive net effect on schooling quality:

$$\left|\frac{\partial \ln I}{\partial AutPro}\right| > \left|\frac{\partial \ln(1-d)}{\partial AutPro}\right| \quad . \tag{25}$$

In the case of process and personnel decisions, one might even think of situations where resource diversion does not occur at all, i.e. $\partial \ln d / \partial AutPro = 0$.

4.3 Distribution of Responsibilities between Administrative Levels

The argumentation so far considers "the administration" as one single body. In reality, there are different administrative authorities at the local, regional, state, and national levels in many countries. The division of responsibilities for educational decision-making and for fund allocation between local, intermediate, and central authorities establishes another feature of the institutional system of schooling which may influence the educational outcome. Once responsibility lies with the administration, the question is which level should take over the tasks to ensure the best possible outcome. Again, different effects should run counter to one another.

The lower the level of administrative decision-making, the smaller should be the loss of school effectiveness I relative to school autonomy as depicted in equation (22). At the

local level, more decentralized knowledge is available and the administration is more directly accountable to parents, which might lead to more informed choices (higher I) than central authorities can make. However, the local administration will also have much closer ties with the school personnel, increasing the possibilities for successful lobbying of school-based interest groups and for collusion. Local administrators and school personnel might collude on the determination of the level and use of funds, so that an opportunistic resource allocation and a larger share of diverted spending d ensues, just like in the case of school autonomy in equation (23).

The central administrative level is more remote from the actors within the school. On the one hand, this should make collusion and thus local resource diversion d harder to achieve. On the other hand, monitoring of actions and resource use from the central level is elusive because of information problems (cf. Hoxby 1999).[6] The higher is the level of administrative decision-making, the larger may be the loss of informed teaching I. Additionally, a self-interested central administration will find it easier to develop an excessive bureaucracy, leading to resource diversion d at the central level. Thus, the impact of an allocation of decision-making power to the central administrative level should decrease I, while the effect on d is ambiguous.

Since both the local and the central level of administrative decision-making face serious deficiencies, an intermediate level might be better positioned to run the administration of schools. An intermediate level of administration is too far away from schools for serious local lobbying and collusion (local diversion), but it is possibly superior to the central level in terms of accountability (central diversion) and in monitoring schools. Ultimately, it is an empirical question whether there are differences in the quality of schooling produced under different administrative set-ups and which administrative level performs best.

4.4 Teachers' Influence

Teachers are probably the most important external determinants of students' learning. Therefore, an important institutional feature of the schooling system are the incentives

[6] Hoxby (1999) emphasizes the benefits of decentralized Tiebout residential choices as a solution to the information problem. However, her model does not consider political-economy effects of lobbyism and collusion, and she concedes that there may be serious flaws in the Tiebout process.

which teachers face within schools and their ability to influence the education process. Teachers have a lot of leeway in how to pursue their teaching, since neither their actions in the classroom nor their effort in evaluating student performance and preparation of tuition after class can be easily monitored. Pritchett and Filmer (1999) have shown that if teachers have large influence on expenditure allocation in the schooling sector, they will use it to promote their own interests. The interests which teachers face will often be conflicting. While they will usually derive satisfaction from seeing their students progressing, they also have a genuine interest in increasing their income or decreasing their work-load. Furthermore, given their numbers and their ensuing ability to influence the electoral process when acting collectively, they are a powerful political interest group.[7] The institutional setting will determine the incentives which teachers face with respect to actions which are conducive or detrimental to student performance and tip them to behave either in one way or the other.

The general effect of an increase in the decision-making power of teachers should be equivalent to the effect of school autonomy depicted in equations (22) and (23): The informational content and thus the effectiveness of teaching decisions I should rise, but the potential for diversion d of resources from teaching to the furthering of other interests should also rise. Thus, the benefits of an increased use of teachers' decentralized knowledge at the classroom level stand against their interest to increase their own financial well-being and to decrease their work-load. The relative size of the two effects and hence the net effect of teachers' influence should again depend on the specific area of decision-making at hand.

Similar to the argumentation for the distribution of responsibility between schools and administration, a high degree of teacher influence on process decisions, such as what supplies to be bought or which textbooks to be used, should be conducive to student performance, because teachers are the actors who know best how to teach their students (large advantage in I) and because there is not much leeway to exploit this kind of decision-making power opportunistically (small disadvantage in d). Therefore, an

[7] Given that there is a large number of teachers in many parliaments in the world, the potential of teachers to lobby for their objectives might be substantial.

increased influence of teachers on teaching methods *TeaMet* should plausibly have a positive net effect:

$$\left|\frac{\partial \ln I}{\partial TeaMet}\right| > \left|\frac{\partial \ln(1-d)}{\partial TeaMet}\right| \quad , \tag{26}$$

just like school autonomy on process decisions in equation (25).

