AN ECONOMISTS' VIEW OF SCHOOLING SYSTEMS

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Summary

This paper presents a simple theory of schooling systems based on the assumption that schooling systems produce two kinds of human capital: a general ability-enhancing knowledge referred to as "education", and many types of skill-specific knowledge referred to as vocational "training". The theory predicts that the differentiation of supply of training leads to the expansion of general education as well as training. If skill-specific talents can be detected later than the general ability, early sorting of pupils by ability will not be efficient. The duality and efficiency of school production is illustrated by a sample of 16 schooling systems of industrialised countries.

Keywords: schooling systems, education and training, differentiation, sorting, efficiency.

1. Introduction

The aim of the present paper is to provide a simple theory and description of schooling systems from an economic perspective. The theory distinguishes between education and training, which may be combined in various proportions by schooling systems for the production of differentiated skills. The description is based on a core-sample of sixteen industrialised countries which was determined by the availability of comparable data from various sources and the answers given by education experts to a questionnaire tailored to our needs[1]. The sixteen countries forming our sample are Austria, Canada, France, Germany, Greece, Hungary, Italy, Japan, Netherlands, Norway, Portugal, the Russian Federation, Spain, Sweden, UK, USA.

The considerable differentiation typically observed in schooling systems is inconsistent with the assumption of homogeneous human capital made in much of economic literature. Thus section 2 presents a simple economic theory of schooling systems relaxing this assumption and making an important distinction between the provision of general education and vocational training. In section 3, we show a variety of indexes of average education, skill (human capital at market value), and types of differentiation and screening for our main sample of sixteen countries. Then section 4 relates productive efficiency at country level with the differentiation of schooling systems. Our main conclusions are summarised in section 5.

2. A simple theory of schooling systems

A schooling system is the institution which allocates social knowledge primarily to young individuals. Drawing on Becker's (1964) seminal distinction between general and specific human capital, we may say that schooling provides both general knowledge and occupation-specific knowledge. General knowledge can be used in all firms and all occupations, while occupation-specific knowledge can be used in all firms but only in specific occupations (note that firm-specific knowledge cannot be provided by the schooling system). We focus our attention here on the dual provision of general and occupation-specific, i.e. vocational, knowledge by schooling systems above the common-core syllabus.

The standard assumption of homogeneous human capital and capacities tends to understate the extent of optimal differentiation of schooling systems[2]. Under this standard assumption, a differentiated schooling system would be described as a common-core syllabus followed by a variety of vocational curricula of optional length. But this is not a good description of what schooling systems actually offer. What is being observed is that students may decide to receive further general education before they engage in vocational training. Further education is seen as a general but optional prerequisite for enhancing the acquisition of skills by vocational training.

2.1 The basic model

It will be assumed that the schooling system provides, above the common-core education, both further general education E and a variety of skill-specific training $T_i, \quad i = (1,...,s)$ at unit price. Each pupil combines school inputs with his own capacities to embody one of the *s* differentiated skills S_i. We write the skill *i*'s individual production function as

$$S_i(E,T_i) = t_i A(E) T_i^{\beta} \ , \tag{1}$$

where t_i (>0) is a given *i*-specific capacity, called "talent", $A(E)$ designates the individual's general ability, and $0 < \beta < 1$. The crucial assumption we make is that the general ability is not entirely given by birth and cultural transmission, but also captures the learning skill acquired through "education"

$$A(E) \equiv S_0(E) \tag{2}$$

with $S'_0(E) \geq 0$, and $S_0(0) = 1$.

The general learning skill uniformly raises the marginal productivity of training in the acquisition of all non-learning skills. It is assumed to be a non-decreasing concave function of the amount of further education, for instance

$$S_0(E) = 1 + aE^{\alpha} \;, \qquad (3)$$

with $\qquad a > 0 \quad , \quad 0 \le \alpha < 1.$

The parameter a describes the student's cognitive ability by the end of the common-core education.

We shall further assume that there are a small number of paths leading to the production of any skill due to large set-up costs in the production of education. For instance, E might only take two values, 0 or 1, if students are given a choice among pure training and one period of general education followed by training. We do not make the same assumption for training because training is partly supplied by firms as a joint product of their activity. Thus, the amount of training is chosen optimally by each individual. Finally, we assume decreasing marginal returns on both education and training, and the Inada condition $S_i'(E,0) = +\infty$. The rational behaviour of a student is described by the choice of skill type i and school inputs E and T_i which maximise the net returns from his general education and vocational training on the discrete set of educational options $E = (0,1,...,n)$

$$\max_{i,E,T_i} \quad p_i S_i(E,T_i) - E - T_i \qquad (4)$$

subject to (1), (2), (3), and non-negativity constraints on the amount of training $T_i \ge 0$. The Inada condition ensures that some training will always be provided $T_i > 0$. It should be noted that the i-specific talent t_i and the price of skill (i.e. specific human capital) i, p_i, cannot be independently identified[3]. Henceforth, in the following paragraphs, we drop the latter variable and adopt a nominal definition of specific talents (i.e. $p_i t_i$). Thus a 1% increase of the rate of return to skill i results in an equal rise of i-specific talent for all students, and a 1% increase in the borrowing rate of a student, reflecting the latter's diminishing opportunities, entails a 1% decline of all his nominal talents. Although the present analysis emphasises variations of specific talents among students, we should not forget that variations of the rates of return on skills and of the average borrowing rate may also have large aggregate effects on the outputs of schooling systems in a cross-country comparison. The conclusions that would be drawn from the model by omitting price effects would only hold for countries of similar income level per capita insofar that the distribution of opportunities may then be assumed to vary little between these countries.

For space limitations, all proofs are omitted here but can be found in our working paper (Lévy-Garboua et alii 2002). The solution of program (4) has intuitive appeal. Students' rational behaviour may be described as if they first chose the specific occupation for which they have more (nominal) talent. Then, they choose the optimal mix of education and training conditional on this choice of occupation. The main proposition follows:

PROPOSITION 1

<u>If cognitive abilities and skill-specific talents differ among students but are perfectly known both by themselves and by schools, it is not optimal to sort students into the more general and the vocational path on the basis of their cognitive ability alone. The optimal sorting rule is described by the following condition, which combines information on cognitive ability and skill-specific talents:</u>

$$\left(\beta^{\frac{\beta}{1-\beta}} - \beta^{\frac{1}{1-\beta}}\right) t_i^{\frac{1}{1-\beta}} \left[(1+a)^{\frac{1}{1-\beta}} - 1\right] > 1 .$$

Moreover, students who prefer the education-cum-training path always engage in longer specific training and, *a fortiori*, in longer studies than those engaged in pure training. The latter prediction is in line with countless observations of complementarity between education and training. Besides, since the more talent a student has for a skill, the more he will be inclined to opt for education (proposition1), this has an important corollary:

COROLLARY

<u>The differentiation of vocational studies increases the demand for general education (and longer studies), for given distributions of cognitive abilities and skill-specific talents.</u>

We believe that this corollary provides a strong and, to some extent, new rationale for the vocationalisation and lengthening of studies, as well as the "massification" of further general education that took place in industrialised countries.

2.2 Screening

In actual practice, schools and universities screen students who are not perfectly aware of their cognitive ability and skill-specific talents. Because the general ability applies to a great many tasks, it will often be detected early in the course of common-core (i.e. primary and lower secondary) education. On the other hand, the assessment of an individual's return-maximising skill-specific talent must often await the later differentiation of curricula since each talent can only be detected on a single set of tasks. The present discussion is summarised by the following assumption:

ASSUMPTION

Students' return-maximising skill-specific talents cannot be detected as early as their cognitive ability.

The presence of a lag between the times when general ability and talents can be detected precisely generates a trade-off between the first-best choices of education and skill.

PROPOSITION 2

As far as *education* is concerned, early screening by general ability is optimal as soon as this can be detected. However, such early screening is inefficient as far as the production of *skills* is concerned, for which screening should occur later on.

The postponement of screening until the upper secondary level, where talents can be assessed with some precision, has often been advocated as a means of reducing inequality.

However it may also be justified for efficiency reasons if abilities and talents are not strongly correlated. Its adoption by market economies entails a vocationalisation of schools at the relative expense of general education. Thus our theory relates the potential "decline of educational standards" to the postponement of differentiation by ability until occupation-specific talents can be assessed.