An additional beneficial effect may spring from the scrutiny with which teachers observe and mark their students' achievement and their monitoring of assigned homework. This scrutiny determines the extent to which studying is rewarded and laziness penalized. That is, teachers' scrutiny of performance examination *TeaScr* should have a positive effect on students' rewards for learning *w*:

$$\frac{\partial w}{\partial TeaScr} > 0 \quad , \tag{27}$$

with the ensuing positive impact on schooling quality *Q* (cf. Table 1). Equation (16) depicts the impact of the parameters a, b, and m on the size of this effect.

In contrast to the decision-making areas relating to teaching methods, the net effect of a high degree of teacher influence should be different in the decision-making areas relating to teachers' salaries and work-loads. Teacher influence in determining teacher salary levels or work-load will be detrimental to the quality of schooling, because this creates large incentives for teachers to behave selfishly (large *d*). Thus, as in equation (24) for school autonomy on standards, teacher influence on the size of their work-load and the size of the rewards for it, *TeaWor*, should have a negative net effect on schooling quality:

$$\left|\frac{\partial \ln I}{\partial TeaWor}\right| < \left|\frac{\partial \ln(1-d)}{\partial TeaWor}\right| \quad . \tag{28}$$

Such decision-making areas which enable teachers to increase their salary levels or to decrease their work-load may include decisions on budgets and on the amount of subject matters to be covered.

An additional effect of teachers' influence comes into play when teachers act collectively through teacher unions. Teacher unions impact the process of political decision-making both through the voting power of the large number of teachers and

through their high degree of ability to organize themselves as an interest group. The very aim of teacher unions is to promote the interests of teachers, and to defend them against the interests of other interest groups.[8] Therefore, they will tend to focus on the interests which are not advanced by the other interest groups. The main interests of teachers which are not advanced by others are to increase their pay and to decrease their work-load. Furthermore, teacher unions can exert collective bargaining power - as opposed to individual teachers and to other groups of agents which can less easily be organized -, and they will advance the interest of the median teacher, which favors a leveling out of salary scales instead of merit differentiation. Thus, a large influence of teacher unions *TeaUni* should not only increase the scope to divert resources *d* (as in equation (28)), but it should also alter the political priorities *P* in the society. A high degree of decision-making power of teacher unions will presumably decrease the political priority *P* which the government gives to schooling quality:

$$\frac{\partial P}{\partial TeaUni} < 0 \quad . \tag{29}$$

A decrease in *P* has a negative impact on the equilibrium levels of student effort *E*, government spending *X*, and schooling quality *Q* (Table 1). Hence by decreasing political priority *P* for schooling quality, a large influence of teacher unions tends to lower the educational performance of students. Since the elasticity of the quality of schooling with respect to political priority, h_{QP}, is the same as the one with respect to the school effectiveness index, h_{QI}, the impact of the size of a, b, and m on the size of this elasticity can be derived from equation (20).

4.5 Parents' Influence

Just the opposite effect should ensue if parents have a large say in schooling policy. Parents are the only actors within schooling who have a relatively undisturbed interest in the educational performance of their children. They have a clear interest in the schooling system functioning efficiently. Therefore, increased parental influence *ParInf* in the political process should increase the political priority *P* given to the quality of schooling.

[8] Hoxby (1996) stresses that teacher unions have both the interest to obtain more generous inputs and the potential to lower the effectiveness of input use.

A large political power of parents will increase the government's incentives to focus on schooling quality Q and make it more worthwhile to increase educational spending. Furthermore, increased parental influence at the classroom level should be beneficial to the informational content of teaching and should thus increase the effectiveness of schooling I:

$$(30) \qquad \frac{\partial P}{\partial ParInf} > 0 \quad \text{, and} \quad \frac{\partial I}{\partial ParInf} > 0 \ .$$

Both effects are conducive to the quality Q of the education produced in the schooling system.

Parents' participation in the educational process is limited by the opportunity cost of their time. Institutions which give parents a greater say both in the political process and in teaching enhance the benefits of participation and make parental involvement more likely. As a result, an institutional setting which ensures increased participation of parents in the political and educational process and gives parents greater influence on decisions on teaching contents and greater monitoring powers should tilt the prevailing incentives in favor of an increased quality of schooling.