3. An economic description of schooling systems

In order to show the relevance of our theoretical distinction between education and training for understanding the productive efficiency of schooling systems, we must measure these two outputs of schooling systems and how the latter differentiate in matching heterogeneous capacities and skills. The appropriate indicators have been derived from available statistics and the answers of selected education experts to a questionnaire. Twenty-three experts[4] from sixteen OECD countries filled this questionnaire in 1997. These sixteen countries form the main sample that will be used below for statistical analysis.

3.1 The production of education and skills

Average scores obtained in standardised tests are commonly taken to be good indicators of school performance, assuming that the distribution of abilities between pupils is the same in all countries. However, the theoretical discussion of section 2 makes it clear that they are not concerned with vocational training and essentially describe the average level of the general ability produced by general education. A better indicator of market skills, or total human capital per pupil, should reflect the market value of school outputs.

(Insert table 1 about here)

Various measures of the production and distribution of human capital (education-cum-training) and its education component appear in table 1 for our sample of sixteen industrialised countries. The most comprehensive index of total human capital per pupil at 1994 market value[5] (HTOT) is shown in column 1. It was derived from OECD's statistics (0ECD 1996:tables R11.1, R12.1) on the distribution of graduate output between four highest completed levels of education (lower secondary, upper secondary, non-university and university sector). Each level was imputed a market value index through the mean earnings of employed male graduates of 25 to 64 years of age at this level relative to the mean earnings at upper secondary level (OECD 1996 :table R22.1). A proxy for the same total human capital index "one generation back" (HTOT0) was obtained by weighting the same value indexes with the distribution of the population 25 to 64 years of age between the four levels of graduation (OECD :table C1.1). The derived estimate of the rate of human capital growth per pupil in a generation (i.e. IH= (HTOT-HTOT0)/HTOT0) is given in column 2. Inequality of the distribution of human capital is summarised in column 3 by the variance of the 1994 value indexes between the four levels of graduation (INEQ). The objective growth of human capital is paralleled in column 4 with an subjective indicator for the "decline of educational standards", derived from the informed opinion of the selected experts. While all of the sampled countries have undergone positive, and often substantial, growth in one generation, education experts frequently expressed the opinion that educational standards had declined. An interpretation of the latter's perception will be given in section 4. Finally, this description of the output of schooling systems is completed in column 5 by the scores obtained in standardised mathematics and science tests by pupils at grade seven (SCORE), who are theoretically thirteen years old. These results were gathered in 1994–95 for a sample of 24 countries by the International Association for the Evaluation of Educational Achievement in its third international study on mathematics and science. These countries include our own sample of 16 countries, with the exception of Italy. We consider this last variable to be a good aggregate index of the general ability produced by education.

(Insert figure 1 about here)

Clearly, HTOT and SCORE do not describe the same schooling output. The rank correlation (Spearman's rho) between these two variables is only 0.134 (n=14) and the assumption that they are stochastically independent cannot be rejected. By plotting these two variables along two axes, Figure 1 shows that a parabolic relation would fit the data better than a straight line[6]. Greece, Portugal, and Spain, which are the least developed countries of the sample, rank low along the two dimensions, Japan is clearly the highest performer in the production of education and Norway has the lead in the production of skills. If the three low-performers were left out of the diagram, the slope would even become slightly negative. Whereas differences in opportunities generate a positive correlation of education and skills, a negative correlation between education and skills emerges from distinctive patterns of differentiation across countries.

3.2 Differentiation and screening

If we use our theoretical distinction between one single general ability and many kinds of occupation-specific talents, we see that the sorting of students, whether it is by ability or by talent, must produce sharply different social outcomes. Since general ability as opposed to occupation-specific talents possessed by an individual determines the extent of his market opportunities, only the differentiation by ability unambiguously produces a ranking of students. We may speak of “vertical” differentiation on one hand and “horizontal” differentiation on the other hand. In our questionnaire, the amount of vertical differentiation is attested by the use of three potential means of sorting students by their general ability: a standardised test, grades and the reference of the school. The amount of horizontal differentiation can be traced by the use of two common means of assessing occupation-specific talents: preferences of the family or the student, and choice of optional courses. These five criteria of differentiation were listed separately by experts for lower secondary and upper secondary levels. This information is summarised below by table 2, which indicates the frequency of use of each of these means of differentiation in our sample of sixteen countries[7].

(Insert table 2 about here)

The first three columns indicate that the vertical differentiation of students is equally present in the lower and the upper levels of secondary schooling and the last two indicate that horizontal differentiation prevails at the upper level. This shows that education takes place at both levels and training eventually starts at the upper level. Moreover, the figures demonstrate that sorting by ability dominates sorting by talent in the lower level, while the reverse is true in the upper level. This is consistent with our assumption that the general ability can be detected rather early but the occupation-specific talents can hardly be known before the specific training has taken place.

Another proof of the last assertion can be found in the increased severity of screening between the lower and upper levels of secondary education. Screening scores have been derived from our survey among education experts by adding up three indicators of downstreaming, class repeating and drop-out[8], each measured on an ordinal 0-4 scale[9]. The resulting index measures the amount of screening taking place at each level of education on a 0-12 scale in a way which allows comparison between levels. Screening increases from a score of 3.2 in the lower level to 4.7 in the upper level of secondary education and this difference is significant at the 1% confidence level (t=2.82, df 28).

The addition of frequencies of use for all five means of differentiation yields country scores of total differentiation at the two levels of secondary education (DIFLOW, DIFUP). Total differentiation increases with level without exception. This picture is confirmed by a t-test of difference between the means of the lower and the upper levels. The mean scores of total differentiation are 1.2 for the lower level and 2.2 for the upper level, and they are unequal at the 5% confidence level (t = 2.168, d.f. 30)[10]. This result is consistent with the theoretical prediction that students should be sorted by a combination of ability and talents, which optimally requires postponement of differentiation until talents can be assessed with sufficient precision. Figure 2 plots the total differentiation scores at the two levels of secondary education. It separates two groups of countries without ambiguity. Canada, Greece, Italy, Japan, Norway, Portugal and Spain have no differentiation of any kind at the lower secondary level (DIFLOW=0). These countries have in common that all pupils must follow a common-core syllabus from the time of entry into primary education to the end of compulsory education (Lassibille, Navarro-Gomez 2000). At the other end of the spectrum, France, Germany, the Netherlands and the USA are strongly differentiated at both levels of secondary education. In between, lie countries which may be further classified in two groups by closer inspection. Hungary and Sweden offer no kind of horizontal differentiation. Austria, Russia and the UK form a residual group of average differentiation, whether we take the distribution of total differentiation between levels or between vertical and horizontal means.

(Insert figure 2 about here)

4. The productive efficiency of schooling systems

In this section we test two implications of our theory of schooling systems, namely proposition 2 and the corollary of proposition 1:

a) Since ability can be detected earlier than talents, it is not optimal to make an intensive use of differentiation too early, say at the lower secondary level, for producing skills. However, it will be optimal to do so for producing education;

b) Horizontal differentiation enhances the aggregate demand for general education and training.

4.1 A first set of results

Table 4 presents the results of regressions for the output measures that appeared in table 1. The explained variables are HTOT (col. 1), SCORE (col. 2), INEQ (col. 3) and DECLINE (cols.4-5). These are all explained essentially by two supply variables, the amount of differentiation at the lower secondary and upper secondary levels (DIFLOW, DIFUP), and by one demand variable, the average level of human capital one generation back (HTOT0).

(Insert table 4 about here)

The first set of implications amounts to the prediction of a negative effect of DIFLOW on HTOT (acting as a proxy for average skills) and a positive effect on SCORE (acting as a proxy for average education). The second implication is a positive effect of DIFUP (acting as a proxy for horizontal differentiation) on HTOT (acting as a proxy for aggregate education-cum-training). Both sets of implications are confirmed in columns 1 and 2 of table 4. The three coefficients describing these effects are significant at the 5% level with the predicted sign. The trade-off between education and skills is strikingly illustrated by the offsetting effects of lower-level differentiation and upper-level differentiation on these two outputs. Lower-level differentiation is good for the production of general education (SCORE) and bad for the production of occupation-specific skills (HTOT). Late differentiation is good for the production of skills. Looking back at figure and table 1, Norway turns out to be the best performer because it has managed to suppress school-leavers at lower secondary level and has developed a large vocational non-university sector. These results are obtained on a small sample and must be treated with caution. However, the qualitative conclusions were replicated with similar but different variables and samples. An instance of this is given by the comparison of column 5 with column 4.