It should be noted that this simple depiction of the potential effects of parents' influence rests on the rather strong assumptions that there are no differences between the parents' benefit function and the children's benefit function and that parents do not face costs of tuition. The former assumption is in effect the dynasty assumption that parents care for their children's well-being as much as they care for their own well-being. Considering parents' tuition costs should have an effect on educational production once it is acknowledged that like the other agents, parents are also self-interested. Given parental tuition costs, a greater influence of parents in the schooling system would make them try to shift some of their own costs into the schools, with their decreased own effort impacting negatively on overall schooling quality.

4.6 Private Schools

In general, production of basic education is run publicly all over the world. However, in most countries there is also some degree of private provision of schooling. When private schools are available, parents with the aim of increasing their children's educational

performance can choose whether to send them to a particular private school. The increased parental choice introduced through the competition of privately managed schools means an increase in the influence of parents in the schooling system. As depicted in equation (30), it seems plausible that greater parental influence tilts both the political priority *P* and the informational content and thus effectiveness of schooling decisions *I* in favor of increased schooling quality.

Through the institution of private ownership, the head of a private school also has a clear monetary incentive to make an efficient use of resources so as to maximize the quality of schooling, because this would make parents choose her school. Therefore, she will try to improve the monitoring of her teachers, which should help in reducing resource diversion *d*. Furthermore, private provision circumvents many monitoring problems within governmental and administrative entities. While private as opposed to public provision of schooling cannot eliminate all the monitoring problems inherent in the education process, private schools may thus nevertheless decrease the number of difficult-to-monitor principal-agent relationships and face greater incentives to tackle the remaining ones. In effect, private school management *PrivSc* should reduce the share of educational spending which is diverted from teaching:

$$\frac{\partial d}{\partial PrivSc} < 0 \quad . \tag{31}$$

This means that more spending should be available for teaching, and the quality of schooling *Q* should rise (Table 1).[9]

By giving parents additional choice, private educational institutions introduce competition into the public schooling system. Because the loss of students to private institutions may have adverse consequences for the heads of public schools which are located close to private schools, increased competition from private schools should also have a positive effect on quality of schooling in nearby public schools. Thus, private

[9] In a similar way, Shleifer (1998) shows that from a contracting perspective, private ownership of schools, combined with choice and competition, establishes strong incentives for cost reduction and qualitative innovation which are missing in publicly run schools. Chubb and Moe (1990) argue that public schools tend to be overbureaucratized and ineffective because they are governed by institutions of democratic control, while private schools tend to possess autonomy and the characteristics of an effective organization because they are governed by markets.

ownership of property rights and competition should generally establish incentives in the schooling system which work in the direction of superior outcomes.

5 Towards an Encompassing Model of the Schooling System

The impact of the different institutional features of the schooling system on the quality of schooling which is produced in the system as depicted in the schooling model are summarized in Table 2. In general, positive effects should be expected from central examinations, centralization of (as opposed to school autonomy in) standard setting and performance control, school autonomy in process decisions and in personnel management, administrative decision-making at an intermediate (as opposed to local or central) level of administration, influence of teachers on the methods of teaching, regular scrutiny of the performance level achieved by the students, parental influence in the classroom and in the political process, and competition from privately managed schools. In contrast, school autonomy in budgetary matters, teachers' influence on decisions which determine their salaries and work-load, and large decision-making powers of teacher unions on the size of teachers' work-load and in the political process in general may be expected to influence schooling quality negatively. As such, these features of the model are very much in line with the empirical evidence which motivated this paper (see Section 1).

The model developed in this paper is very parsimonious. A more thorough modeling of the process of educational production which goes beyond the restriction on the government and students as the two sole actors seems a promising direction for future research. E.g., teachers might be introduced as independent actors, who are agents to the government in a contract to teach the students. As rational actors, teachers might choose their level of teaching effort, as well as their level of effort in trying to divert resources from teaching. They would choose these variables in order to maximize their own net benefits. In such a model, the government might not only choose educational spending, but also how much to monitor the behavior of teachers. The chosen level of monitoring would affect teachers' cost of resource diversion. Likewise, parents, the administration, or heads of school might be introduced as further agents who maximize their own respective net benefits. An even further step might be to endogenize the choice of the institutions which

prevail in the schooling system. While these institutions are exogenous to the present model, in reality they should develop through the political process.