Comparison of columns 4 and 2 shows that the perception of declining standards (see, on the same topic, Baudelot and Establet 1989) addresses the relative decline of education in the total output of schooling systems. This interpretation is confirmed by the regression of column 5. STTPRIM designates the ratio of students to teaching staff in primary education for 1994, as given by OECD (1996: table P32 (public and private)). This is positively related to early differentiation if education expenditures are constrained. For a given budget, larger class size is the price for having more differentiation that obviously uses more teachers[11]. Therefore, DIFLOW and STTPRIM both capture aspects of early differentiation and have a negative effect (significant at the 5% level) on DECLINE. Indeed, the selected experts did not stress the decline of educational standards in France, Germany and the Netherlands which have strongly early-differentiated schooling systems on both accounts. The converse is true for Italy.

By introducing the level of human capital one generation back in the regressions, the dynamics of education and human capital can be analysed. The coefficient of this variable is positive and smaller than one in column 1, but close to one in column 2. These results suggest the convergence of the human capital or skill output of schooling systems but the lack of convergence of the education output. For instance, table 1 shows that Canada, Germany, the

Netherlands, Sweden and the USA have been expanding slowly in comparison with developing countries like Italy, Portugal, and Spain. Finally, the results of column 4 suggest that the dispersion of human capital within countries (INEQ) is not increased by early differentiation.

4.2 A second set of results

Our first results may be open to criticism in that they are based on a small sample of countries and on qualitative or even subjective explanatory variables. Fortunately, we were able to replicate, on a larger sample and with more and well-accepted indicators, the regression analysis concerning the scores obtained in standardised mathematics and science tests (SCORE) by pupils in grade seven and grade eight. Twenty-four countries are included in this analysis, encompassing the sixteen countries of our main sample. In the twelve "non-differentiated" systems[12], all the pupils had normally completed the same curriculum when they took the tests; while the pupils in the twelve "differentiated" systems[13] had been sorted into several streams after completing the common-core syllabus (see Lassibille and Navarro-Gomez (2000) for a full description of the differentiation and other variables). On average, pupils in differentiated systems perform better than pupils in non-differentiated systems. For example, at grade seven, pupils in the first systems achieved a score of 502, while the second achieved only 477.

In order to show the extent to which the characteristics of the two systems affect pupils' achievement, in Table 5 we regress the mathematics test scores in grades seven and eight on the following “objective” variables: the ratio of the length of common-core syllabus to the length of compulsory education (an index of non-differentiation of systems which takes value 1 for "non-differentiated" systems and values smaller than one for "differentiated" systems), the pupil/teacher ratio, the instructional time from the first year of primary education up to the age when pupils took the tests, the percentage of pupils enrolled in the private sector, and the degree of decentralisation of systems, estimated on the basis of the share of central government funding. The test scores in the seventh and eighth grades are adjusted within the framework of a fixed-effect model. To take into account the correlation between the results obtained in each grade, the variance-covariance matrix is corrected for heteroscedasticity by clustering observations by country (see, for example, Greene 1997). Given the availability of data, the estimation covers fourteen countries, yielding twenty-eight observations. Among these, seven countries have differentiated and seven have non-differentiated education systems.

(Insert table 5 about here)

Differentiated systems obtain better results than non-differentiated systems, all things being equal. The effect of the structure of the system is far from negligible, as the timing of differentiation of pupils into streams explains about 15 percent of the difference in scores between pupils. Since the differentiation index retained here is mainly concerned with early (vertical) differentiation, this finding confirms the results obtained in table 4 (column 2), namely that early differentiation is good for education. The generally accepted idea among educators that non-differentiated systems are the best way to maximise the production of education is probably wrong. Even the superiority of these systems for reducing social inequalities at an early age seemed questionable in table 4.

The results in Table 5 also show that the pupil/teacher ratio has a negative impact on pupils' scores after allowing for differentiation. This result is similar to those obtained by other studies (see, for example, Hanushek 1986). The total number of school hours, which differs widely across countries, has no significant effect on achievement in mathematics. However, the instructional time in primary education explains the good performance of certain countries better than the instructional time in secondary education. These results confirm that marginal returns are decreasing in the acquisition of learning skills. Furthermore, the regression results indicate that countries where private education is more widespread perform significantly better than countries where it is more limited. Once again, private education widens the choice set of families and children and thus operates like another kind of differentiation by choice (this point is developed in Damoiselet and Lévy-Garboua 2000, 2001). Finally, centrally managed education systems perform as well as decentralised ones, after controlling for differentiation.

5. Conclusion

This paper has made a basic distinction between general education and vocational training. Education contributes to the production of the learning skill, which is a general investment for producing many other sorts of occupation-specific skills in combination with specific training. The diversity of marketable skills introduces a policy trade-off for schooling systems between education and non-learning skills. If the objective was to maximise the net returns to education alone, students should be sorted by their cognitive ability alone. But if the objective is to maximise the net returns to both education and many kinds of specific training, then students should be given an option to receive further general education before they engage in vocational training and be sorted between these alternative paths according to some combination of their cognitive ability and occupation-specific talents. Early differentiation is good for education but is bad for the production of skills. Furthermore, the horizontal differentiation of schooling systems at a later stage induces a rising demand for both education and training.

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Table 1

The production and distribution of education and skills in 16 schooling systems

Country	Total human capital per pupil at 1994 market value (upper secondary=100) HTOT	Rate of growth of human capital in a generation(%) IH	Inequality INEQ	Opinion on the decline of educational standards DECLINE	Score in math. and sc. test in grade seven SCORE
Austria	102.4	4.1	0.152	1	509
Canada	112.0	5.1	0.252	1.5	494
France	117.7	11.6	0.277	0	492
Germany	109.8	0.3	0.203	0.5	484
Greece	102.8	5.8	0.221	2	440
Hungary	105.8	n.a.	0.234	2	502
Italy	100.6	15.6	0.188	2	.
Japan	117.3	n.a.	0.215	1	571
Netherlands	104.7	3.8	0.192	0	516
Norway	127.4	16.8	0.165	1.5	461
Portugal	96.7	24.8	0.392	1	423
Russian Fed.	116.3	n.a.	0.219	1	501
Spain	102.8	16.0	0.248	1	448
Sweden	107.8	1.2	0.223	1	478
UK	117.9	13.4	0.263	1	463
USA	115.6	3.3	0.349	2	476

Table 2

The frequency of use of various means of differentiation in lower secondary and upper secondary levels

means level	By standardised test	By grades	By reference of the school	By preferences of family or student	By optional courses
Lower secondary	1*	7	5.5	4.5	1.5
Upper secondary	0.5	6	5.5	12.5	9.5

* The range of variation of all the indicators is 0-16.

Table 3
Regression analysis of schooling outputs

	HTOT	SCORE	INEQ	DECLINE	DECLINE
Constant	36.162 (2.83)*	367.939 (6.75)**	0.453 (2.15)	0.044 (0.02)	2.641 (5.59)
HTOT0	0.648 (4.72)**	1.191 (2.11)	-0.003 (1.34)	0.013 (0.66)	- -
DIFLOW	-3.494 (3.15)*	15.870 (3.58)**	-0.010 (0.57)	-0.348 (2.14)	-0.243 (2.63)
DIFUP	5.428 (2.95)*	-15.170 (1.98)	0.046 (1.52)	0.077 (0.29)	- -
PTRPRIM	- -	- -	- -	- -	-0.079 (2.68)
R^2	0.83	0.74	0.26	0.40	0.61
Number of observations	13	12	13	13	13

Absolute value of t-statistics in parentheses.
* significant at 5% level; ** significant at 1% level.