While abstracting from these issues, the model presented in this paper is still capable of depicting the main effects of several institutional features on educational production. Furthermore, it throws some light on the empirical literature of resource effects in schooling. The choice of spending levels is endogenous in the model. In a schooling system where institutions are not such that spending would bring much pay-off for the quality of schooling, the optimal resource policy would be not to increase the level of spending (cf. Table 1). Furthermore, as long as differences in the institutionally driven parameters are not perfectly controlled for, empirically estimated resource effects may be biased. Since an optimizing government would increase resources if institutions are conducive to student performance, beneficial institutions would go hand in hand with higher resources in an optimizing world and the bias would be upwards. However, this need not be the case in reality since actual decision-making of governments may not necessarily be optimal.

Finally, several features depicted in the model can prevent an increase in educational spending X from increasing student performance Q. First, the impact of increased spending on the educational performance of students depends on the institutions prevailing in the schooling system. If X is increased in a way which is easily diverted from being used for teaching, the share of diverted resources d may be 100 percent for these additional resources and the marginal effects of increasing X would be 0. Second, increases in X may not lead to large results if students do not face incentives to learn, because student effort E would be low in such a setting and the effect of X on Q would thus be small. Third, the expenditure level X reached in a schooling system may already be so large that increases in X do not cause a significant increase in schooling quality Q, given the decreasing returns to educational spending in the education production function. More generally, a central implication of this paper is that institutional policies may be much more promising to increase the quality of schooling than resource policies.

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Table 1: Elasticities of Endogenous Variables with Respect to Exogenous Variables

	Student Effort E	Government Spending X	Educational Quality Q
Ability A	$h_{EA} = \frac{1}{\Delta}$	$h_{XA} = \frac{m}{\Delta}$	$h_{QA} = \frac{m}{\Delta}$
Cost of Effort c	$h_{Ec} = -\frac{1-b}{\Delta}$	$h_{Xc} = -\frac{a}{\Delta}$	$h_{Qc} = -\frac{a}{\Delta}$
Rewards w	$h_{Ew} = \frac{1}{\Delta}$	$h_{Xw} = \frac{m}{\Delta}$	$h_{Qw} = \frac{a+bm}{\Delta}$
Priority P	$h_{EP} = \frac{b}{\Delta}$	$h_{XP} = \frac{m-a}{\Delta}$	$h_{QP} = \frac{bm}{\Delta}$
Effectiveness I	$h_{EI} = \frac{b}{\Delta}$	$h_{XI} = \frac{bm}{\Delta}$	$h_{QI} = \frac{bm}{\Delta}$
Limit to Diversion $(1-d)$	$h_{E(1-d)} = \frac{b}{\Delta}$	$h_{X(1-d)} = \frac{bm}{\Delta}$	$h_{Q(1-d)} = \frac{bm}{\Delta}$

Source: Equations (11) to (14).

Table 2: Institutional Effects on Schooling Quality

	Schooling Quality	**Through:**				
		Cost of Effort	Rewards	Priority	Effective-ness	Limit to Diversion
	Q	*c*	*w*	*P*	*I*	(1–*d*)
Central examinations	+	–	+		+	+
Centralization of standard and control decisions	+				(–)	+
School autonomy on budget	–				(+)	–
School autonomy in process and personnel decisions	+				+	(–)
Intermediate administration (relative to local/central)	(+)				(–/+)	(+)
Teachers' influence on teaching methods	+				+	(–)
Teachers' scrutiny of student assessment	+		+			
Teachers' influence on work-load	–				(+)	–
Teacher unions' influence	–			–		–
Parents' influence	+			+	+	
Private schools	+			+	+	+

+ = positive impact. – = negative impact. ( ) = small effect.

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468	J. Wagner	The Impact of Risk Aversion, Role Models, and the Regional Milieu on the Transition from Unemployment to Self-Employment: Empirical Evidence for Germany	1	04/02
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472	R. Foellmi J. Zweimüller	Structural Change and the Kaldor Facts of Economic Growth	3	04/02
473	J. C. van Ours	A pint a day raises a man's pay, but smoking blows that gain away	5	04/02
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475	Z. Hercowitz E. Yashiv	A Macroeconomic Experiment in Mass Immigration	1	04/02
476	W. A. Cornelius T. Tsuda	Labor Market Incorporation of Immigrants in Japan and the United States: A Comparative Analysis	1	04/02
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479	J. T. Addison C. R. Belfield	Unions and Employment Growth: The One Constant?	1	04/02
480	G. Saint-Paul	The Complexity of Economic Policy: I. Restricted Local Optima in Tax Policy Design	6	04/02
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483	H. Rapoport A. Weiss	In-Group Cooperation in a Hostile Environment: An Economic Perspective on Some Aspects of Jewish Life in (Pre-Modern) Diaspora	1	04/02
484	J. H. Bishop L. Woessmann	Institutional Effects in a Simple Model of Educational Production	5	04/02