Table 4
Adjustment of mathematics test scores in grades 7 and 8

	SCORE	
Constant	569.315 (9.11)**	620.496 (14.81)**
I_1	-83.024 (2.66)*	-187.817 (2.17)*
PTR	-5.438 (2.05)*	-5.633 (3.08)**
INSTIME [a]	0.009 (0.73)	n.a.
INSTIMEP	-	0.012 (1.52)
INSTIME	-	0.004 (0.91)
SIZEPRIV	0.609 (2.06)*	0.796 (3.68)**
DECENTR	-0.057 (0.27)	0.118 (0.37)
Adjusted R^2 F	0.392 10.82	0.452 18.76
Number of observations	28	28

Note: Fixed-effect model corrected for heteroscedasticity by clustering observations by country. Absolute value of t-statistics in parentheses; * significant at 5% level; ** significant at 1% level.
a/ INSTIME= instructional time in primary level (INSTIMEP)+ instructional time in secondary level - up to thirteen or fourteen years of age - (INSTIMES).
Sources: International Bureau of Education (1997), OECD (1996) and UNESCO (1996) for instructional time; UNESCO (1996) for the size of private sector; OECD (1996) for the degree of centralisation.

Figure 1

Comparing the performance of schooling systems along two dimensions: education and skills

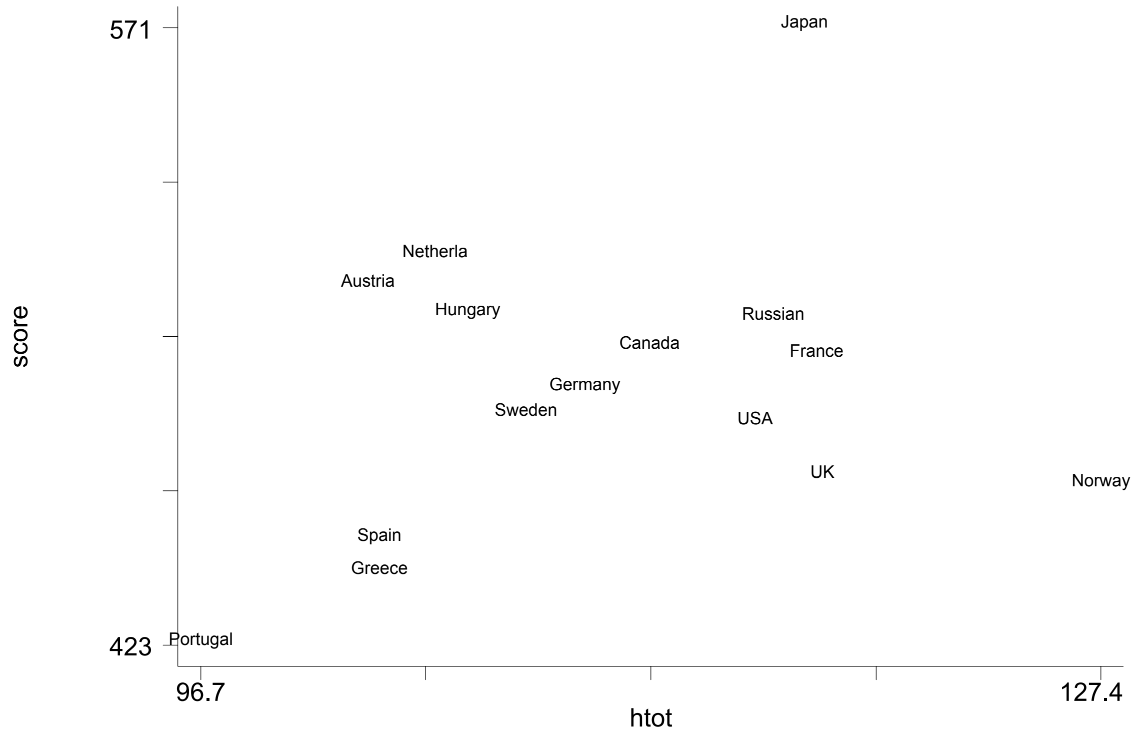
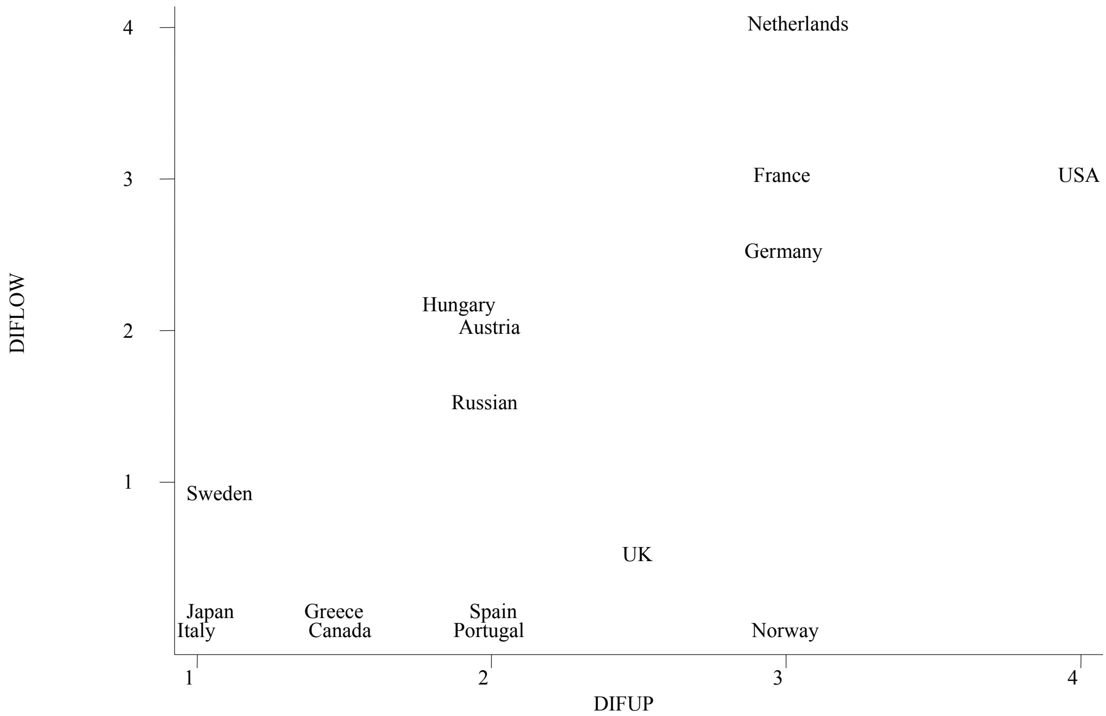


Figure 2

Comparing total differentiation of schooling systems in the lower secondary and upper secondary levels



Notes

[1] We are grateful to Wim Groot and Jean-Jacques Paul for helping us in the preparation of the questionnaire and the selection of experts.

[2] Some amount of differentiation is optimal, even if human capital and capacities are assumed homogeneous, when students differ in capacities (see Damoiselet 1998).

[3] If human capital yielded a constant rental price w_i over an infinite duration of life and if r was the constant individual's borrowing rate, the price of skill i for an individual of unit i-specific talent would be: $p_i = w_i/r$.

[4] Since the list of topics reflected the economic issues raised by schooling systems, due weight was given to their economics background in the selection of experts.

[5] See Damoiselet and Lévy-Garboua (2000, 2001) for a detailed description of this indicator.

[6] This statement is unambiguously supported by the data. We regressed SCORE on a quadratic function of HTOT and found strong non-linearity.

[7] Frequencies may vary by steps of 0.5 because, in some countries, two experts responded to the questionnaire independently and disagreed in their answers.

[8] "Down-streaming" means that a student may switch from a higher education level to a lower education level. "Class repeating" means that a student will not be given access to the next level if he does not meet the academic requirements. Lastly, "drop-out" describes a student leaving an institution of education without a diploma or certificate.

[9] 0 - never, 1 - not very often; 2 - sometimes; 3 - frequent; 4 - very frequent.

[10] This index of total differentiation gives more weight to ability than talent since the questionnaire mentions three criteria of vertical differentiation and only two criteria of horizontal differentiation. An equal weighting of the two kinds of differentiation would still reinforce our conclusion.

[11] The substitution between differentiation and the reduction of class size is further attested by the absence of correlation between the expenditure per student and the ratio of students to teaching staff at

the secondary level.

[12] Australia, Canada, Denmark, Greece, Iceland, Japan, Norway, Portugal, the Russian Federation, Scotland, Spain, Switzerland.

[13] Austria, the Czech Republic, France, Germany, Hungary, Ireland, Korea, the Netherlands, New Zealand, Sweden, the United Kingdom, and the United States.